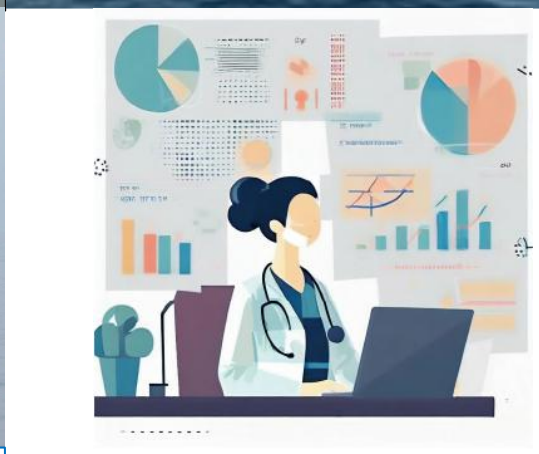
Graduate School of Integrated Science and Technology, Nagasaki University

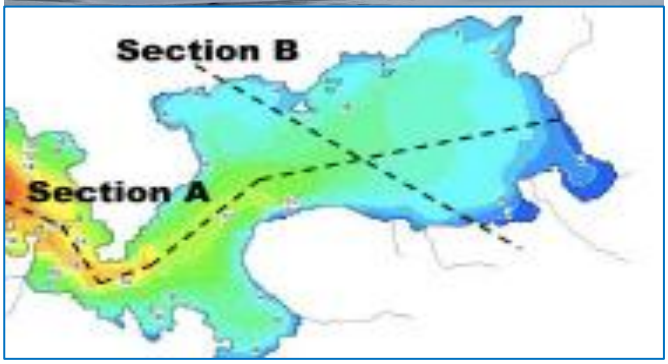
RESEARCH PROFILES

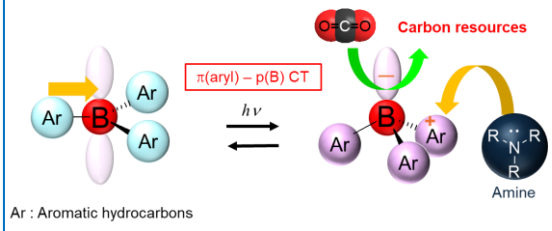












Top left: Experimental study on the effects of air pollution and climate change on plants
Top right: Offshore wind power and its impacts on fisheries
Middle left: Bottlenose dolphins accompanying TS Kakuyo-maru
Middle right: Big Data -Identifying factors from data-
Bottom left: Development of aquatic ecosystem model using machine learning
Bottom right: CO_2 Capture and Conversion

April 2026

Preface

Today, we are confronted with complex and interrelated challenges, including the depletion of energy and resources, climate change, the conservation of biodiversity and the environment, the securing of water and food supplies, the development and maintenance of social infrastructure, and issues arising from the rapid advancement of digital technologies. These challenges cannot be solved within the boundaries of a single discipline; rather, they require the integration of interdisciplinary knowledge and the cultivation of human resources capable of addressing them.

Nagasaki University is committed to contributing to the concept of *Planetary Health*, which seeks sustainable futures for humanity and ecosystems by engaging with these global issues. As part of this initiative, in April 2024 we established the Graduate School of Integrated Science and Technology, a transdisciplinary graduate school founded upon the School of Information and Data Sciences, the School of Engineering, the Faculty of Environmental Science, and the Faculty of Fisheries. The Japanese name of this graduate school reflects our aspiration to “create broadly” not only tangible products but also knowledge, ideas, technologies, methodologies, and more.

The Graduate School encompasses the following programs: the Program for Symbiotic Science and Technology, the Program for Frontiers of Marine Science, the Program for Water and Environmental Science, and the Program for Advanced Green Sustainable Science and Technology (a five-year integrated doctoral program). This “*RESEARCH PROFILES”* booklet is intended to showcase the diverse research conducted in the Graduate School, organized by fundamental academic disciplines, to audiences both within and beyond the university. We sincerely hope that this publication will deepen understanding of our achievements and potential, and serve as a catalyst for new academic exchange as well as collaboration among industry, government, and academia.

April, 2026

Dean Kazuaki Kawamoto
Vice-Dean (Research and International Affairs) Hideki Nakayama
Graduate School of Integrated Science and Technology
Nagasaki University

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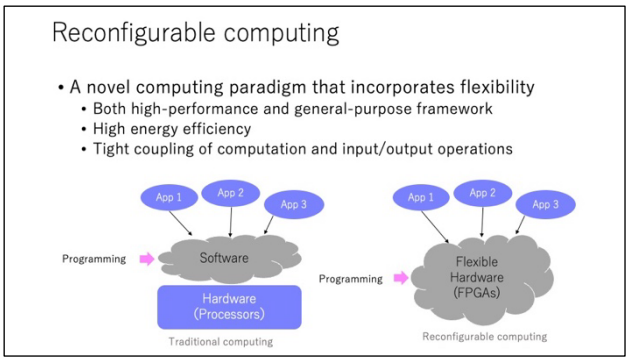
Division of Information and Data Sciences

Name	Job Title	Area of Expertise
SHIBATA Yuichiro	Professor	Computer Engineering

1. Main Research Topics

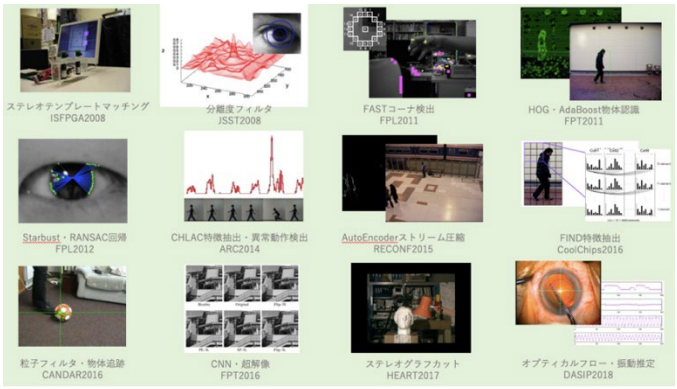
① Realization of Reconfigurable Computing

I am conducting research on the operating principles and design methodologies to realize a "flexible computer" that can adapt its logical structure according to each application. In particular, I am interested in making full use of field-programmable gate arrays (FPGAs: reprogrammable semiconductor devices) to develop computers that achieve both high speed and energy efficiency, as well as establishing programming methods for them.



② Applications of Reconfigurable Computing

I am also conducting research on the application of flexible computers in various fields. By designing algorithms and architectures in an integrated manner for application domains such as real-time image processing, cryptographic processing, high-speed control of energy conversion devices, and medical robots, I aim to establish a framework that optimizes performance and energy consumption.



③ Error Correction for Quantum Computing

Quantum computers, which are attracting attention as computers based on novel operating principles, require the ability to detect and correct errors that occur during quantum computation to realize their advantages in large-scale computing. To realize a fault-tolerant quantum computer (FQTC: a quantum computer with error resistance), I am developing dedicated circuits capable of executing error correction algorithms at high speed in collaboration with RIKEN and other institutions.

2. Keywords

Computer Architecture, Reconfigurable Computing, FPGA, Parallel Processing, Quantum Error Correction

3. Remarks and Websites

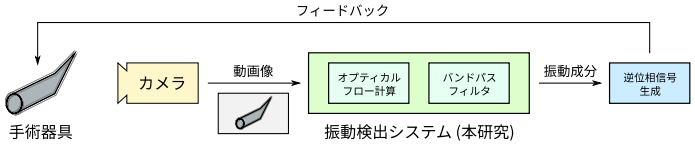
Joint research projects on high-level synthesis implementation of existing software algorithms on FPGAs have also been conducted.

researchmap: https://researchmap.jp/read0072743
Laboratory: http://slab.cis.nagasaki-u.ac.jp

Name	Job Title	Area of Expertise
MANABE Taito	Assistant Professor	Reconfigurable Computing

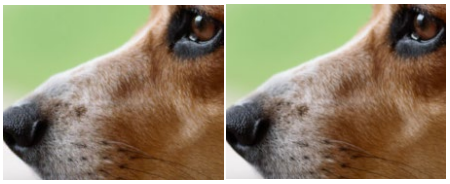
1. Main Research Topics

① Real-Time Image-Based Tremor Extraction System with FPGA



In microsurgery, which means surgery using microscopes to perform intricate procedures, a surgeon often suffers from physiological hand tremors. Therefore, I am working on a system to extract vibration components of tremors in real time from images using a camera for heads-up surgery, as a part of the project to realize tremor suppression system. The system mainly consists of two parts: 1) a pipelined optical flow calculation module using feature matching based on gradient angles, and 2) a block-based adaptive filter module for frequency filtering and tool-background isolation. The system is implemented on a field-programmable gate array (FPGA), a device on which we can program any logic circuits, and handles camera images directly in a stream-processing manner to achieve low latency required for tremor suppression using anti-phase vibration. Using a tremor reproduction system developed in Chuo University, it was confirmed that the system was able to extract 10 Hz stationary vibration components.

② Real-Time Video Compression System with FPGA



Compressed (2 bits/ch) Uncompressed

Image processing using dedicated hardware including FPGAs can offer high performance by adopting stream processing, combining shift registers and line buffers to eliminate the need for slow and energy-consuming external memory (DRAM). However, high-resolution images require huge line buffers and make the implementation infeasible. Therefore, I developed a light-weight video compression algorithm based on adaptive differential coding for FPGA implementation. Both compression and decompression modules achieve very low latency and resource utilization, making it possible to integrate the system into pipeline flawlessly. Based on the evaluation results of a hardware module for high dynamic range (HDR) synthesis combined with the compression system, it can reduce block memory usage greatly and improve a balance of resource utilization, resulting in better synthesis quality. Though the system itself requires a small amount of line buffers internally, it should be possible to add another pixel prediction mode which reduces or even eliminates the buffers, making the system applicable to a wider range of applications.

③ Real-Time Video Super-Resolution System with FPGA



Bicubic Super-Resolution Original

Super-resolution is a technique to reconstruct fine high-resolution images from coarse low-resolution images. In this work, the whole convolutional neural network used to interpolate pixels is spatially expanded as a pipeline on an FPGA for better performance by making the best use of its parallelism. This approach inevitably faces high resource utilization required for numerous arithmetic units. To mitigate this problem, I introduced a residue number system (RNS), a numeral system where a value is expressed as a set of remainders, for efficient implementation of multiply-accumulate operations using look-up tables (LUTs), in conjunction with per-layer optimization of bit widths (the moduli of the RNS). The system is characterized by its very low latency, as low as about 300 μs for 1080 60p output.

2. Keywords

Reconfigurable Computing, FPGA, Real-Time Image Processing, Machine Learning

3. Remarks and Websites

Flexibility of FPGAs is a key for efficient processing considering the property of target applications.
researchmap: https://researchmap.jp/taito_manabe

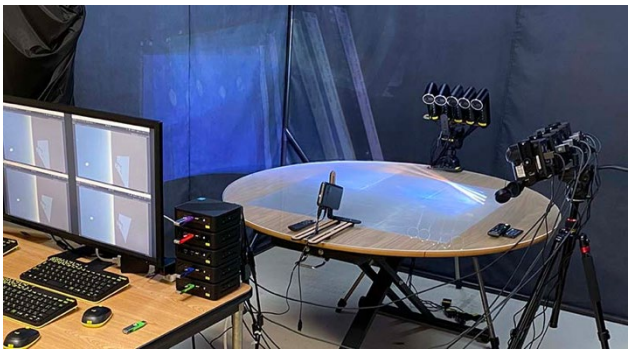
Name	Job Title	Area of Expertise
TAKADA Hideaki	Professor	High-Reality Display Media

1. Main Research Topics

Audiovisual information plays an important role in connecting people to each other.
Focusing on 3D audio-visual devices and HCI (Human-Computer Interaction) technology, we will promote a wide range of research from the fundamentals of human perception to devices and applications, aiming to realize the ultimate communication media that naturally communicate intentions and even the mind beyond reality.

① Autostereoscopic 3D Display Devices using Visual Perception

As one of the ultimate video displays in the future, autostereoscopic 3D display capable of natural stereoscopic vision including motion parallax without the 3D glasses is expected. In particular, the display technologies that can realistically reproduce 3D images in front of your eyes are expected to be used in a wide area of applications, such as video-communication, cooperative work, e-sports and live entertainment, and they will be widely promoted from basic research to product development.



② Human-Friendly Tele-Communication with Audio-Visual Devices

Audio-visual information is the most important interface in human communication. Using 3D audio-visual technology and HCI (Human-Computer Interaction) technology, our research project will realize the ultimate communication system that goes beyond reality and naturally connects people by the expressing intention, mind and sympathetic response. In particular, we will research next-generation communication methods intervening the communication system that are widely effective in both face-to-face and on-line communication, such as being able to speak naturally while feeling the atmosphere and being aware of the comprehension.



2. Keywords

3D Display, Visual Perception, Optical Devices, Tele-Communication, Audio-Visual Media

3. Remarks and Websites

researchmap: https://researchmap.jp/racerhide
Laboratory: https://www.takadalab.com

Name	Job Title	Area of Expertise
OZAKI Tomochika	Professor	Information Systems

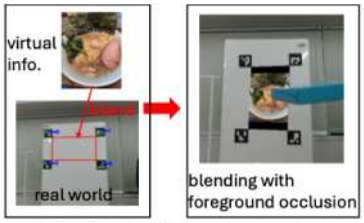
1. Main Research Topics

① Spatial Computing

Our research aims to realize a world where the real and virtual seamlessly coexist. Specifically, we explore augmented reality (AR) technologies using devices such as smartphones, smart glasses, and head-mounted displays (HMDs). The key challenges we address include the following:

(1) Displaying Virtual Information That Blends with Reality:

One of the primary goals is to present virtual content in a way that feels natural and non-intrusive. This involves recognizing and understanding the real-world environment to display virtual information that integrates seamlessly—for example, utilizing flat surfaces like walls for projections and implementing occlusion so that virtual objects correctly appear behind real ones. We investigate techniques that ensure virtual content appears naturally embedded in the physical world.



A display that blends virtual and real world

(2) Interaction with Virtual Objects:

Since virtual objects do not physically exist, a core challenge is enabling intuitive and convincing interaction with them. We explore how users can perceive control over virtual objects and easily understand interaction methods. This includes research into visual and haptic feedback mechanisms, as well as interaction techniques using gaze, gestures, and other natural user inputs.

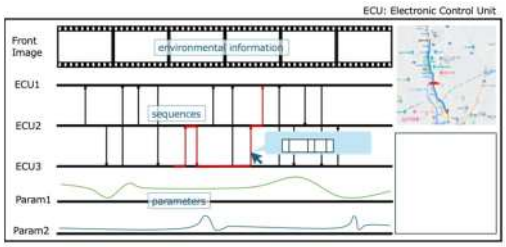

Manipulating the position and orientation of a virtual figure

(3) Capturing Human Motion in the Real World:

To facilitate rich interaction with virtual environments, we study methods for capturing full-body human motion in real time. This enables more immersive and responsive experiences, allowing virtual systems to adapt dynamically to users' physical movements.

② Visualization of System Behavior

We are conducting research on dashboards that enable intuitive understanding of internal system behavior by visually presenting information such as external environmental conditions, internal parameters, and events occurring within the system. This visualization helps identify malfunctioning components and diagnose the root causes of issues more efficiently.

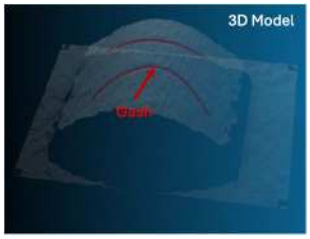


Example of Dashboard

Our current focus is on complex modern systems, particularly automobiles, where internal operations have become highly intricate. By visualizing internal processes in real time, we aim to support system monitoring, debugging, and maintenance, thereby improving system reliability and development efficiency.

③ 3D Modeling and Automatic Measurement Methods

We are conducting research aimed at realizing a robotic system capable of automatically suturing wounds. Our focus is on developing methods to automatically detect lacerations, generate accurate 3D models of the wounds, and create appropriate suture patterns based on those models.



Currently, we are working with sensors capable of capturing both RGB images and depth data simultaneously. Our research includes developing techniques for extracting wounds from the sensor data and automating the tuning of parameters used in the extraction process. These efforts are essential for achieving reliable and efficient wound recognition and treatment by autonomous robotic systems.

2. Keywords

Spatial Computing, XR(AR/VR/MR), Embedded Systems, HMI(Human Machine Interface)

3. Remarks and Websites

I aim to conduct practical research by leveraging my experience in the private company. In the research process, I also incorporate the methodology of "Design Thinking", which is gaining attention as a process for driving innovation. Furthermore, I actively promote collaborative research with industry partners.

researchmap： https://researchmap.jp/TomochikaOzaki

Laboratory: https://www.idsci.nagasaki-u.ac.jp/research_ac/facultylist/staff5

Name	Job Title	Area of Expertise
FUJIMURA Makoto	Associate Professor	Image Processing, Human Interfaces and Interactions

1. Main Research Topics

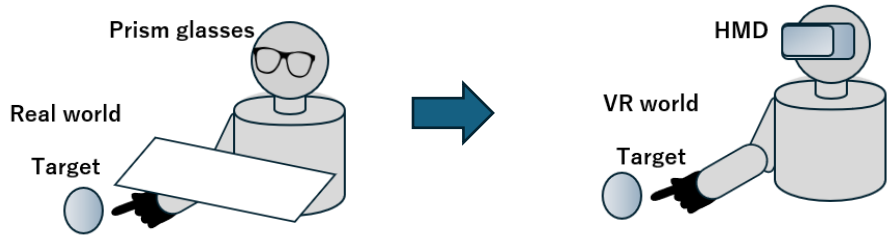
An application of virtual reality technology to rehabilitation for brain dysfunction is expected to improve the effectiveness of rehabilitation therapy and reduce the labor required to set up the rehabilitation environment.

In addition, to deter unauthorized use of image content on the Internet, I research a method of embedding digital watermarks into the relevant images.

① Application of virtual reality technology to prism adaptation therapy for Unilateral Spatial Neglect

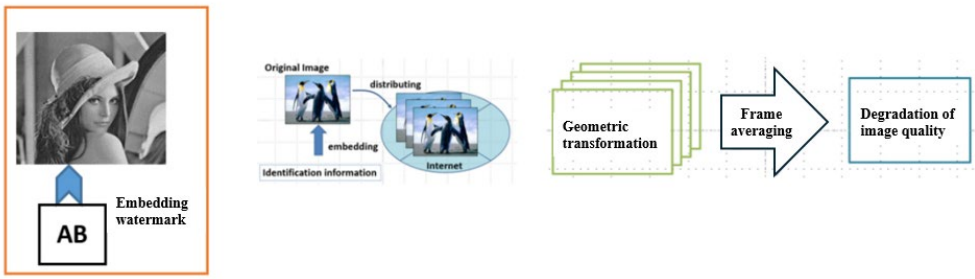
One of the disorders of brain function is Unilateral Spatial Neglect, which is a symptom of loss of spatial awareness, primarily on the left side of the brain. One of the rehabilitation therapies for Unilateral Spatial Neglect is prism adaptation therapy.

As shown in the left figure below, patients wear prism glasses that shift their gaze laterally and repeatedly touch the target with their fingers to recognize the neglected area. However, it requires effort to adjust the deflection of the prism glasses in real space and to place the target. The application of virtual technology will solve these problems (bottom right figure).



② Image watermarking

Currently, the distribution of image content on the Internet is very active, but there are problems such as unauthorized use. In order to prevent unauthorized use, I am researching digital watermarking, which embeds copyright and other information in images.



2. Keywords

Rehabilitation, Virtual Reality, Watermark

3. Remarks and Websites

I will continue the current collaborative research on the introduction of virtual reality technology applied to rehabilitation.

researchmap: https://researchmap.jp/fujimuramakoto/
Laboratory:

Name	Job Title	Area of Expertise
KIYASU Senya	Professor	Pattern Information Processing

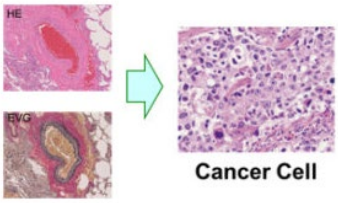
1. Main Research Topics

① Medical image processing and information extraction

In medicine, various images are used for diagnosis and treatment. Our study aims at developing methods to support medical doctors in diagnosis and treatment by using computers to extract useful information from medical images.

Pathological images

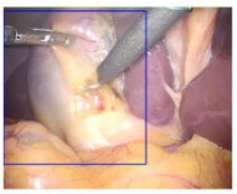
Pathological images obtained from living tissue are indispensable for the diagnosis of cancer and other diseases, but they require a great deal of visual labor for pathologists. We are working on computer-aided diagnosis techniques, such as the method that improves the accuracy of machine learning using differently stained images, as shown in the figure on the right.



Pathology Images

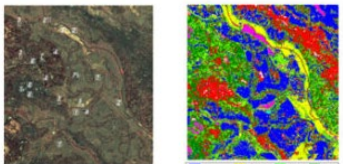
Endoscopic images

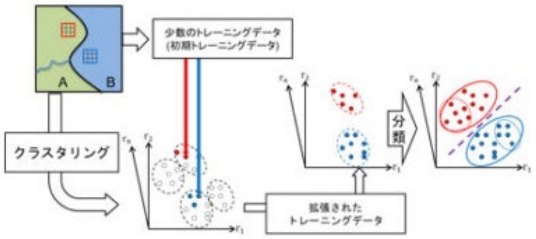
We are studying methods to realize a robot that can hold an endoscopic camera during surgery. We are developing methods to track specific organs in endoscopic moving images, display the appropriate surgical field, stabilize the image, and so on.


Endoscope Image

② Remote sensing image analysis

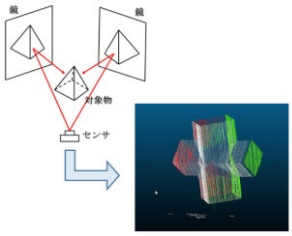
We are researching methods to accurately identify objects on the Earth's surface from remote sensing images obtained by satellites or aircraft. Under the condition that a large amount of observational data is available and a limited number of supervised data, we are attempting to improve the accuracy of classification by applying semi-supervised learning.


Classification of Remote Sensing Image



③ 3D Measurement

We are researching a method to measure the three-dimensional shape of an object using a stereo method with structured light projection. We are also studying a method to measure the shape of an object from a moving platform using the slit light projection method, assuming the condition that the object is in turbid water.



3D Measurement using Mirrors

2. Keywords

pattern recognition, machine learning, medical image, pathological image, endoscopic image
remote sensing, semi-supervised classification, 3D measurement, structured light projection

3. Remarks and Websites

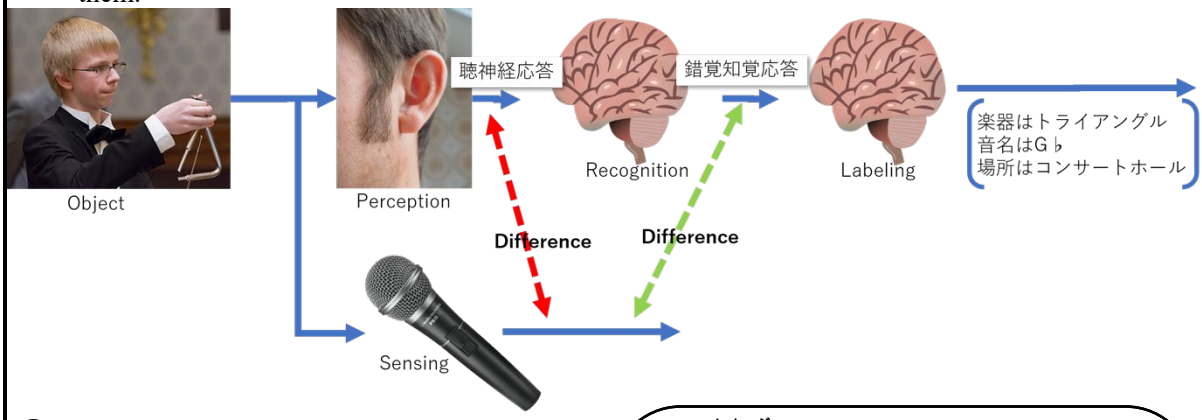
We aim to realize new measurement algorithms, mainly using image data, to extract useful information by classification, discrimination, and quantitative evaluation.

researchmap: https://researchmap.jp/read0062710

Name	Job Title	Area of Expertise
SONODA Kotaro	Assistant professor	Acoustical Information Sciences, Enriched Multimedia

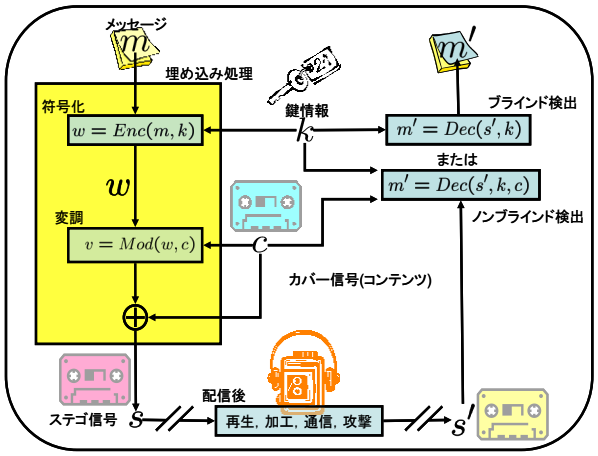
1. Main Research Topics

Unraveling the biases in human and machine perception, and leveraging the differences between them.



① **Enriched Acoustics via Information Hiding**
For audio signals, new information is embedded without causing audible discomfort. The receiving side can then read the information embedded in the audio. This enables the enhancement of the value of the audio signal.

② **Differentiation between natural sounds and speaker-reproduced sounds.**
Although both sounds are perceived as identical to humans, we are analyzing features that allow for their differentiation.



2. Keywords

Human Auditory systems, Coding Communication, Information Hiding, Watermarking, Steganography, Fingerprinting

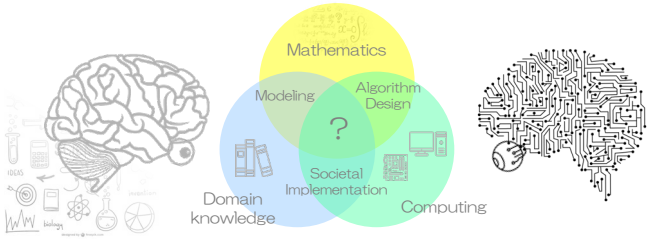
3. Remarks and Websites

I am interested in human perceptual characteristics, microphone and speaker characteristics, and the propagation characteristics of sound in space. I believe that a unique characteristic (like a fingerprint) that humans are missing is hidden within each sound that fills the world.

researchmap: https://researchmap.jp/helmenov/
Laboratory: https://sites.google.com/view/kiyasu-cis-nagasaki-u/

Name	Job Title	Area of Expertise
SAKAI Tomoya	Associate Professor	Information and Data Sciences

My research focuses on understanding and developing foundational technologies for the rational extraction of information from small or low-quality datasets, by leveraging scientific knowledge expressed in language and mathematics.



1. Main Research Projects

A) Data × Mathematics: Transferring Knowledge from Mathematical Models

This project is conducted on integrating scientific knowledge described mathematically into deep learning frameworks to extract information rationally from limited data. Unlike typical deep learning approaches that rely heavily on large-scale datasets, this approach supplements information actively from mathematical models—especially sparse models—and algorithms, enabling the construction of highly generalizable neural networks.

B) Data × Language: Knowledge Distillation from Foundation Models to Task-Specific Models

Recent generative AI systems are based on foundation models that align data such as images or audio with text. Research and development efforts focus on distilling knowledge from such foundation models into neural networks tailored for specific targets or tasks, thereby building deep learning frameworks that effectively utilize knowledge expressed in natural language.

C) Applications to Medical Imaging and Biosignal Analysis

The deep learning techniques that incorporate knowledge represented through data, mathematics, and language are applied to the analysis of medical images and biosignals. This enables support for diagnosis, quantitative assessment of disease states, and prediction of treatment outcomes, while maintaining greater medical rationality compared to standard deep learning approaches.

Collaborative research is currently underway with experts in medicine and dentistry on a variety of studies utilizing different medical imaging modalities, including differential diagnosis of salivary gland tumors using multiparametric MRI, screening for oral cancer with microscopic imaging (Fig. 1), evaluation of treatment response in Sjögren's syndrome using ultrasound imaging (Fig. 2), detection of cervical lymph node metastasis with CT, and diagnostic support for primary ciliary dyskinesia using electron microscopy, among others.

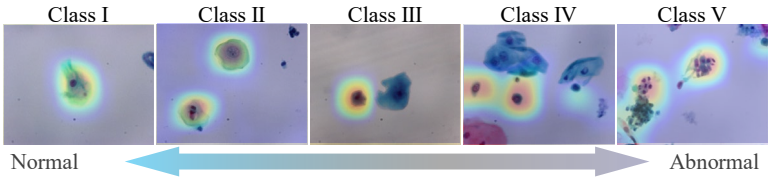


Fig. 1 Oral exfoliative cytology (unsupervised deep learning to highlight diagnostically relevant cells)

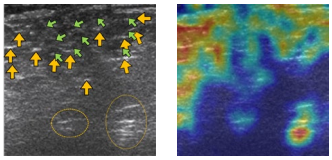


Fig. 2 Feature learning from salivary gland US images

2. Keywords

Pattern recognition, medical imaging, foundation models, deep learning, signal processing, inverse problem theory, mathematical optimization

3. Remarks and Websites

Priority is given to research enabling information extraction and to medical-informatics collaborations aimed at scientific understanding (such as identifying and quantifying imaging features representing disease states), rather than to the development of automated systems (e.g., AI-based diagnostic systems). Research interests are not limited to the medical domain.

researchmap: https://researchmap.jp/tsakai
Laboratory: https://tsakailab.github.io/

Name	Job Title	Area of Expertise
TAKEDA Keita	Assistant Professor	Pattern Recognition, Medical Image Analysis

1. Main Research Topics: Medical Image Analysis with Deep Learning Utilizing Domain Knowledge

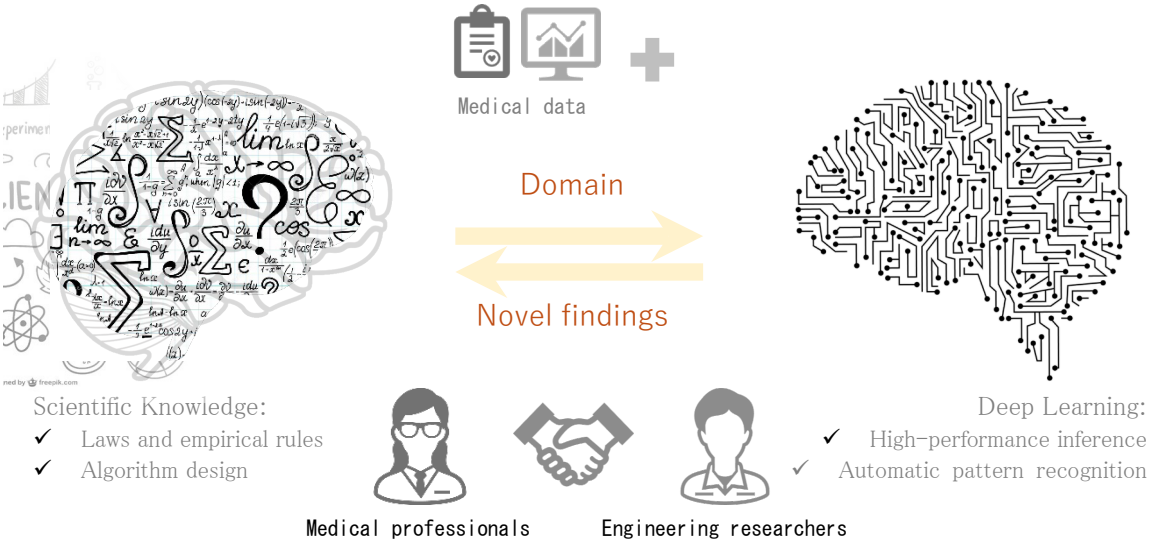


Figure 1: Utilizing Domain Knowledge in Medical Image Analysis via deep learning

Artificial intelligence based on deep learning can achieve advanced information processing when large amounts of data are available. The scientific knowledge and empirical rules (domain knowledge) cultivated in each research field can provide artificial intelligence with information comparable to that of large datasets. I am engaged in research to create artificial intelligence that can interpret data based on domain knowledge and extract information that supplements that knowledge.

Practical Example: Suppression of Background Information and Unsupervised Cell Region Detection in Oral Cytology Images

Oral cytology is a type of cytological diagnosis involving the microscopic examination of cells. It is used for the non-invasive diagnosis of oral cancer, where epithelial cells from the oral cavity are collected by scraping with a cotton swab or a special brush, stained with Papanicolaou stain, and then observed under a microscope. Pathologists analyze cells; however, the condition of the microscope used for imaging significantly affected the image background. Because background patterns appear in images obtained from same imaging conditions for each subject, deep learning models utilize these inappropriate background features for classification. To avoid this, I proposed a background subtraction approach that detects cell-only images by subtracting similar backgrounds across images. By leveraging the properties of cytology images, it removes the redundant background in an unsupervised manner. This improved the classifier to focus only on the cell regions.

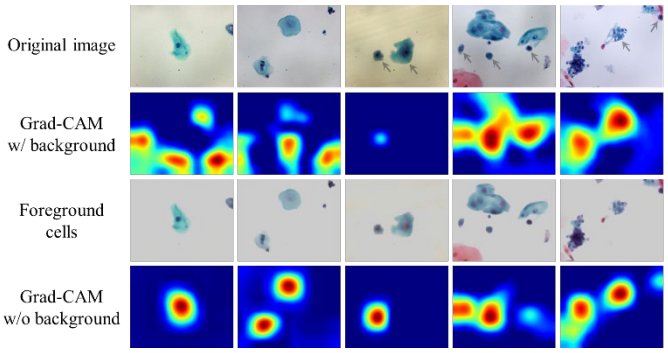


Figure 2 Distribution of class discriminative features with and without background removal.

2. Keywords

Pattern Recognition, Machine Learning, Deep Learning, Medical Image Analysis

3. Remarks and Websites

researchmap：https://researchmap.jp/KeitaTakeda

Name	Job Title	Area of Expertise
Muthu Subash Kavitha	Associate Professor	Adaptive Intelligence in AI

1. Main Research Topics

We are investigating self-supervised foundation AI models and continual learning methods to learn robust representations from diverse multimodal data, to adapt in dynamic real-world environments, ensuring scalable and trustworthy applications in healthcare and Industry.

①Self-supervised foundation model in healthcare

We are developing self-supervised learning approaches to build foundation models from diverse healthcare data, including medical imaging, pathology, and electronic health records. These models learn rich representations without requiring extensive manual annotations. By leveraging multimodal data, they capture comprehensive information for creating scalable models that can generalize across diseases, modalities, and institutions (Fig 1).

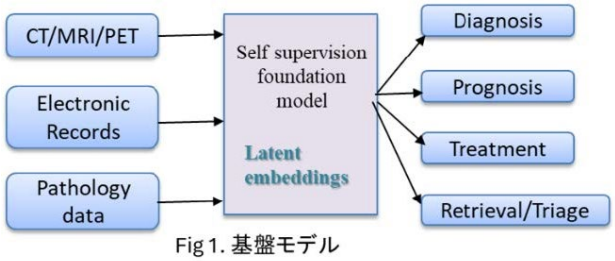


Fig 1. 基盤モデル

②Development of continual learning methods for adaptive AI in real-world data streams

We are creating AI systems that can keep learning new things over time without forgetting what they already know. Just like people, these systems need to remember past lessons while picking up new ones. Our methods advance AI by combining memory mechanisms, and adaptive architectures that adjust when the world changes, such as new tasks, data, or environments, this makes the technology more reliable and useful in everyday situations. It builds AI that stays smart, adaptable, and trustworthy as it continues to learn (Fig 2).

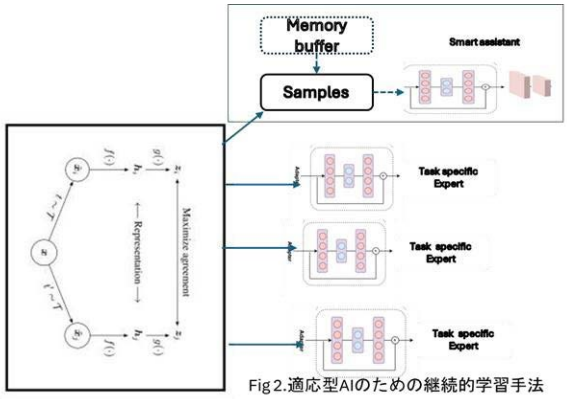


Fig 2.適応型AIのための継続的学習手法

2. Keywords

Self-Supervised representation learning, Foundation models, Continual learning, Multimodal data integration, Adaptive and trustworthy AI

3. Remarks and Websites

This technology is scalable, trustworthy, and applicable across various domains.
We develop AI that grows smarter with experience and adapts to change, helping to deliver reliable, future-ready solutions for real-world markets.

researchmap: https://researchmap.jp/Kavitha?lang=ja

Name	Job Title	Area of Expertise
MIYAJIMA Hirofumi	Associate professor	Machine Learning

1. Main Research Topics

① **Research on machine learning methods combined with secure multiparty computation method**

In recent years, machine learning has been widely adopted. In particular, the use of cloud computing in machine learning has made it possible to efficiently perform computational processing on large datasets. However, cloud computing is required to enhance the data security. In this regard, one of the methods to enhance data security is the secure multiparty computation method. This method encrypts the data and performs computations while the data are encrypted, thereby increasing data security. In the field of machine learning, research is being conducted on methods to increase data security by combining secret computation. In our research, we are also engaged in research on machine learning combined with secure multiparty computation method.

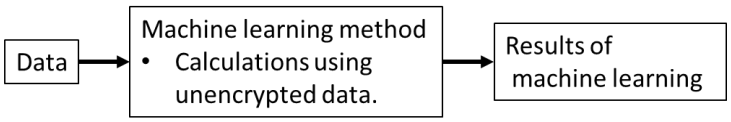


Figure 1. Outline of conventional machine learning methods.

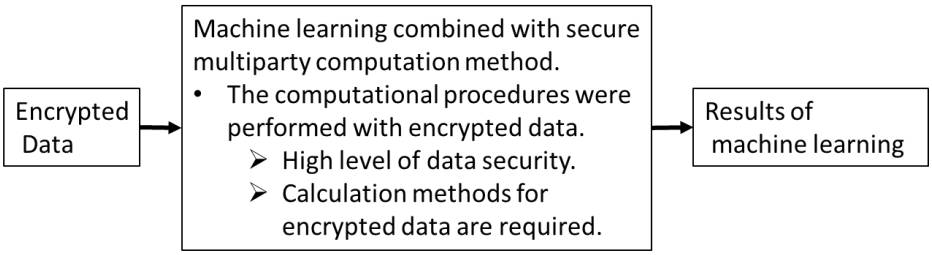


Figure 2. Outline of the machine learning method combined with the secure multiparty computation method for our research.

Various methods have been proposed for conventional machine learning (Figure 1). However, because unencrypted data are required for the computation process, it is difficult to combine it with secret computation. In contrast, in machine learning combined with secret computation (Figure 2), which is handled in this laboratory, the computation process is performed with encrypted data. However, compared to ordinary machine learning, there have not been enough proposals on how to perform machine learning using encrypted data.

In our research, I am engaged in research on computational methods to perform machine learning while keeping the data encrypted. We have also proposed several methods for this purpose.

② **Research on fuzzy inference methods.**

In recent years, with the development of information technology, highly accurate machine learning has been applied in various fields. However, in machine learning, it is sometimes desirable to know not only the accuracy of the solution but also the basis of the solution. In this regard, a technique called the fuzzy inference method can be used.

Fuzzy inference methods are known to enable human interpretation, as they are mathematical formulae based on inference rules of the form "If ... then ~," which can be interpreted by humans. However, in the field of machine learning, it is known that high accuracy of solutions and human interpretability are difficult to reconcile.

In our research, I focus on fuzzy inference methods characterized by high solution accuracy and human interpretability. We have also proposed several methods.

2. Keywords

Machine learning, Supervised learning method, Unsupervised learning method, Steepest descent method, Secure multiparty computation method

3. Remarks and Websites

The aim of our research is to create new value and improve capabilities by devising computational processes for machine learning methods.

researchmap: https://researchmap.jp/sks

Name	Job Title	Area of Expertise
ITO Sohei	Associate Professor	Computer Science

1. Main Research Topics

In modern society, software has become a crucial part of our infrastructure. Depending on the type of software, bugs can sometimes lead to significant economic damage. To prevent such incidents, a technical field known as "formal methods" has emerged, which involves mathematically describing and verifying software and its specifications. I conduct research on formal methods, covering both foundational and applied aspects.

① **Logical Systems Suitable for Software Verification**

Programs written in languages such as C often use pointers, which are notoriously difficult to handle and frequently lead to bugs. One of the key safety requirements for such programs is memory safety. A logical system called Separation Logic (Reynolds, 2002) has been developed to describe memory operations in programs. However, pure separation logic cannot express another essential aspect of programs—computation. Therefore, I am researching which logical systems are suitable for combining separation logic with arithmetic. One of my findings reveals that a logical system combining the most basic form of separation logic with very simple arithmetic can be as expressive as a system equipped with both addition and multiplication [1]. Additionally, data structures such as lists and trees, which are inductively defined and commonly used in programming, require logical systems that allow inductive definitions. I have identified the computational complexity class of the problem of determining the truth value of formulas in such a logical system that enables complete inference [2].

② **Conformance Checking of Process Models Using Time Attributes**

Business processes represent the sequence of tasks that should be executed in a workflow and can be mathematically modeled as state transition systems. Records of actual business operations are stored as event logs in enterprise information systems. Ideally, actual operations should conform to predefined business processes. However, due to execution errors or discrepancies between the process model and reality, deviations often occur. Conformance checking is a technique used to evaluate whether a process model and an event log match, identify where deviations occur, and assess the extent of those deviations. Traditional conformance checking methods could only evaluate deviations in task execution order. I am researching conformance checking methods that incorporate additional information, such as task execution time and resource usage. So far, I have developed a method to evaluate how much the execution time of tasks deviates from predefined ranges [3].

③ **Safety Verification of Autonomous Driving Systems**

Autonomous driving technology is a highly promising field with the potential to significantly transform society. However, ensuring its safety is a major challenge. I am researching methods to mathematically verify whether the required safety properties are satisfied by modeling vehicle behavior using hybrid systems, which combine both continuous and discrete state transitions.

Currently, I have conducted verification to determine whether a PID controller, which is responsible for vehicle speed control, satisfies the required safety properties [4].

2. Keywords

Theoretical Computer Science, Formal Methods, Software Engineering, Mathematical Logic, Process Mining

3. Remarks and Websites

Although my research is more theoretical in nature, I believe that theory truly proves its value when applied to solving real-world problems. Therefore, I intend to place greater emphasis on practical applications in the future.

Publications：

[1] Sohei Ito, Makoto Tatsuta: Representation of Peano Arithmetic in Separation Logic (2024)

[2] Sohei Ito, Makoto Tatsuta: Computational Complexity of Reasoning with Induction (in Japanese) (2023)

[3] Sohei Ito, Kento Hamae: Conformance Checking on Timed Automaton Process Models (2024)

[4] Sohei Ito, Zen Haneda, Ryutaro Uraoka: Verifying PID Controller of Robot Car by Delta-Reachability Analysis (2025)

researchmap: https://researchmap.jp/p-ctl

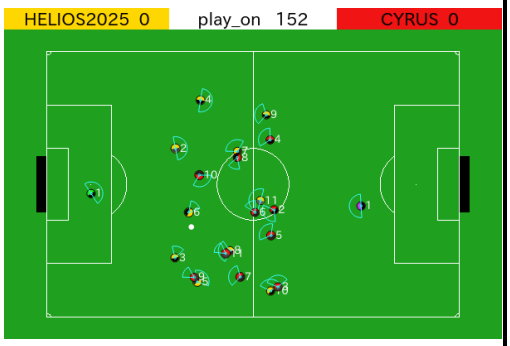
Laboratory: https://www.cis.nagasaki-u.ac.jp/~s-ito/

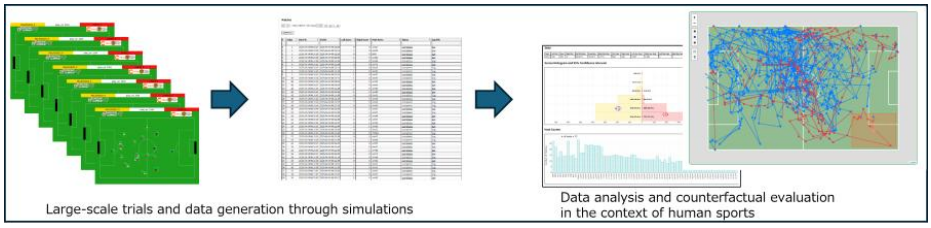
Name	Job Title	Area of Expertise
AKIYAMA Hidehisa	Associate Professor	Intelligent Systems

1. Main Research Topics

① Multiagent Simulation and Its Applications

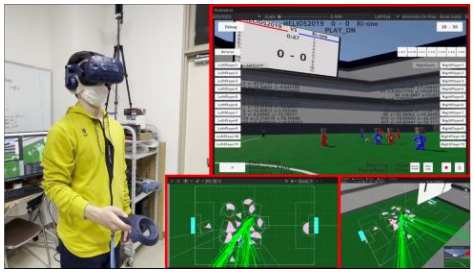
My research focuses on using computer simulations to reproduce the cooperative and competitive behaviors of robots and humans in group settings. Specifically, I develop simulators for team sports, such as soccer, along with the software agents (decision-making programs for players) that operate within these environments. For practical applications, I aim to generate massive amounts of match data, a scale impossible to achieve in reality, to advance sports data analysis. Additionally, I am working toward the realization of "what-if" analysis (counterfactual evaluation) to explore potential outcomes had different decisions been made during a game.

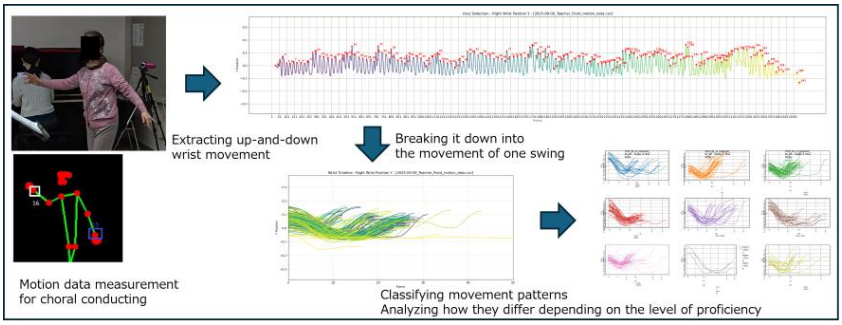




② Human Skill Analysis

We are onducting research on skill analysis, using motion sensors and VR devices to measure human physical movements and identify differences based on proficiency levels in specific tasks. We are advancing research on methods for extracting more detailed motion data from video, analyzing joint trajectory data, and, in conjunction with multiagent simulations, developing evaluation methods for cognitive and decision-making abilities within groups.





2. Keywords

Multiagent Systems, Skill Science, Sports Analytics

3. Remarks and Websites

We possess world-class technology in the development of soccer simulators and decision-making programs, and we are working toward the practical implementation of a counterfactual evaluation system for team sports using computer simulations. Furthermore, to facilitate real-world applications, we are advancing efforts to collect human decision-making data, incorporate it into simulations, and apply it to actual robots.

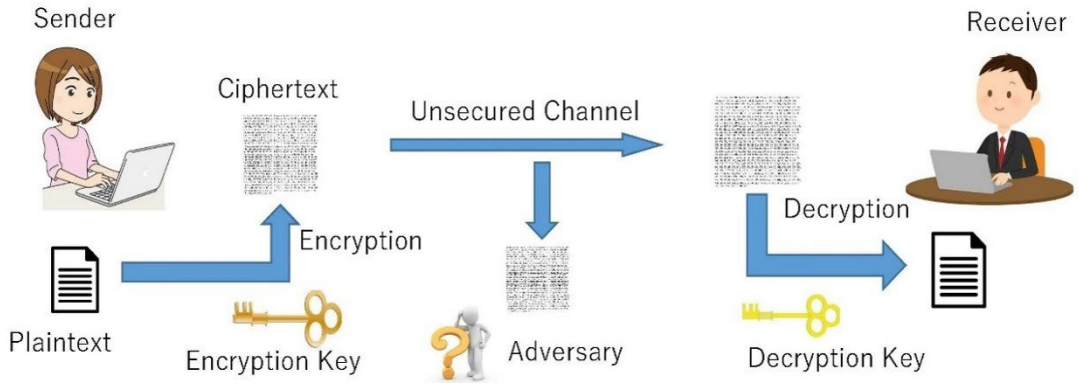
researchmap: https://researchmap.jp/hidehisa.akiyama
Laboratory:

Name	Job Title	Area of Expertise
HARASAWA Ryuichi	Associate Professor	Computational Algebra

1. Main Research Topics: Finite Algebraic Systems and Applications to Cryptography

In the modern information society, the value of information is increasing. Therefore, it is important to handle information safely. For example; (1) Communicating information securely; (2) Guaranteeing the validity of information; (3) Processing information safely;

Cryptography is an indispensable technique to realize those topics above. My research topic contains the establishment of theories on finite algebraic systems (finite sets with operations) and their computational theory, and their application to cryptography. For example, number theory (prime factorization, etc.), algebraic geometry (sets of solution of equations, curves, etc.), and lattice theory.



Overview of encrypted communication



(Left) Webpage **without** encrypted communication
(Right) Webpage **with** encrypted communication

2. Keywords

Computational Algebra, Cryptography, Number Theory

3. Remarks and Websites

researchmap: https://researchmap.jp/read0193855/?lang=japanese
Laboratory: https://www.cis.nagasaki-u.ac.jp/~harasawa/

Name	Job Title	Area of Expertise
ARAI Kenichi	Associate Professor	Information Security

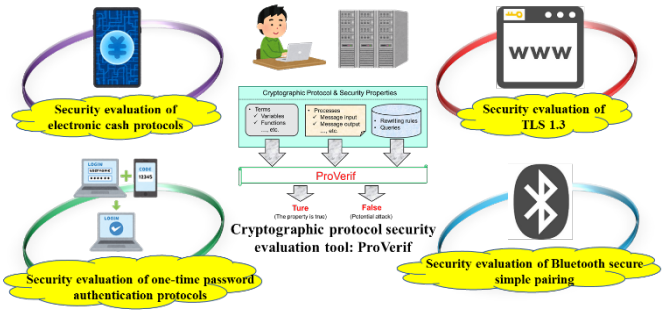
1. Main Research Topics

My main research topics are: (1) Research on the security evaluation of cryptographic protocols, and (2) Research and development of systems that benefit people through the use of IoT and AI.

① Research on security evaluation of cryptographic protocols

In recent years, ICT and the Internet of Things (IoT) have become indispensable in government, industry, and the daily lives of citizens. Cryptographic technology plays a crucial role in supporting the ICT/IoT society. Cryptographic technology is used as a cryptographic protocol that combines various cryptographic primitives such as symmetric-key cryptography, public-key cryptography, and digital signature schemes. As the ICT/IoT society evolves, the need for cryptographic protocols tailored to a wider range of applications will increase. Consequently, it is of the utmost importance to conduct security evaluations of these cryptographic protocols to ensure that general users can securely utilize systems employing cryptographic technology in the ICT/IoT society.

This study focuses on conducting security evaluations using formal methods, which have recently gained attention, to enable general users to securely use systems that employ cryptographic technology.



Main cryptographic protocols evaluated for security by ProVerif

② Research and development of systems that benefit people through the use of IoT and AI

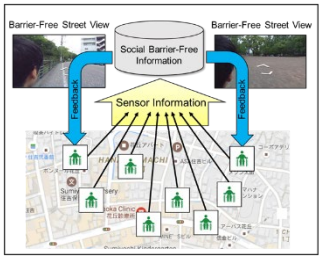
With the concept of developing systems that are useful to people, I am developing systems that utilize IoT and AI.

- Research and development of street view system for wheelchair users

This system collects sidewalk information from multiple wheelchair users and provides them with visual feedback on the latest sidewalk conditions. By developing this system, I aim to make Nagasaki a more wheelchair-friendly city.

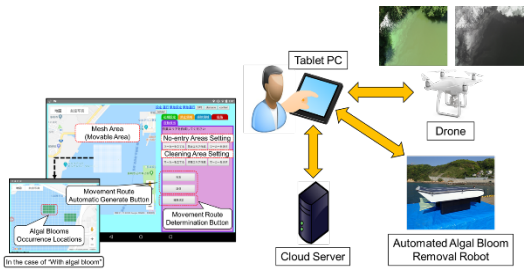
- Research and development of independent algal bloom removal system

This system uses a tablet PC, drones, automated algal bloom removal robots, and a cloud server to automatically detect algal bloom occurrence locations and remove algal bloom autonomously. By developing this system, I aim to make Nagasaki a safe and environmentally friendly city.





Street view system for wheelchair users



Independent algal bloom removal system

2. Keywords

Information security, Cryptographic protocol, Formal method, Security evaluation, IoT, AI

3. Remarks and Websites

researchmap: https://researchmap.jp/kenichi_arai

Name	Job Title	Area of Expertise
IMAI Tetsuo	Associate Professor	Network Science, Complex Systems, Machine Learning

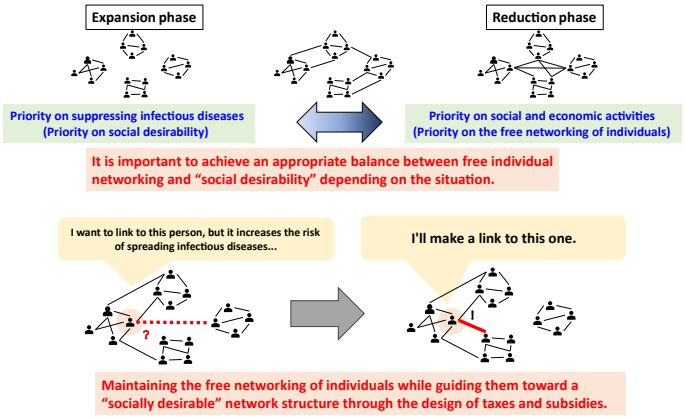
1. Main Research Topics

①Network Science and Its Applications

Our society has many hidden networks, like social connections between people, product relationships from what's bought together, and the internet. It's becoming clear that these different networks share common features, often called complex networks. My research uses mathematical models and computer simulations to understand the structure, function, and how these networks in society are formed. By figuring out ways to control and guide them to be more efficient, I aim to discover new things about how our society works.

Research Example 1: Making Social Networks Better and Guiding Them During Infectious Disease Outbreaks

During the COVID-19 pandemic, rules were put in place to limit human contact to stop infections from spreading. This also greatly limited social activities. My research looks at questions like: "What kind of social network structure can help stop infections while still letting people do some social activities?" and "How can we create such a network structure?" I am working to answer these using network theory, game theory, mathematical modeling, and computer simulations.

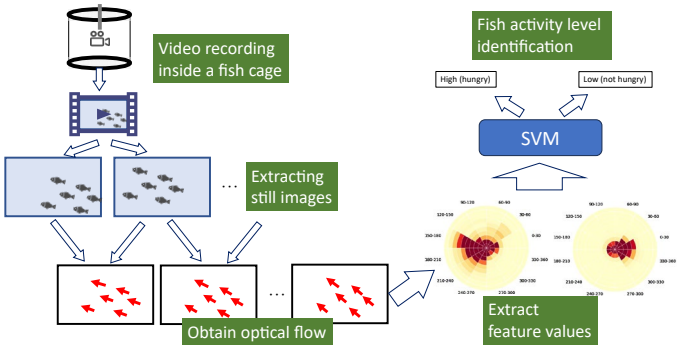


②DX Promotion in Local Industries using IoT and AI

Recent progress in AI and IoT technologies has made it possible to automate and make many tasks more efficient that used to be done by people. My research focuses on automating and improving tasks that involve making decisions, like anomaly detection, which skilled workers used to do based on their experience and intuition. This is done by combining IoT systems (like cameras and sensors) with machine learning. For example, I am researching how to detect anomalies in products on factory production lines, and how to estimate how hungry fish in their aquaculture cages are by watching their group behavior with underwater cameras, so we can feed them at the best times.

Research Example 2: Using Machine Learning to Identify How Hungry Fish Are in Aquaculture Cages

In fish farming, feed costs can be as much as 70% of the total cost, so reducing this is very important. To feed fish at the best time and with the right amount, it's necessary to watch them and give them food appropriately. Traditionally, fish farmers would go to the aquaculture cages to do this. This research aims to automatically tell how hungry fish schools are by watching them in their aquaculture cages with underwater cameras and analyzing the video using machine learning.



2. Keywords

Network science, Complex networks, Complex systems, Emergence, Network analysis, Network formation games, Game theory, Artificial Intelligence, Machine Learning, Internet of Things (IoT)

3. Remarks and Websites

I have experience conducting DX research through joint research with companies in Nagasaki prefecture. Currently, I am analyzing data from a gratitude messaging system developed by a company and conducting research on ways to activate organizations through gratitude communication based on network science.

researchmap: https://researchmap.jp/tetsuo.imai

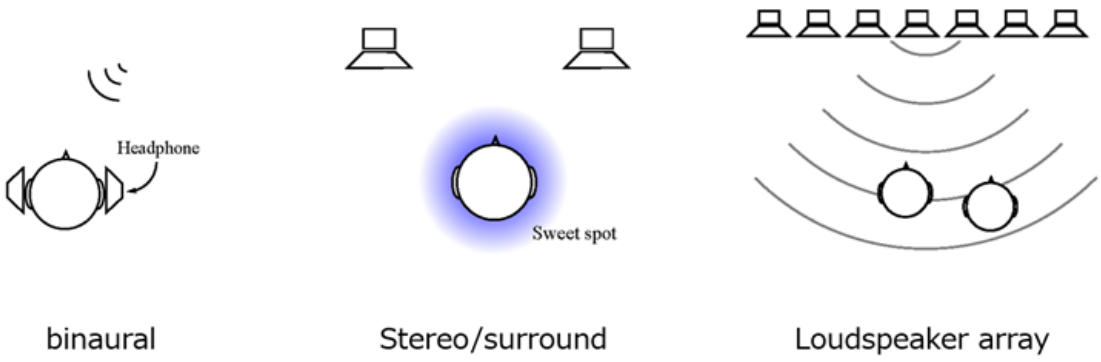
Laboratory: https://www.cis.nagasaki-u.ac.jp/~imai/

Name	Job Title	Area of Expertise
TSUTSUMI Kimitaka	Associate professor	Acoustic Signal Processing

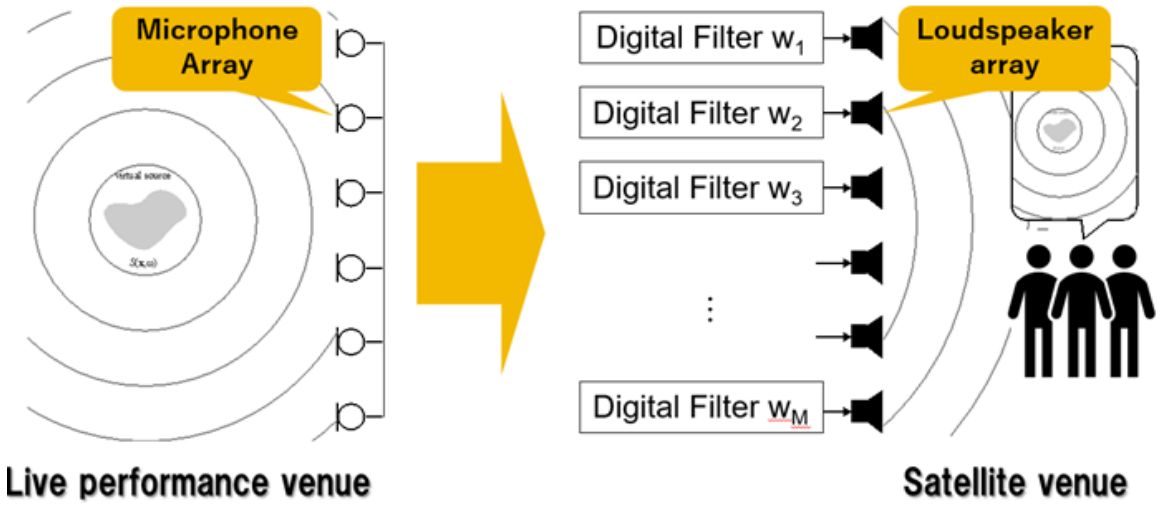
1. Main Research Topics:

Sound field analysis/synthesis for acoustic virtual reality

Our laboratory is developing technologies that provide complete immersive experiences using state-of-the-art acoustic signal processing. Most of the existing spatial audio technologies are based on stereo/surround technology. They are effective if listeners are in so-called sweet spot in which listener perceive sound images at pre-defined locations.



In contrast to those existing solutions, we are developing array signal processing technology which reproduces desired sound fields physically. Sound Field Analysis/Synthesis reproduces acoustic pressure field and provides depth-wise control of sound images on top of wide listening area, thereby providing unrivaled quality of immersion for VR.



2. Keywords

Speech signal processing, Acoustic signal processing, Spatial sound

3. Remarks and Websites

researchmap: https://researchmap.jp/kimitaka.tsutsumi

Name	Job Title	Area of Expertise
UMEZU Yuta	Associate Professor	Statistical Mathematics and Machine Learning

1. Main Research Topics

① Development of fundamental theory in statistics and machine learning and its application to data sciences

Roughly speaking, data sciences consist of the following three steps.

i. Statistical modeling
ii. Deriving algorithm
iii. Application to real data

When analyzing data, it is extremely important to apply appropriate modeling to the data at hand. In fact, using an inappropriate model for the data often makes it difficult to interpret the analysis results. For example, even though the observed data should theoretically only take positive values, the analysis results may show that negative values are also possible. Furthermore, various models can be considered for a single set of data. For example, when predicting tomorrow's weather, should we use only today's weather information, or should we use information from up to three days ago? The method of letting the data itself determine how much past information to use is called model selection. This approach is not limited to weather prediction but can be applied to various fields, such as identifying genes that influence diseases or identifying peaks in spectral analysis.
In many cases, models have parameters. By appropriately adjusting the parameters to fit the data, we attempt to explain the data using the model. However, as the model becomes more complex, optimization can become difficult. Therefore, the design of algorithms to solve optimization problems is also an important factor in data analysis. Additionally, by examining the statistical properties of the estimated parameters or models, we can evaluate the reliability of those parameters or models. Such reliability evaluations are particularly important in sample surveys where it is not possible to examine the entire population. Since the behavior of the estimated parameters varies depending on the model, it is necessary to respond individually when performing such analyses.
Finally, after formalizing the above procedures, we apply them to real data to determine whether the analysis results are natural and to use them as clues for creating better models.

2. Keywords

Model selection, High-dimensional data Analysis, Multivariate analysis, statistical modeling, sparse estimation

3. Remarks and Websites

researchmap: https://researchmap.jp/7000024867
Laboratory:

Name	Job Title	Area of Expertise
SETOZAKI Norio	Associate Professor	Educational Technology, Science Education

1. Main Research Topics

My research focuses on the development of educational materials utilizing technologies such as Virtual Reality (VR), Augmented Reality (AR), and Tangible User Interfaces (TUI), as well as on the evaluation of these materials and the examination of their educational effectiveness from a practical perspective. In addition, I am engaged in constructing learning environments that support creative activities through the use of tools such as 3D printers, game development software, and programming applications. These efforts also extend to research on fostering human resources for Society 5.0.

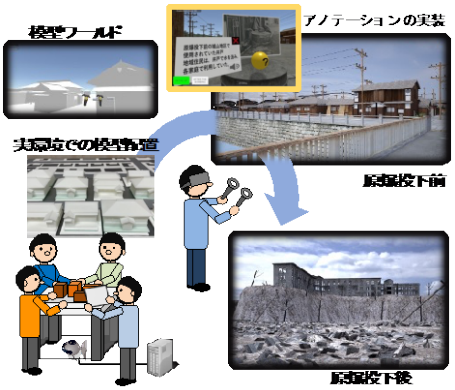
① Developing a Spatiotemporal Multiverse for Disaster Learning

This study aims to construct a "spatiotemporal multiverse environment" by setting up multiple metaverse spaces along different temporal axes. Focusing on disaster prevention education, the project applies AR technology and tangible user interfaces to develop a disaster learning environment that is seamlessly connected to the real world.



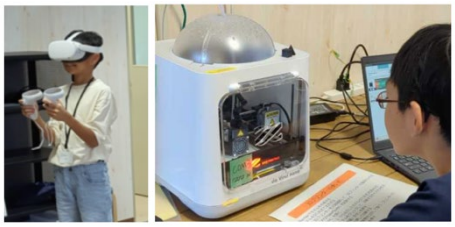
② Development of Peace Education Materials Linked to Physical Model Manipulation

This study developed an immersive VR-based peace education tool linked to the placement of physical models. Learners can reconstruct the streets of Nagasaki before the atomic bombing by arranging building models on a tabletop based on maps and photographs from that time. The reconstructed streets are simultaneously generated in a virtual environment, allowing learners—by wearing a head-mounted display—to explore and compare the virtual cityscape before and after the bombing.



③ Practical Study on Creative Learning Environments and STEAM Education

Through a collaborative project with the DX Promotion Division of Nagasaki City, a makerspace called Creation Switch: tec-nova Nagasaki was established under the theme of "learning through play with cutting-edge technologies." This research visualizes and analyzes learners' activities within the makerspace and examines effective approaches for fostering STEAM-oriented human resources.



2. Keywords

Virtual Reality, Augmented Reality, Tangible User Interface

3. Remarks and Websites

I conduct research across a wide range of fields, with a primary focus on the use of technology in education.

researchmap: https://researchmap.jp/setozaki
Laboratory: https://www.setozakilab.com/

Name	Job Title	Area of Expertise
KITAMURA Fumito	Assistant Professor	Educational Technology, Communication

1. Main Research Topics

① **Research on Mutual Interaction in Bodywork and Its Application to Communication Education**

We have analyzed communication activities within teaching and learning processes, using workshop activities in the arts as case studies, to investigate what constitutes effective interaction. Recently, focusing on bodywork practices such as dance and martial arts, we are researching and developing educational applications concerning the impact of non-verbal interaction and mutual understanding on communication activities.

② **Research on Embodiment in the Educational Use of VR Technology**

We are developing educational materials to utilize VR devices, which have become widely available in recent years, within educational activities. Additionally, we are researching interactions with others during VR experiences, focusing on embodiment, and applying these findings to communication education.

③ **Development of Materials to Promote Active Learning**

We conduct practical research on effective lesson designs and necessary materials to deepen learner engagement. To date, we have developed media materials for elementary and junior high school students, as well as materials for university students. Currently, we are particularly focused on designing lessons that facilitate group activities in project-based business practice and developing self-assessment tools to deepen self-regulated learning.

2. Keywords

Communication, Embodied Cognition, Teaching-Learning-Processes, Instructional Design, Workshop

3. Remarks and Websites

In the Project Based Learning courses I teach at the undergraduate level, we collaborate with various external organizations to establish themes and create learning opportunities for students. If you are interested in participating, please feel free to reach out.

researchmap: https://researchmap.jp/kitamura_f

Name	Job Title	Area of Expertise
KANAYA Ichiroh	Professor	Computer Science

1. Main Research Topics

Seeking an ideal relationship between human and artifacts

① **Capturing reality**

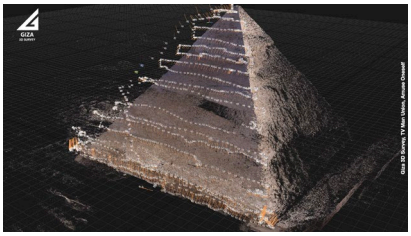
Acquire digital models of everything from industrial products to world heritage sites by developing 3-D and 4-D scanning technologies.

👉 Digital heritage, Life log

② **Understand how it works**

By modeling artifacts mathematically and statistically, we understand "why" and "how" they were designed.

👉 Design science



(Digitizing the Great Pyramid of Giza)
Image courtesy of Giza 3D Survey

③ **Create what artifacts should be**

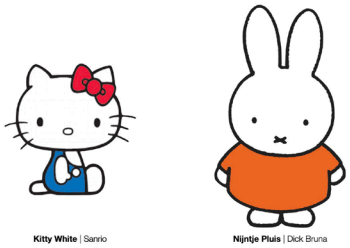
Think and create what artifacts should be to enrich people's lives.

👉 Media art, Manga science

④ **Explain the importance**

Explain the importance of every discovery, every understanding, every creation as a story.

👉 Information architecture



(Research on emotion and facial expression)
Image courtesy of Sanrio and Dick Bruna

2. Keywords

Design science, digital heritage, emotion engineering, media art, information architecture

3. Remarks and Websites

We regard social implementation as our mission and actively conduct joint and funded research.

researchmap : https://researchmap.jp/kanaya
Laboratory: https://madlab.tumblr.com/ https://pineapple.cc/

Name	Job Title	Area of Expertise
ICHIFUJI Yu	Associate Professor	Data Science

1. Main Research Topics

① Analysis of Tourist Behavior Using Location Registration Data

We are conducting a study that utilizes location registration data from telecommunications carriers to analyze differences in behavior by place of residence, gender, and age group, with the aim of developing predictive models. For example, an analysis focusing on Huis Ten Bosch revealed that the peak visiting periods of tourists from Fukuoka and those from the Kanto region overlap in a nested pattern. These findings indicate that travel behavior differs significantly depending on the area of residence and the distance to the tourist destination. Based on such insights, we are currently working to develop models that can contribute to formulating strategies for alleviating the strain on tourist destinations caused by overtourism.

② Analysis of Tourist Behavior Using Online Hotel Reservation Data

To revitalize regional areas through tourism, it is essential to increase not only repeat visitors but also tourists who stay overnight rather than making day trips. Among the key strategies, visualizing tourist accommodation patterns plays a vital role, serving as an important indicator for both developing management strategies for lodging facilities and evaluating the economic impact of promotional events at tourist destinations. This study aims to establish such an indicator by utilizing online hotel reservation data. Since September 2019, we have been collecting daily reservation data for accommodations in Nagasaki Prefecture through the API of a major online booking platform. The dataset includes reservation availability for the same day, as well as for 3, 5, 7, and 14 days ahead, and contains details on available plans, the number of rooms, and pricing information. However, simply aggregating these data does not provide an accurate visualization of occupancy rates. This is because multiple plans with different options may be offered for the same room, meaning that the number of available plans does not directly reflect the number of available rooms. To address this, we developed an occupancy estimation model that assumes plans showing simultaneous decreases in availability at the same point in time correspond to the same room. For validation, we compared our estimated results with official occupancy rates published every three months in the *Accommodation Travel Statistics Survey* by the Japan Tourism Agency. As shown in Figure 1, the estimated trends closely matched the survey data, indicating that reservation data can reliably estimate real-world accommodation trends. While the current analysis focuses on the prefecture as a whole, the availability of individual hotel-level data suggests promising applications for estimating trends in specific regions.

③ Research on Indoor Positioning with BLE Beacons

The location registration information provided by telecommunications carriers offers accuracy only at the base station level, generally within a range of several hundred meters. Moreover, it is not suitable for indoor positioning, which requires the use of alternative methods such as Wi-Fi. To address this limitation, our study has established a method to extract movement histories using Bluetooth beacons and receivers. The objective is to support disaster education by visualizing evacuation drill data conducted at an affiliated elementary school and identifying potential issues. Visualization of a fire evacuation drill revealed that some first- and second-grade students moved toward the fire source in order to seek instructions from their teachers. Such behavior is inadequate as an evacuation response and highlights problematic patterns. These findings underscore the need to provide effective feedback and represent an important challenge for improving disaster education in the future.

2. Keywords

Location Registration Data, Tourism, Behavioral Analysis

3. Remarks and Websites

Since July 2025, we have been conducting a tripartite joint research project with the Kyoto Chamber of Commerce and Industry and SoftBank. The project aims to address the impacts of overtourism in Kyoto and explore potential solutions. In parallel with the initiatives in Kyoto, we also plan to conduct similar evaluations and experiments in Nagasaki.

researchmap: https://researchmap.jp/ichifuji

Name	Job Title	Area of Expertise
KAMIYAMA Takeshi	Associate Professor	Mobile/Edge Computing, IoT, Data Science/AI

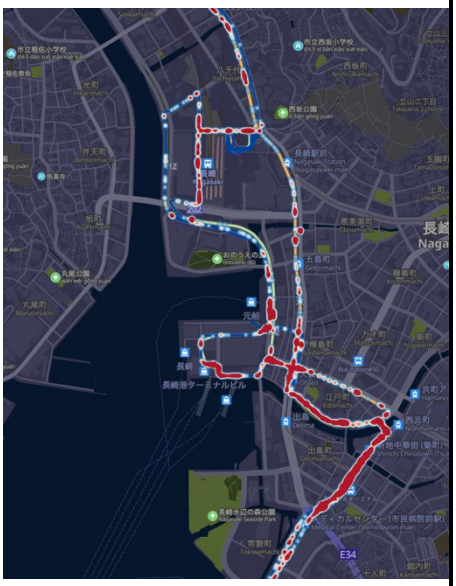
1. Main Research Topics

Urban Sensing Technologies and Applications for Smart Cities

We are working on technologies to collect valuable data about people, objects, events, and their states in urban environments, aiming to realize smart cities. This includes research and social implementation of new services utilizing the collected data.

① **Micro-level User Behavior and State Estimation Technologies and Applications**

Using various information obtained from smartphones and IoT devices, we estimate individual user behaviors, states, preferences, and interests. These estimations are applied to personalized service recommendations. We also address system design challenges necessary to realize these technologies.



② **Macro-level User Behavior and State Estimation for Solving Social Issues**

By capturing the "movement of society" centered around humans on a wide scale and combining it with various data sources, we predict real-time changes in population, transportation demand, and consumption demand in specific regions or spots. These predictions contribute to proposing and implementing services that revitalize local communities and economies.

③ **Urban Sensing Infrastructure Utilizing Transportation Systems**

We consider public transportation as "mobile data collection agents" to gather diverse urban data, such as dashcam footage. We analyze this data to extract meaningful information and develop urban sensing infrastructure systems. We also apply the data collected from real-world fields to service development.

2. Keywords

Mobile Computing, Edge Computing, IoT, Urban Sensing, Data Science, AI, Big Data

3. Remarks and Websites

Leveraging strengths as a former industry professional, I promote projects with clear goals and timelines. As a university faculty member with high autonomy, I actively seek diverse partnerships and engage in activities beyond the boundaries of academia.

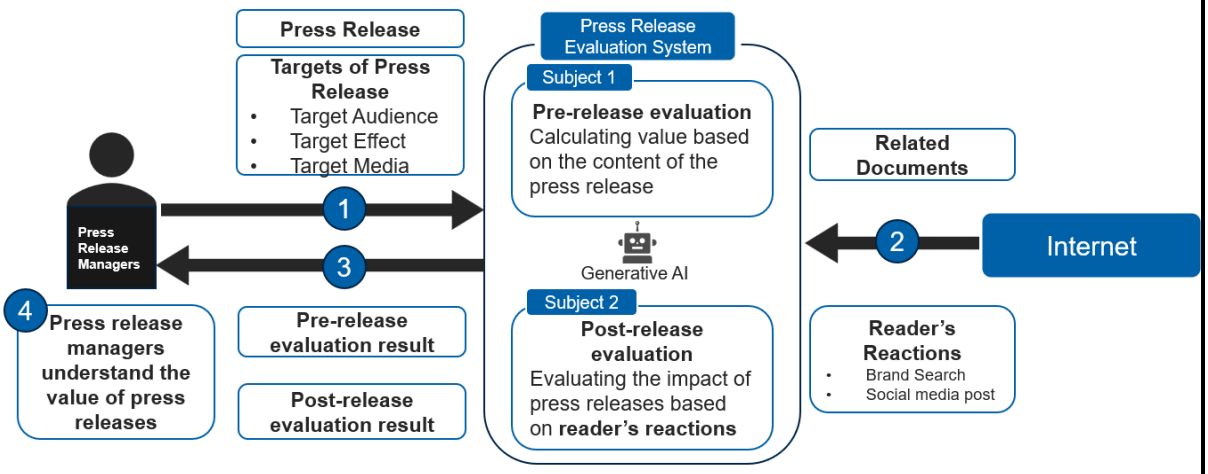
researchmap: https://researchmap.jp/takeshi_kamiyama
Laboratory: https://www.idsci.nagasaki-u.ac.jp/research/faculty-list/staff15

Name	Job Title	Area of Expertise
TSUJIMOTO Wataru	Assistant Professor	Information Systems

1. Main Research Topics

① Quality Assurance of Business Documents Using Generative AI

Generative AI can process and generate text, and these capabilities are increasingly being applied to a wide range of business operations, for example, in drafting and summarizing reports. While document creation has become more efficient, the authors and reviewers of these documents are still expected to ensure their quality. This research aims to leverage generative AI to ensure the quality of business documents. As a first step, I am studying the development of generative AI that quantitatively evaluates the value of press release content prior to its publication, focusing on corporate public relations workflows.



2. Keywords

Artificial Intelligence, Generative AI, Multi-Agent Systems, Web Systems, Natural Language Processing, Quality Evaluation

3. Remarks and Websites

I previously worked in R&D at an IT company, where I engaged in research on applying generative AI to business systems. Specifically, I was involved in the research, development, and operational deployment of a domain-specific translation system and an investment-candidate comparison system. Based on these experiences, I focus on practical utility, pursuing methods that keep operational costs low while maintaining accuracy.

My current research focuses on improving the efficiency of public relations operations by using generative AI to evaluate the value of the information to be issued.

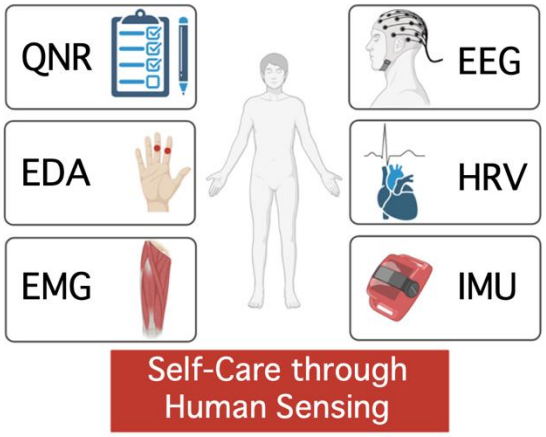
researchmap: https://researchmap.jp/wataru_tsujimoto

Name	Job Title	Area of Expertise
UNO Kohei	Associate Professor	Data Science

1. Main Research Topics

① Multimodal Analysis Using Biosignal Data

Our research focuses on the quantitative evaluation of human movement, psychological states, and health conditions through the integration of diverse biosignal and behavioral data, such as electromyography, electroencephalography, motion capture, video, and acceleration data. A particular emphasis is placed on developing analytical methods to estimate latent human states that cannot be directly observed, including stress resilience and well-being. We aim to extend these approaches to applications in medicine, rehabilitation, and sports science.



② Development of New Statistical Models and Analytical Methods

We develop statistical models and analytical methods to extract meaningful information from complex data, such as psychological scales, questionnaire responses, biosignals, behavioral data, and other structured or unstructured data. Our research draws on item response theory, factor analysis, machine learning, Bayesian statistics, and regularization methods to better model latent structures, individual differences, and temporal changes. These methods are applied to the quantitative assessment of psychology, health, and well-being, as well as to practical evaluation support and broader data-driven research.

2. Keywords

Biosignal Analysis, Motion Capture, Psychometrics, Statistical Modeling

3. Remarks and Websites

Human health and well-being are difficult to capture using a single indicator. Our research develops data science methods for quantifying human states and characteristics by integrating biosignals, body movement data, questionnaire responses, and other sources of information. In particular, we focus on the assessment of stress resilience and on applications that deepen our understanding of human health and behavior in medicine and rehabilitation.

We also conduct data analysis research across a wide range of fields. Through interdisciplinary collaboration, we aim to develop analytical methods and evaluation frameworks that contribute to solving real-world problems.

researchmap: https://researchmap.jp/kohei_uno_stat?lang=en
Laboratory: https://sites.google.com/view/nagasaki-ids-unolab

Name	Job Title	Area of Expertise
MIYAMOTO Michiko	Professor	Management

1. Main Research Topics

① **Data Analytics and Decision Support**
This research analyzes real-world sales and customer data in collaboration with industry partners to support managerial decision-making. Particular focus is placed on applying Structural Equation modeling (SEM) and machine learning to visualize consumer behavior and advertising effectiveness.

② **Consumer Behavior and Marketing Strategies in the Global Market**
Focusing on the diffusion of AI technologies, this research investigates purchasing behavior among consumers in Asian markets. Using experimental marketing and cross-cultural approaches, it aims to optimize advertising and branding strategies.

③ **Comparative Study on AI Governance in the Information Society (Japan, Korea, Taiwan, Malaysia)**
This comparative study explores AI governance, privacy protection, and IT policy across Japan, Korea, Taiwan, and Malaysia. It examines differences in policy formulation and public acceptance within digital societies.

④ **Promotion of Interdisciplinary Education and International Collaboration**
To enhance students' global research experience, exchange programs with universities in Korea, Portugal, Thailand and Taiwan are conducted. These initiatives promote practice-based interdisciplinary education.

2. Keywords
Consumer Behavior, AI Governance, Marketing, Data Analytics, Innovation Diffusion, International Comparison, Industry–Academia Collaboration

3. Remarks and Websites

researchmap: https://researchmap.jp/mi-chi
Laboratory:

Name	Job Title	Area of Expertise
JIANG Jiaming	Assistant Professor	Economics

1. Main Research Topics

① A Study on the Potential of Green Transformation (GX) Innovation in Agriculture and the Creation of Agribusiness

This study aims to explore solutions to issues such as labor shortages, aging populations, and declining income of agricultural workers, taking into account the social context of declining numbers of agricultural workers and soaring agricultural product prices from the perspective of agricultural protection and revitalization. In particular, the study focuses on the role that promoting Green Transformation (GX) innovation plays in enhancing the sustainability of agriculture. To this end, we will systematically collect and search patent information on GX-related technologies in the agricultural sector using J-PlatPat, and build a reliable database suitable for analysis. Based on this, the study aims to visualize and represent trends in GX-related patents in Japan's agricultural sector using descriptive statistical methods, and quantitatively clarify how these innovations impact agricultural productivity and business profitability. Furthermore, based on these findings, we will comprehensively examine the potential for agricultural smartification and the creation of new agribusinesses. In addition, at the School of Information and Data Sciences, Nagasaki University, we will actively promote interdisciplinary collaboration with other laboratories that possess advanced technologies, such as AI sensor technology for automatic detection of pests and diseases, real-time monitoring of soil conditions, and integrated analysis with meteorological data. Through this, we also aim to enhance the feasibility of practical implementation in the field. Through the integration of such technologies and collaboration with local communities, the outcomes of this research are expected to serve as foundational technologies that support the smartification and advancement of regional agriculture, leading to further social implementation and development in the future.

② The Professionalization Trajectory of Healthcare Interpreter Certification in the Context of the Language Industry: A Comparative Study of Industry-Led and Government-Led Models

This study compares two contrasting certification models—the industry-led model adopted in the United States and the government-led model developed in Japan—against the backdrop of increasing linguistic diversity and growing demand for multilingual healthcare communication in the United States, Japan, and China. Furthermore, in China, it examines the impact of distinctive environmental factors such as the advancement of the Belt and Road Initiative, the expansion of visa-free entry for foreign nationals, and the sharp increase in tourists. From the perspectives of professionalization theory and the political economy of language services, the study investigates how various actors—including professional associations, government agencies, and language service providers—are involved in the formation and operation of certification standards, ethical frameworks, and mechanisms for integrating services. Moreover, it considers the unique advantages and the significance of paid human healthcare interpreting services by comparing them to AI translation tools, such as ChatGPT and DeepSeek, and other state-of-the-art AI technologies as means of interpretation and translation support in medical settings. The study aims to position healthcare interpreter certification not merely as a regulatory measure, but as a framework that contributes to strengthening language governance, ensuring equity in public health, improving the quality of medical services, and realizing a multicultural, inclusive society.

2. Keywords

Smart Agriculture, Statistics, Data Science, Regional Economy, Green Transformation (GX) Innovation, Language Industry, Healthcare Interpreting

3. Remarks and Websites

researchmap: https://researchmap.jp/jiangjiaming?lang=en
Laboratory:

Name	Job Title	Area of Expertise
TAKETOMI Nanami	Assistant professor	Statistical Science, Biostatistics

1. Main Research Topics

① Development of statistical methods and their applications for medical and health data

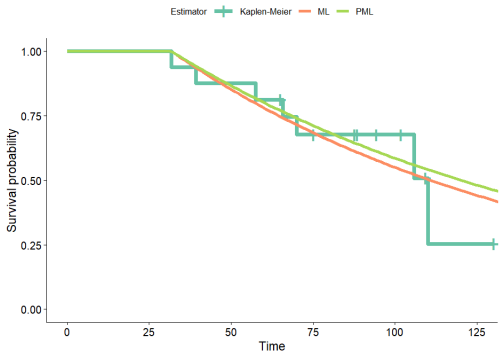


Figure 1 Survival functions

I am interested in the development and application of statistical methods, particularly in the field of survival analysis, which deals with time-to-event data.
Based on time-to-event data, I calculate the survival probability at each time point (Figure 1).

With a background in biostatistics from graduate school and the experience supporting the planning and progressing of clinical studies at a university hospital as a biostatistician, I am interested in researches targeting clinical studies and medical data.
In addition, I am trying to progress statistical theory and applied research in other fields, such as reliability engineering, which deals with time to failure data.

② Statistical inference on the common mean in meta-analysis

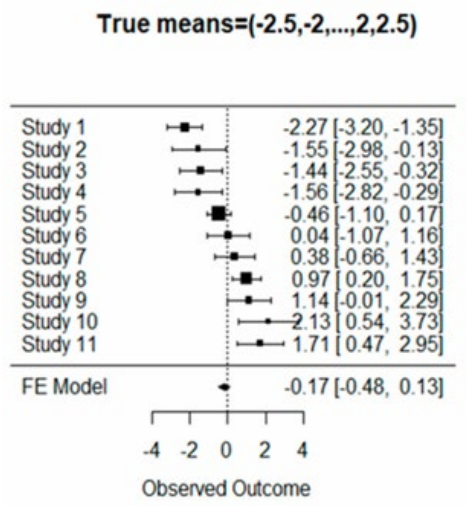


Figure 2 An example of meta-analysis.

I am doing research on meta-analysis, a statistical method that integrates results (such as sample means and other summary statistics) from multiple independent studies.

For estimating the overall mean across studies, we assume that the summary statistics from each study share a common mean (Figure 2).

My work is developing methodologies for meta-analysis when the assumption of a common mean is not held, applying these methods to real-world data, and developing an R package.

2. Keywords

Meta-analysis, Parametric model, Reliability analysis, Shrinkage estimation, Survival analysis

3. Remarks and Websites

I am grateful if my research could contribute to the real society and human wealth.
If you have any questions or you are interested in the field of my research, please let me know.

researchmap: https://researchmap.jp/n_taketomi
Laboratory: None.
Google scholar: https://scholar.google.jp/citations?user=BgGThgEAAAAJ&hl=ja&oi=ao

Name	Job Title	Area of Expertise
UEKI Masao	Professor	Statistics

1. Main Research Topics

We conduct research on statistics and related methodologies necessary for data analysis. With the recent emergence of complex multi-dimensional and high-dimensional data, it is increasingly common to encounter data that cannot be adequately analyzed using conventional procedures. To enable appropriate analysis of such complex data, we work on improving and developing new statistical methods. Our primary focus is on statistical methods for analyzing complex data arising in medicine and biology.

① Development of statistical methods for analyzing complex biomedical data

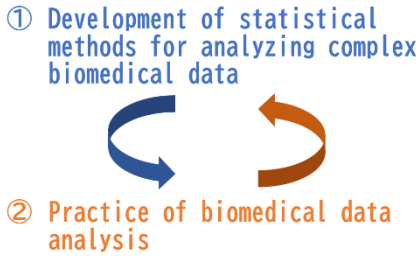
We develop statistical methods for knowledge discovery from complex medical and biological data, as well as statistical models for disease prediction. The work mainly involves theoretical research, simulation studies, and implementation. Specific research topics include:

- Development of disease prediction models by integrating clinical and genomic data
- Development of statistical methods to detect interactions between clinical or environment factor and genomic data
- Development of statistical modeling and analysis methods that account for data heterogeneity
- Development of procedures for evaluating the adequacy of statistical models
- Development of statistical methods for analyzing small-sample data

② Practical biomedical data analysis

This area of research focuses on the analysis of medical and biological data itself. If data are modeled appropriately, even complex datasets can often be analyzed effectively by combining existing procedures. Furthermore, even for datasets that were previously difficult to analyze, researchers worldwide are rapidly developing and packaging new methods. By promptly identifying and appropriately utilizing these methods, it becomes possible to analyze such data effectively.

Moreover, the practical analysis of medical and biological data can motivate the development of new statistical methods. Conversely, experience and insights gained from developing statistical methods can lead to better modeling and analysis of data. We pursue research by integrating both aspects.



2. Keywords

Biostatistics, Medical Statistics, Statistical Genetics, Data Science

3. Remarks and Websites

Statistics plays a vital role across a wide range of fields, including medicine, biology, economics, finance, marketing, business, psychology, education, environment, agriculture, climate, transportation, quality control. Therefore, collaborative research can be conducted in any area where data analysis is required, without limiting to a specific field. Statistical consultation is also available.

researchmap: https://researchmap.jp/uekim7818?lang=en

Name	Job Title	Area of Expertise
MATSUMOTO Hirotaka	Associate Professor	Bioinformatics

1. Main Research Topics

With the revolutionary advancements in various experimental technologies, including DNA sequencers and genome editing techniques, life science data with diverse types of information can now be obtained in a high-throughput manner. Our research aims to understand biological phenomena from the perspective of data science and mathematics, while also pursuing applied research in areas such as regenerative medicine and personalized medicine.

(1) Unraveling the Processes of Cell Differentiation and Early Development

We aim to understand the dynamics of various cellular states by integrating mathematical/informational theories with biological data. In particular, we have developed theoretical frameworks using single-cell RNA-seq data—which measure gene expression at single-cell resolution—to model cell differentiation as stochastic processes and to investigate transcriptional regulation and cell fate fluctuations (Figure 1). Additionally, we conduct studies that reconstruct early developmental processes using information on mosaic mutations—novel genomic variants acquired during development (Figure 2).

Fig.1 Reconstruction of cellular differentiation

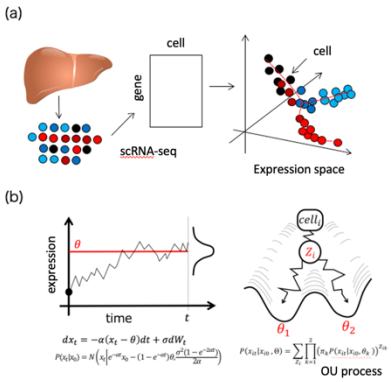
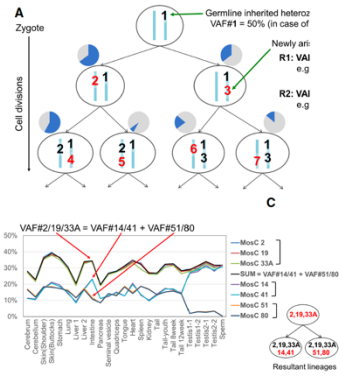


Fig.2 Reconstruction of early development



(2) Deciphering Parasite Genomes through Mathematical and Computational Approaches

We conduct research on protozoan parasites, such as malaria and trypanosomes—pathogenic eukaryotic microorganisms—using mathematical and computational approaches. These protozoa have evolved unique mechanisms to adapt to diverse parasitic environments and evade host immune responses. Our work seeks to understand these mechanisms by studying their characteristic genome structures.

(3) Sequencing Analysis of Various Diseases, Centered on Single-Cell RNA-seq

We have collaborated with a wide range of researchers within and outside Nagasaki University to investigate various biological phenomena. Our collaborative studies include research on diseases such as osteosarcoma, lung cancer, autoimmune disorders, and Parkinson's disease, as well as infectious diseases such as malaria.

2. Keywords

Genome, Gene, Transcriptome, Single-cell, Development and differentiation, Cancer, Parasite, Machine learning, Probabilistic model

3. Remarks and Websites

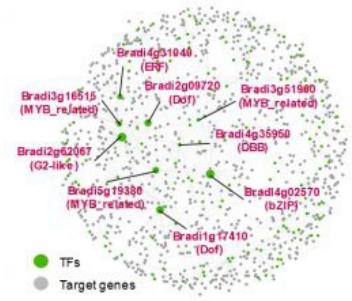
We have conducted research on a wide range of biological phenomena from the perspectives of mathematical and information sciences. To this end, we have not only made effective use of existing tools but also developed new algorithms and machine learning methods as needed. Moving forward, we aim to continue promoting interdisciplinary research in collaboration with researchers from diverse fields.

researchmap: https://researchmap.jp/hmatsu1226
Laboratory: https://sites.google.com/view/matsumotolab

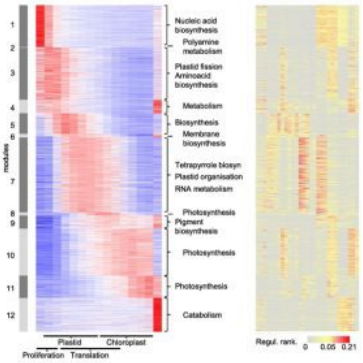
Name	Job Title	Area of Expertise
MOCHIDA Keiichi	Professor	Genome Informatics

1. Knowledge Extraction and Application from Deep Phenotyping Data

Comprehensive measurement of biomolecules within living systems enables the generation of diverse, high-dimensional datasets that accurately capture biological states. By integrating and analyzing bioimaging data together with transcriptomic, proteomic, and metabolomic profiles, our research seeks to systematically extract knowledge regarding functionally important genes and their roles, thereby advancing the understanding of complex biological processes.



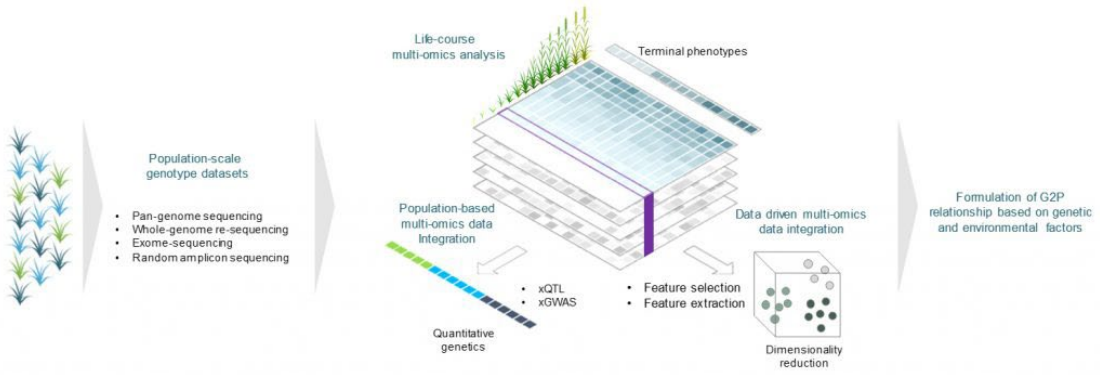
Gene regulatory networks inferred from comprehensive gene expression data



Linkages between gene expression maps and predicted regulatory networks

2. Modeling the Relationship Between Crop Genomic and Phenotypic Diversity

To elucidate how genomic variation in crops influences interactions with the environment, growth trajectories, and final agricultural trait diversity, we are developing models that describe genome-to-phenome relationships grounded in a life-course perspective of crop–environment interactions. This research aims to advance our understanding of the genetic basis of phenotypic diversity and contribute to more effective strategies for crop breeding.



Genome-to-phenome representation grounded in a life-course perspective of crop–environment interactions

2. Keywords

Genome, gene expression, gene regulatory networks, phenotyping, and crops

3. Remarks and Websites

researchmap: https://researchmap.jp/keiichi_mochida?lang=en

Division of Engineering

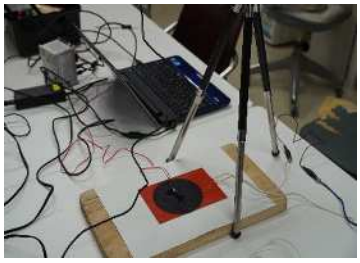
Name	Job Title	Area of Expertise
SAIMOTO Akihide	Professor	Mechanics of Solids

1. Main Research Topics

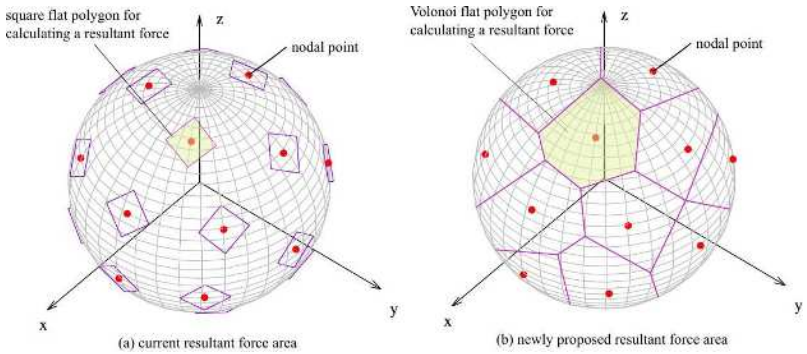
① **Development of an innovative system for numerical stress analysis**
A numerical calculation system that enables high-precision stress analysis of arbitrary three-dimensional elastic bodies using the body force method, which is a boundary stress analysis method is being developed. This system is particularly powerful for crack analysis.

② **High-precision processing of materials for electric devices by controlling crack propagation**
In general, machining of hard and brittle materials often results in reduced processing accuracy due to tool wear and heat generated. Additionally, coolants used to reduce the temperature of the cutting tools can contaminate the material. Therefore, we are researching a method to cut hard and brittle materials without using tools by controlling the crack path. Specifically, we are investigating the industrial application of crack propagation control for the processing of electronic devices using SiC and GaN as substrates, which are highly anticipated as power semiconductors.

③ **Numerical prediction of deformation and failure processes of solids based on numerical simulations of crack growth and coalescence**
As there exist a strong stress singularity at the crack tip, its numerical analysis is generally very difficult. In particular, numerical analysis of situations where multiple cracks exist and interfere with each other is almost impossible using general-purpose numerical methods such as FEM. Therefore, a powerful numerical evaluation system for predicting a behavior of crack growth and coalescence is being developed. This system has potential applications in the medical field, such as the analysis of fractures caused by excessive external forces acting on the human body.



Preliminary experiment for Wafer cleaving



New analysis strategy for calculating a 3D stress concentration using resultant force of surface area

2. Keywords

Stress analysis, Deformation analysis, Dynamic analysis, Electric device, Body force method

3. Remarks and Websites

We are conducting research on processing wafers made of semiconductor materials such as Si, SiC, and GaN into the desired shape without using cutting tools. These semiconductor materials share the common characteristics of being hard and brittle, making them unsuitable for mechanical processing that involves cutting or removal. On the other hand, their brittle nature means that they have low crack propagation resistance. Therefore, we are investigating methods for controlling crack propagation to perform fracture processing. Here, the key point is to establish a method for intentionally propagating cracks along a desired path, utilizing technologies such as lasers, ultrasonics, and non-contact heat sources.

researchmap: https://researchmap.jp/s-aki
Laboratory: http://www.mech.nagasaki-u.ac.jp/lab/solid/index.html

Name	Job Title	Area of Expertise
KOYAMA Atsuhiro	Associate Professor	Strength and Fracture of Materials, Fatigue

1. Main Research Topics

In order to prevent global warming, there are many things that must be done to reduce the weight and improve the efficiency of mechanical structures. To reduce the weight of mechanical structures, it is necessary to fully understand the strength properties of the mechanical structural materials and ensure the safety and long-term reliability of structures that use these materials. Therefore, we are conducting experimental research to understand the strength properties, especially the fatigue strength properties, of various mechanical structural materials.

① **Evaluation of fatigue characteristics of structural materials**

We investigate the fatigue properties of materials such as steel and aluminum alloys, as well as the fatigue properties of materials that have been joined by dissimilar metal bonding, welding, adhesives, etc. Furthermore, we obtain the fatigue strength properties not only in air at room temperature, but also in water. We obtain the S-N curves (Fig. 1) and fatigue crack growth behavior, providing basic data for reliability design.

② **Development and application of laser and electron beam induced acoustic microscope**

Micro-defects on the surface of a material or inside the material near the surface are one of the factors that have a significant effect on the fatigue strength of the material. In this research, we are developing the microscope system for non-destructive observation of micro-defects (micro-cracks, voids, etc.) near the surface of a sample using the laser or electron beam. (Figs. 2 and 3 are examples of images observed using the electron beam induced acoustic microscope.)

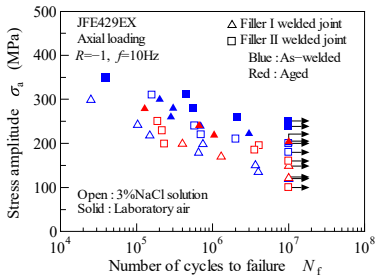


Fig.1 Comparison of fatigue strength characteristics of MIG-welded stainless steel in air and in 3% NaCl solution (*S-N* curves).

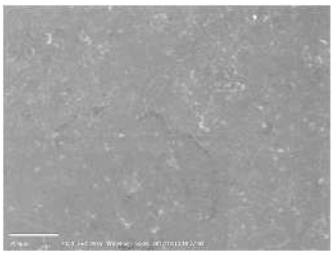


Fig.2 Surface observation of Aluminum alloy with 0.2 mm diameter hole inside.

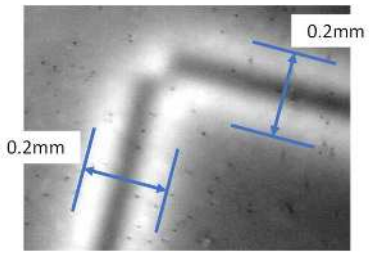


Fig.3 Image of internal hole observed using the electron beam induced acoustic microscope.

2. Keywords

Fatigue life, Fatigue crack growth behavior, SLAM, SEAM

3. Remarks and Websites

We can perform tensile and fatigue tests and provide highly accurate data.
In addition, because SLAM and SEAM can detect very small defects of about a few μm in size, we believe they can be applied to the inspection and quality assurance of semiconductors and MEMS materials.

If you provide us with test materials or observation samples, we will evaluate the material properties and provide you with the results.

researchmap: https://researchmap.jp/read0068615
Laboratory:

Name	Job Title	Area of Expertise
KITAMURA Takuya	Assistant Professor	Fluid Mechanics

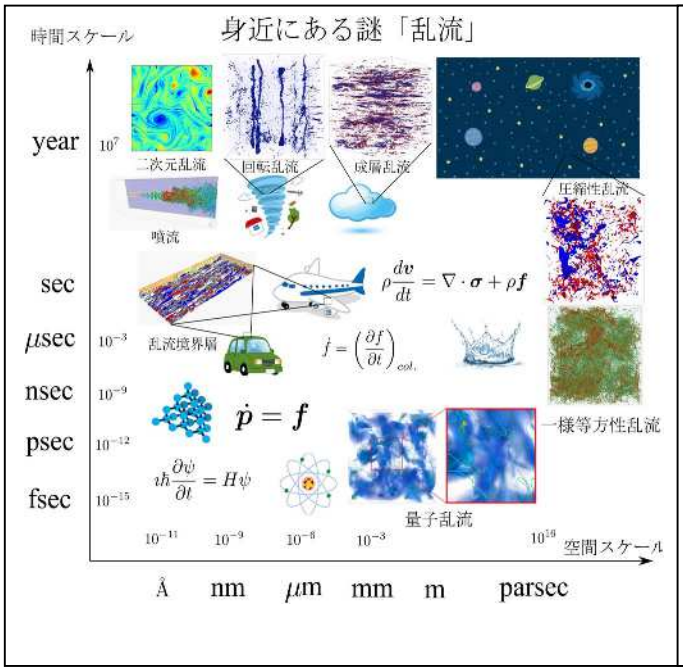
1. Main Research Topics

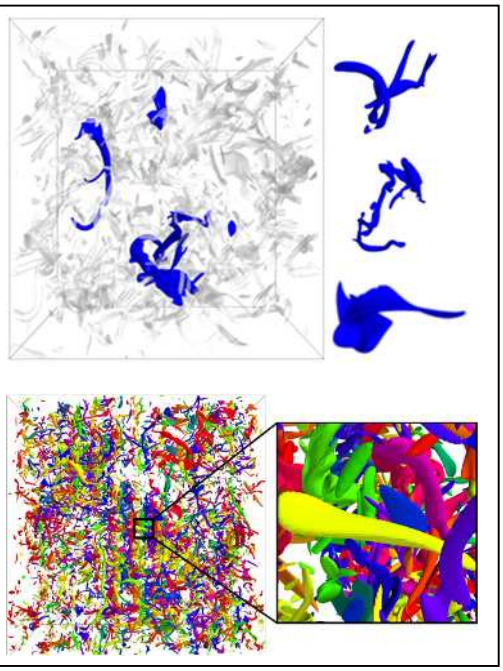
Turbulence is a significant phenomenon that appears across a vast range of spatiotemporal scales—from quantum to cosmic—and affects a wide variety of fields, including weather forecasting, the design of aircraft and automobiles, mixing and diffusion of heat and substances, and our understanding of oceanic and space environments. However, its behavior is extremely complex, and many aspects remain unresolved to this day. We are conducting fundamental research in fluid dynamics, with a focus on turbulence, in the following areas:

① **Statistical Theory of Turbulence**
We are conducting mathematical analyses to elucidate the statistical laws of turbulence.

② **Numerical Simulation of Turbulence**
We perform numerical simulations of turbulence using supercomputers.

③ **Experimental investigation of Turbulence**
We conduct turbulence measurements using hot-wire anemometry.





2. Keywords

Fluid Mechanics, Turbulence

3. Remarks and Websites

Features: Our research focuses on both fundamental and applied aspects of fluid phenomena using a three-pronged approach: theoretical analysis, numerical simulation and experiment.

Research Achievements: Publications include *Journal of Fluid Mechanics*, Vol. 1010 (2025), A14, among others.

Future Outlook: In addition to contributing to fundamental research in fluid dynamics, we are committed to promoting its practical implementation through applied studies.

Ongoing Projects: JSPS KAKENHI Grant-in-Aid for Scientific Research (C), 2025
/JHPCN-Q: “Parallel Computation of High-Reynolds-Number Turbulence Using Compact Finite Differences and Investigation of Turbulence Universality”
/Development Research: “Wind Tunnel Experiments on the Development of a High-Reynolds-Number Turbulence Generator for Offshore Wind Power and Its Impact on Wind Turbine Performance”

researchmap: https://researchmap.jp/tk-0426
Laboratory: https://www.mech.nagasaki-u.ac.jp/lab/kitamura_lab/index.html

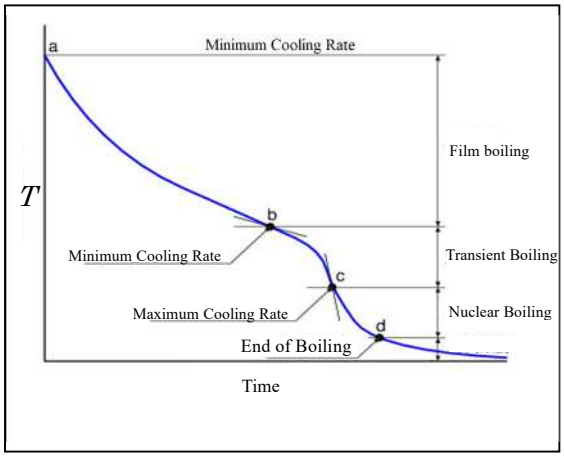
Name	Job Title	Area of Expertise
MOMOKI Satoru	Professor	Thermal Engineering

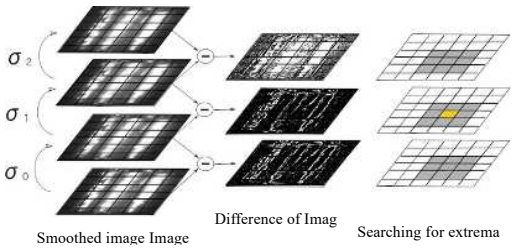
1. Main Research Topics

① Analysis on Heat Transfer Phenomena by Information Processing of Flow Patterns in Cooling of High Temperature Objects

The situation when cooling an extremely hot object with a liquid such as water is complex. Normally, the generated steam covers the surface (heat transfer surface), significantly reducing the cooling performance. Once the temperature of the object has dropped to a certain level, the heat transfer surface becomes wet, and normal boiling occurs, causing intense turbulence between the gas and liquid, resulting in rapid cooling. The purpose of this study is to predict the heat transfer performance in this case and to elucidate the mechanism leading up to the onset of wetting.

To quantitatively and accurately understand this phenomenon, it is important to measure the rapidly fluctuating local temperature, but this is not easy. Therefore, we take advantage of the fact that the gas-liquid state is turbulent depending on the heat transfer situation. By combining the results of appropriately processing observation images taken with a high-speed camera using a computer with knowledge of heat transfer phenomena, we are developing a system to obtain heat transfer information from image processing.。





Examination of feature points in film boiling phenomena images

② Development of program libraries for the thermophysical properties and its usage

We are investigating the development and use of PROPATH, a program library that calculates the main thermophysical properties of commonly used fluids such as water, air, and hydrogen - temperature, pressure, density, enthalpy, viscosity coefficient, thermal conductivity, etc. We are focusing on the value of data and how to access it, replacing the use of databases for predicting various physical properties that require different values in various situations.



WEB Interface of PROPATH

2. Keywords

Energy, Information Processing, Thermal Engineering, Heat Transfer, Manufacturing

3. Remarks and Websites

This research is characterized by its attempt to quantify the quantities necessary for thermal engineering by utilizing both thermal engineering and information engineering. In recent years, we have begun research into heat transfer phenomena in machining technology and their image processing. Considering the local temperature conditions inside tools and coolants during various special machining processes, we will build a more general "heat transfer model for predicting temperature changes in tools during machining."

researchmap: https://researchmap.jp/read0172749

Laboratory:

Name	Job Title	Area of Expertise
YAZAWA Takanori	Professor	Mechanical Engineering

1. Main Research Topics

We conduct research related to precision production and address various social issues based on its outcomes. With a focus on "measurement time as non-productive time," "minimizing work paths," and "achieving required uncertainty," we propose and research systems that can be implemented from the initial stages.

① **Research on non-contact on-machine measurement and corrective machining of dies and molds**

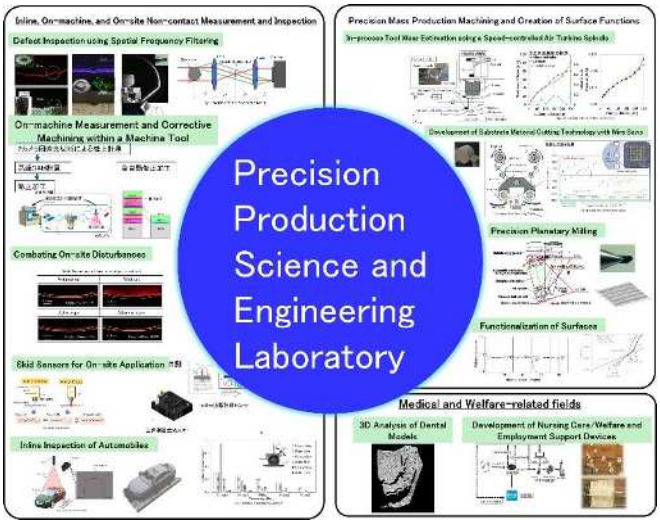
This research involves measuring and performing corrective machining on the shapes of dies and molds, which are processed by cutting and electrical discharge machining, directly on the machine tool in a practical amount of time. Currently, multiple systems are in the phase of social implementation.

② **Research on precision edge projection**

This is a high-precision edge projection system that uses spatial frequency filtering. It has numerous achievements in fields such as dimensional measurement, contour measurement, and defect inspection. It has achieved on-site measurements with a 6σ value of 1.8 μm

③ **Research on practical machining and measurement of next-generation semiconductor materials**

This research focuses on machining and measuring next-generation semiconductor materials such as SiC (silicon carbide) and GaN (gallium nitride) at practical speeds and precisions. The machining research primarily concerns wire saws, while the measurement research focuses on wafer shape error and internal stress.



2. Keywords

Production Engineering, Inline Measurement, On-machine Measurement, Shape Measurement, Edge Detection, Defect Inspection, Optical Design, Precision Mass Production Machining, Machining Phenomenon Analysis, Wire Saw, Creation of Surface Functions using Micro-scale Irregularities,3D Brain Analysis, Development of Assistive Devices with Voice Support

3. Remarks and Websites

Please contact us about anything related to production, such as building the optimal measurement system.

researchmap： https://researchmap.jp/t_yazawa
YouTube： https://www.youtube.com/watch?v=VMABRyYdJjE

Name	Job Title	Area of Expertise
YAMAGUCHI Tomohiko	Professor	Thermal Engineering

1. Main Research Topics

① Measurement of sound speed in gas



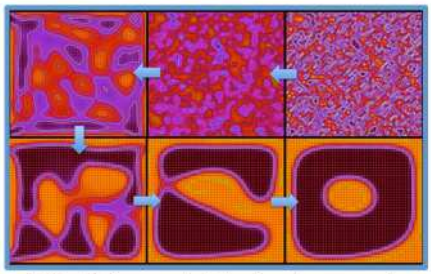
We accurately measure the speed of sound in gases from -20°C to 80°C and from 100 kPa to 1 MPa by using a spherical resonator. The speed of sound of hydrogen can be measured with an uncertainty of several hundred ppm by this apparatus. On the measurement of the sound speed of hydrogen sealing is difficult due to its small molecules and difficult to measure with high precision due to its high speed of sound. From the sound speed data, it is possible to calculate the specific heat of an ideal gas state, which is necessary for estimating thermal properties by equation of state.

② Development of global equation of state

We are developing a general equation of state that can be applied to various fluids, using excess Gibbs energy (activity coefficient) calculated by the group contribution method. I have developed the Volume and g^E Translated Peng-Robinson (VTPR) equation of state and demonstrated that it can be used to calculate the thermal properties of mixtures using group contribution method parameters in collaboration with Professor Gmehling and Professor Rarey (University of Oldenburg) from 2002. We are working on applying SAFT-type equations of state to calculate the thermal properties of more complex mixtures, such as ammonia and water mixtures, and fluorocarbon and lubricant mixtures.

③ Numerical simulation for liquid-gas two-phase flow with large density difference in complex boundary

We are conducting the research about the numerical simulations of gas-liquid two-phase flow using the lattice Boltzmann method (LBM). It is possible to simulate heat and mass transfer in gas-liquid two-phase flows with large density ratios for low Reynolds number flows. Features of this numerical calculation method include its ability to handle complex boundaries, self-formation of free surfaces, and portability to parallel computer systems. The right figure shows a fluid with randomly distributed densities, which aggregates with other fluids of the same density to form a droplet and liquid film on the wall surfaces. We have conducted the research about numerical analysis of flow in complex channels simulating multi-layer sintered wicks in a heat pipe and bubble behavior considering wall wettability. Currently, we are attempting numerical simulations of water transport within plant xylem by LBM.



Lattice Boltzmann simulation for phase separation

2. Keywords

Numerical simulation of thermal fluids, Thermophysical properties of fluids, Equation of state

3. Remarks and Websites

We conduct a comprehensive range of research and activities, from measuring the thermal properties of fluids to developing equations of state. We are currently preparing to operate a apparatus for the sound speed in liquid measurement and are in the process of tuning the devices. In addition, we are conducting joint research with Saga University on the thermal properties of ammonia, for which demand is expected to grow significantly. Numerical simulation of heat and mass transfer has expanded rapidly with the advancement of computers. We are working on analyzing gas-liquid two-phase flow with large density difference in complex boundary, which has been difficult to calculate until now.

researchmap: https://researchmap.jp/yamagch
Laboratory: http://www2.mech.nagasaki-u.ac.jp

Name	Job Title	Area of Expertise
OTSUBO Tatsuki	Assistant Professor	Precision Engineering, Optical Measurement

1. Main Research Topics

① Development of an On-Machine Non-Contact Shape Measurement System

On-machine measurement is a key technology that enables both high precision and high efficiency in machining, and it plays a critical role in the full automation of machining processes. However, because such measurements are performed using the spindle of the machine tool, motion accuracy tends to degrade during high-speed scanning. This degradation adversely affects measurement accuracy and limits the potential for improving measurement throughput. In this study, we developed a laser displacement sensor for on-machine measurement that incorporates the optical skid method, which effectively eliminates the influence of vibration and motion errors.

② Development of an In-Line Non-Contact Film Thickness Measurement System

We have developed a device that can measure the film thickness of paint surfaces that are still wet immediately after painting. The main feature of this measuring device is that it can accurately measure film thickness even when the object being measured is shaking, by eliminating the effects of the shaking while the object is suspended during painting.



Fig. On-machine measurement sensor

2. Keywords

Production engineering, 3D shape measurement, on-machine measurement, micromachining

3. Remarks and Websites

- We conduct research and development of manufacturing technologies (measurement and machining) that meet the needs of production sites.
- We specialize in developing in-line and on-machine measurement technologies.
- We are engaged in the development of measurement systems that are robust against external disturbances such as vibrations within factories.
- We can design custom-made measurement systems tailored to your specific requirements.

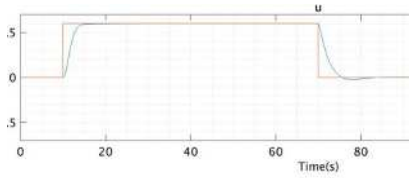
researchmap: https://researchmap.jp/otsubo

Name	Job Title	Area of Expertise
UCHIHORI Hiroshi	Professor	Underwater Robotics

1. Main Research Topics

① Research for Underwater Vehicle Dynamics and Control

The motion of underwater vehicle is described by non-linear six-degree-of-freedom rigid body equations of motion. Furthermore, the coefficients of fluid dynamics force around the body must be determined by water tank tests. However, the hovering type underwater vehicles which have a frame type complex structure have not been fully modeled. So we are conducting the research about the modeling method and the control system for them.



Example of simulation result of the vehicle control

② Research for Guidance and Control using Underwater Imaging

When visual inspection of underwater structures using an ROV, the target object is tracked by visual navigation and control by human pilot using underwater camera, however, it requires high level skill to maintain a certain distance from the target while being influenced by tidal currents. For this reason, we are conducting research into semi-automatic target tracking using a stereo camera to recognize target image so that anyone can easily operate the vehicles. This research was selected for the Cabinet Office's 2024 AUV Demonstration Project, and the sea trial was conducted for the mooring chain.



Semi-automatic tracking mooring chain

③ Research for Low Cost AUV

Currently, ROV which has tether cable is mainly used for the underwater operation, furthermore, AUV have come into practical use, however, AUV is expensive. So we have started the low cost AUV research.

2. Keywords

Underwater vehicle, ROV, AUV, Guidance and Control

3. Remarks and Websites

Underwater Vehicle (ROV and AUV) have become an essential technology for inspecting the underwater structure like an offshore wind farm. Our research can contribute to spread of underwater vehicle instead of the human diver operation which is dangerous and high cost.

researchmap: https://researchmap.jp/hiroshi-uchihori
Laboratory: https://robotics-mech-nagasaki-univ.conohawing.com

Name	Job Title	Area of Expertise
SAKAGUCHI Daisaku	Professor	Turbomachinery

1. Main Research Topics

① Multi-objective Optimization of Turbomachinery

Turbomachinery plays a vital role in transporting fluids such as air and water. Additionally, when harnessing renewable energy sources like wind and tidal currents, the efficient design of turbomachinery is essential. Although turbomachinery can be designed using computer-based numerical simulations, the challenge lies in the fact that it requires the combination of many design variables—making it difficult to identify the optimal shape. To address this, a system that combines a genetic algorithm-based shape optimization method with an artificial-neural-networks has been developed, enabling the efficient and automated search for optimal designs. This system allows the computer to automatically modify shapes and search for the best design. It has been applied to various turbomachinery design goals, including improving efficiency, reducing noise, and expanding operational ranges. Through the development of high-performance turbomachinery, it will be contributed to energy conservation in the industrial sector.

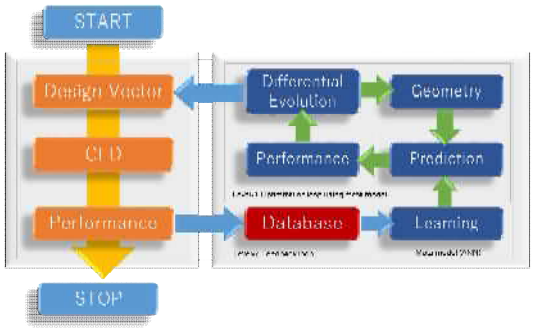


Fig.1 Multi-objective Optimization System

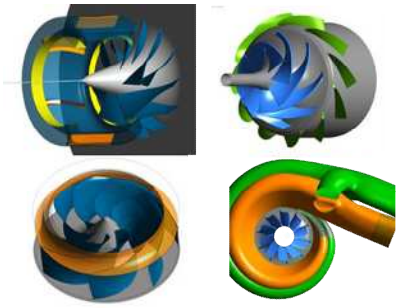


Fig.2 Applications to Turbomachinery Design

② Development of an Energy Harvesting Smart Buoy

Effective utilization of marine resources requires a sampling system capable of long-term, fixed-point observation over wide ocean areas. To address this need, it has been developed a smart buoy equipped with a tidal current turbine for independent power supply. The turbine was optimally designed to achieve high efficiency across a wide range of current velocities, corresponding to the roughly 6-hour tidal cycle.

The developed smart buoy is capable of measuring seawater temperature, tidal current velocity, salinity, chlorophyll concentration, and the FSI value which is an indicator of red tide. Leveraging the high-power generation capacity of the tidal turbine, the buoy can support multiple high-power-consuming sensors. This smart buoy is intended for various applications, including the efficient utilization of marine resources, remote monitoring of offshore aquaculture, and red tide sensing.

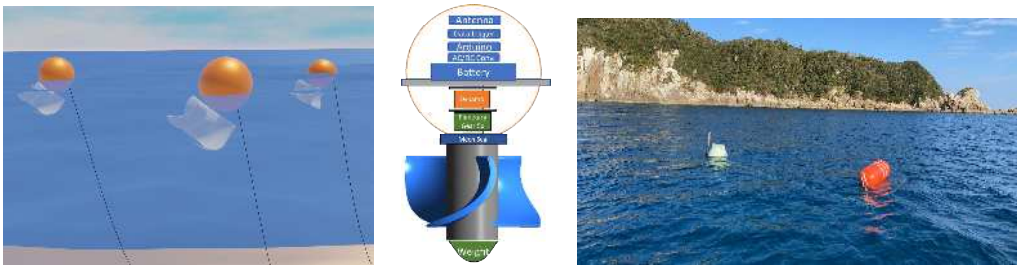


Fig. 3 Development and Demonstration Testing of a Smart Buoy

2. Keywords

Turbomachinery, Multi-objective optimization, Tidal turbine, Smart buoy

1. Remarks and Websites

AI based optimization system enables efficient design of turbomachinery, contributing to energy conservation and the development of renewable energy sources. In addition, the smart buoy equipped with a tidal current turbine is expected to provide fundamental data for future marine development.

researchmap: https://researchmap.jp/dai_sakaguchi

Laboratory: https://www.mech.nagasaki-u.ac.jp/lab/sakaguchi_lab/html/home.html

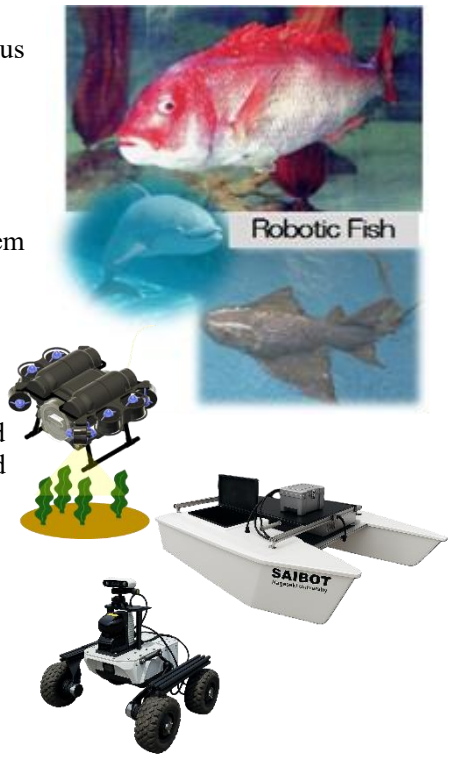
Name	Job Title	Area of Expertise
YAMAMOTO Ikuo	Professor	Robotics, System Engineering, Dynamics & Control

1. Main Research Topics

① **Robotics**
Offshore, Onshore, Aerospace, Medical robotics with autonomous function have been developed.

② **Offshore energy**
Total technologies for practical renewable offshore energy system such as offshore wind have been developed.

③ **Civil infrastructure**
Robotic systems for assessing the degradation of civil and industrial infrastructure, including bridges, tunnels, roads, and plants have been developed.



2. Keywords
Robotics, Offshore energy, Infrastructure inspection robot

3. Remarks and Websites
2025 IEEE/IFAC GOLD BEST PAPER AWARD at the ICCAD'25 (Development of Land Robot), 2005 Archipelago award, France (Bio-Manoeuvring Type Underwater Vehicle),The world record of autonomous underwater vehicle cruising 317km by Urashima from Feb.26-28,2005.
MARIN CONTROL SYSTEMS, IFAC International Journal Robust and Nonlinear Control, Vol.11, No.13, 2001, Wiley.
Practical Robotics and Mechatronics, Marine, Space and Medical Applications, ISBN978-4-320-08186-4, ISBN978-4-320-08191-8, IET.
Red Tide Monitoring, Smart Fisheries, pp.136-137, Midori Shobo, ISBN978-4-89531-885-3, 2023

researchmap: https://researchmap.jp/iyamamoto_nu
Laboratory: https://robotics-mech-nagasaki-univ.conohawing.com/
Offshore Technology R&D Innovation Center HP: https://sites.google.com/view/otic-nagasaki-u

Name	Job Title	Area of Expertise
OKUMURA Tetsuya	Associate Professor	Tribology

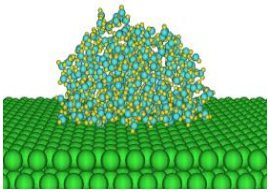
1. Main Research Topics

We conduct both fundamental research and technological development centered on the themes of "surface" and "water." Our investigations focus on phenomena occurring at and near solid–liquid and gas–liquid interfaces, employing experiments, analytical methods, and computer simulations. In particular, our simulations encompass a broad range of length scales—from the nanometer scale of atoms and molecules up to the meter scale—with the aim of elucidating the behaviors and underlying mechanisms of solids, liquids, and gases.

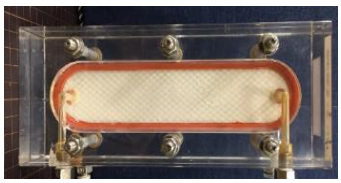
① Water desalination and Osmotic power generation

Our research aims to enhance the efficiency of seawater desalination and to develop salinity gradient power generation using osmotic membranes. Through a combination of simulations and experiments, we are engaged in the following studies:

- Impurity and ion transport mechanisms
- Evaluating membrane performance
- Recovery of membrane performance
- Membrane module performance improvement



Molecular simulation



Membrane test rig

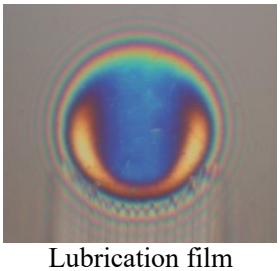
② Ttribology: friction, wear, and lubrication

To contribute to energy and resource conservation, our research aims to achieve low friction and low wear through the development of new technologies.

- Surface damage caused by raindrop impact
- Reducing friction in lubrication
- Mechanisms of nano-lubrication
- Corrosive wear in seawater environments
- Effects of hydrogen on lubrication performance



Corrosive wear

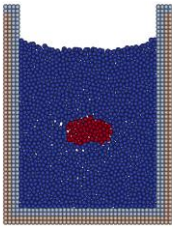


Lubrication film

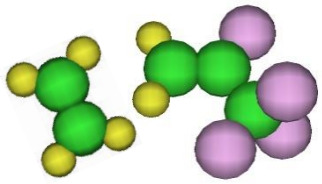
③ Reduction of environmental impact

To address urgent global challenges, we are conducting research aimed at developing effective solutions.

- Microplastic separation
- Red tide mitigation via plankton capture
- Next-gen refrigerant property prediction
- Wind turbine blade damage reduction



Bubble simulation



Molecular refrigerant analysis

2. Keywords

water, seawater, surface, interface, friction, wear, lubrication, membrane, corrosion, bubble

3. Remarks and Websites

Our research focuses on surfaces and interfaces. We undertake both technological development and fundamental studies aimed at advancing renewable energy technologies (e.g., salinity gradient power generation), promoting energy conservation (such as friction reduction), and reducing environmental impact (including removal of contaminants from water and development of novel refrigerants). Our investigations employ computer simulations and experimental validations spanning a broad range of scales, from the nanometer to the meter scale.

researchmap: https://researchmap.jp/okumurat

Name	Job Title	Area of Expertise
SHIMOMOTO Yoichi	Associate Professor	Control Engineering / Machine Learning

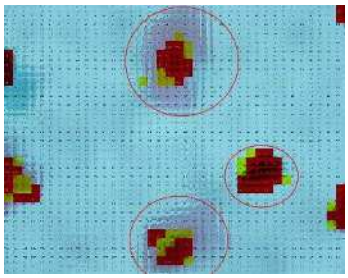
1. Main Research Topics

① Control theory and its applications

Control systems are generally designed based on a "mathematical model of the controlled object" that mathematically describes the characteristics of the controlled object, but there are always unpredictable differences between the characteristics of the actual object and the characteristics shown by the mathematical model. We regard such differences as uncertainty in the characteristics of the controlled object, and are conducting research into control system design methods that take this uncertainty into account.

② Research on the use of machine learning in oral cytology diagnosis

Oral cells are key to treating oral cancer. However, there is a shortage of pathologists who can perform this treatment, and it is difficult to increase the number of skilled pathologists at an early stage. Therefore, in this research, we are using machine learning, which is increasingly being used in image diagnosis and disease diagnosis, to research the construction of an image classifier that can classify oral cancer using oral cytology.



③ Research on the use of machine learning in buffing

In this research, we aim to provide a system that can supplement training data on metal surface defects similar to the Buff-Polishing Defect Dtaset (BDD) using image generation AI before the BDD is completed. Ultimately, we aim to present a method for generating large-scale datasets to support defect detection similar to BDD, and to efficiently support the discrimination and verification of BDD.



2. Keywords

Control Engineering, Control Theory, Mathematical Science, Machine Learning, Diagnostic Imaging

3. Remarks and Websites

researchmap: https://researchmap.jp/read0072742

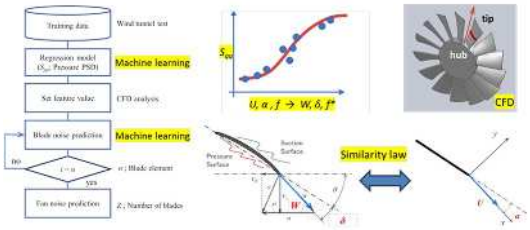
Laboratory: http://www.mech.nagasaki-u.ac.jp/index.htm

Name	Job Title	Area of Expertise
SASAKI Soichi	Assistant Professor	Fluid Engineering

1. Main Research Topics

① Machine Learning for Aerodynamic Noise

Fans are used for the heat exhaust of electronic devices, and there is a demand for these fans to operate quietly. I am engaged in research aimed at predicting the aerodynamic noise of fans by using machine learning. In data-driven machine learning, it is only possible to predict objective variables within the range of provided training data. This study focuses on methodology for the aerodynamic noise prediction using neural networks based on physical laws.



Machine learning of low-pressure fan noise

② Low GWP Binary Power Generation Units

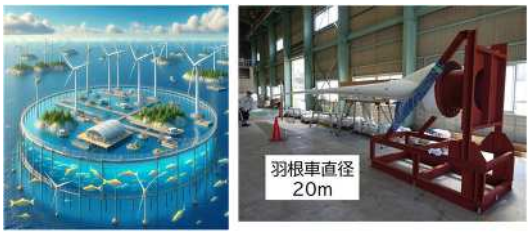
According to international agreements on global warming, a numerical target has been set to reduce the use of HFC-based refrigerants as working fluids by 85% by 2036. To solve this societal issue, I am developing a low-GWP binary power generation unit. In addition, I am developing technologies to control the operation of these power-generation units through adaptive machine learning. A distinctive feature of this control is that the machine learns the optimal conditions for autonomous operation while continually experimenting in real-time.



R&D of low-GWP binary power generation unit

③ Stall-Controlled Wind Turbines

To create stall-controlled wind turbines, I aim to establish a unique methodology by integrating machine learning with the aerodynamic analysis of blade elements, thereby achieving blade design, aerodynamic noise prediction, and operation control. I am currently studying the feasibility of designing rotors based on Bayesian optimization. Furthermore, I am engaged in research on methodologies for predicting the aerodynamic noise generated from rotors based on trailing-edge noise theory.



Stall-controlled offshore wind turbine

2. Keywords

Fan, Aerodynamic Noise, Organic Rankin Cycle, Adaptive DOE, Wind Turbine, Water Tunnel Test

3. Remarks and Websites

A hydroelectric power generation machinery jointly developed by a corporation was implemented in Niigata Prefecture. I am also accepting researcher from a corporation involved in offshore wind power generation and am considering the application of stall-controlled wind turbines to offshore wind power generation. To implement outcomes in society, it is necessary to take the initiative and act proactively. By constantly maintaining the motivation for the future and staying close to society, I can realize the social implementation of our research. Through these research activities on renewable energy machinery, we are working to expand the scope of planetary health research.

(1) JSPS, KAKEN, Grant-in-Aid for Scientific Research (C), 21K12294, 2021-2024.
(2) JSPS, KAKEN, Grant-in-Aid for Scientific Research (C), 24K08325, 2024-2027.
(3) JST, Adaptable Seamless Technology Transfer Program through target-driven R&D, (2025.7, under reviewing.)

researchmap：https://researchmap.jp/read0055706?lang=en

Name	Job Title	Area of Expertise
MORINAGA Akihiro	Assistant Professor	Robotics

1. Main Research Topics

① Development of Marine Robots

This study develops underwater robotic platforms for station-keeping and target tracking without relying on costly navigation sensors. For ROVs (Remotely Operated Vehicles), usually teleoperated, image-based feedback control was introduced to enable autonomous station-keeping and target following. These methods allow efficient data collection and quantitative evaluation of area and volume in subsea infrastructure inspection and seagrass/coral reef monitoring. Marine environmental monitoring is further enhanced through cooperative control with Autonomous Surface Vehicles (ASVs) and optical wireless communication.

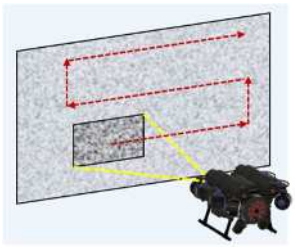


Fig.1 Semi-auto ROV



Fig.2 Seagrass survey



Fig.3 ROV–ASV cooperation

② Robots for Infrastructure Maintenance

This study focuses on the development of robotic systems to support infrastructure inspection and maintenance. For waterway tunnel inspection, we are developing a vessel-type robot capable of autonomous navigation along tunnel walls using LiDAR and other range sensors. For pedestrian space inspection, images acquired by a vehicle-type robot are analyzed to evaluate steps and obstacles. Furthermore, a window-cleaning robot combining a parallel wire mechanism with a multirotor system is being developed to achieve safe and efficient façade maintenance.



Fig. 4 Waterway inspection robot



Fig. 5 Pedestrian space inspection

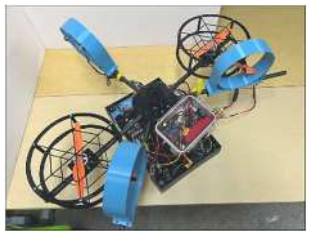


Fig. 6 Window-cleaning robot

③ Development of Rehabilitation Devices

A device is being developed for quantitative assessment of spasticity, a condition of excessive muscle tension after stroke or spinal cord injury. The wrist joint is passively moved, and resistance force is measured to construct a spasticity model. Model parameters are estimated using machine learning, enabling objective evaluation.

2. Keywords

Robotics, Autonomous Control, Image Sensing and Recognition, Machine Learning
Medical–Engineering Collaboration

3. Remarks and Websites

Based on autonomous control technologies utilizing image sensing and machine learning, our research extends to underwater exploration, infrastructure inspection, and rehabilitation support. Moving forward, we aim to advance social implementation of practical robotic technologies through field demonstrations and collaboration with industry.

researchmap: https://researchmap.jp/a_morinaga
Laboratory: https://robotics-mech-nagasaki-univ.conohawing.com/

Name	Job Title	Area of Expertise
Garcia Novo Patxi	Assistant Professor	Ocean Numerical Modelling

1. Main Research Topics

① Optimization of tidal farm layouts

Tidal energy has two main advantages over other traditional renewable sources: its predictability and its periodicity. However, the Levelized Cost of Energy (LCOE) of this technology is still too high compared with solar PV or wind energy. To reduce tidal energy cost, we aim to optimize the spatial distribution of tidal turbines in a farm to mitigate wake losses and maximize the farm's energy yield.

Before carrying out the optimization work, a clear understanding of the turbine wake characteristics is crucial. Wake characterization is performed through the analysis of field and Computational Fluid Dynamics (CFD) simulations. For the optimization, the methodology we are using combines coastal ocean modelling with a genetic algorithm supported by artificial neural networks. This method allows the evaluation of many farm layouts with high accuracy and a relatively small computational effort.

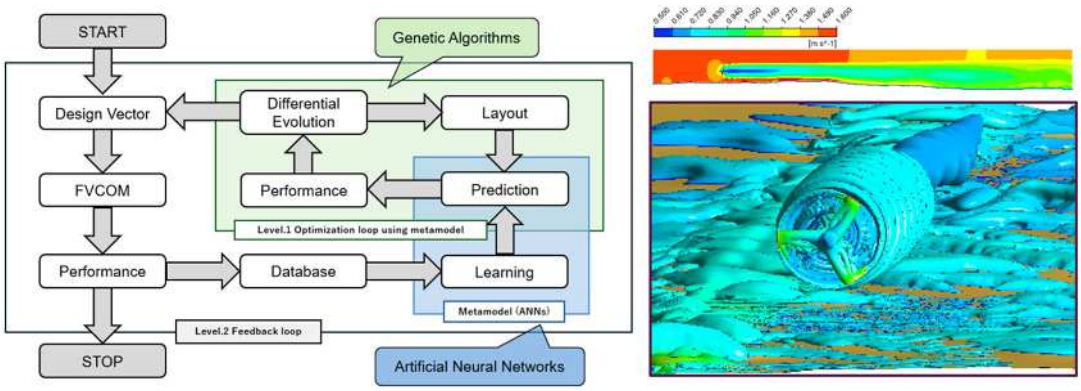


Fig.1 Tidal farm layout optimization system (left) and tidal turbine wake characterization with CFD simulation (right)

② Red tide prediction using coastal ocean model

In recent years, the frequency and intensity of red tides (or harmful algae bloom events) in coastal waters of Nagasaki Prefecture has increased. Besides the negative environmental impact, red tides have caused significant losses in the Nagasaki Prefecture aquaculture industry.

To mitigate the negative impact of red tides, we aim to develop an early warning system that alerts aquaculture operators before red tides reach the cage areas, allowing timely implementation of countermeasures to protect the cultivated fish. The objective of this research line is to couple a coastal ocean model with an ecosystem model that can predict the generation and circulation of red tides.

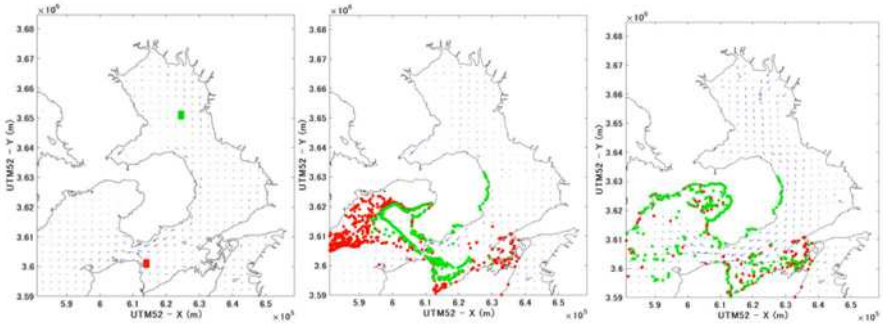


Fig. 2 Coastal ocean model results for particle circulation in the Ariake Sea.

2. Keywords

Tidal Energy, Farm Layout Optimization, Red tide

3. Remarks and Websites

The farm layout optimization research line aims to become a multi-objective optimization tool that can maximize energy yield from tidal farms while minimizing cost, space needed, or environmental impact. For the red tide prediction, future works will consider the combination of numerical modelling with machine learning to enable earlier prediction and faster response to red tide events.

researchmap: https://researchmap.jp/garcia_novo_patxi

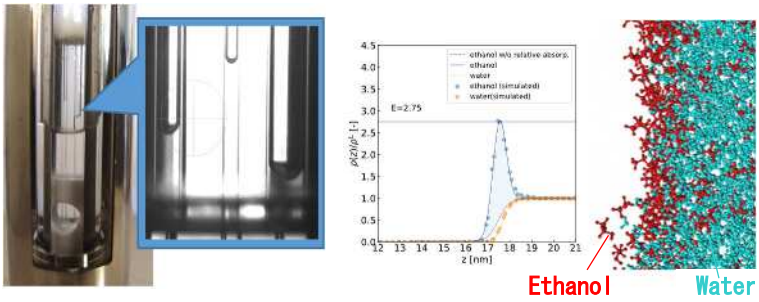
Laboratory: https://www.mech.nagasaki-u.ac.jp/lab/sakaguchi_lab/html/home.html

Name	Job Title	Area of Expertise
KONDOU Chieko	Professor	Thermal Engineering, Refrigeration

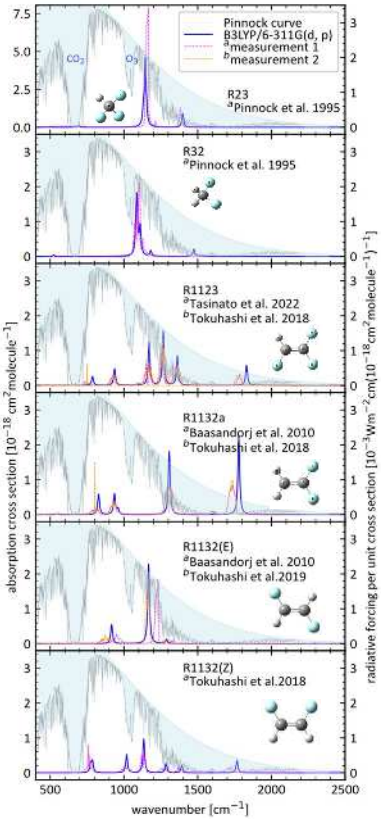
1. Main Research Topics

(1) Thermophysical roperty measurement and energy analysis for new low global warming potential refrigerants

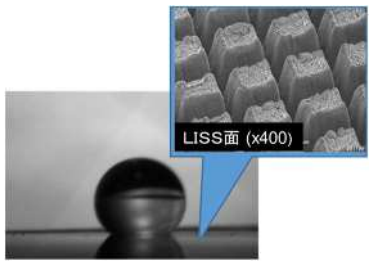
(2) A new fabrication technique of boiling surface in passive cooling devices removing denser heat flux from semiconductors



(Upper left) Surface tension measurement device. The measurement results for low-GWP refrigerants have been adopted by the REFPROP database of the US NIST and are disseminated worldwide. (Upper right) Mixture state near the vapor-liquid interface of water-ethanol system. In a mixture system, the concentration varies drastically at the interface. We reproduce this using molecular simulation to perform more accurate surface tension prediction.



(Right) Absorption cross section (infrared absorption capacity) of candidate refrigerants. Quantum chemical calculations are performed to obtain the atmospheric lifetime and global warming potential of various substances. The products generated during the decomposition process are also examined.



(Left) By using a laser to process metal surfaces such as aluminum to a depth of several to tens of microns, it is possible to change the wettability of various liquids. By utilizing this, it is possible to significantly improve boiling heat transfer performance, enabling the design of compact, high-performance coolers.

2. Keywords

global warming potential, refrigerants, heat pump, heat exchangers, cooling

3. Remarks and Websites

The data obtained from our laboratory are posted at the following URL.
Please take a look at the students' hard work.

researchmap: https://nagasakiuniv-mech.org/
Laboratory: https://researchmap.jp/kondou_chieko

Name	Job Title	Area of Expertise
MOTOMURA Fumitaka	Assistant Professor	Laser Processing

1. Main Research Topics

① **Elucidation of modified layer formation mechanism inside transparent material using ultrashort pulse laser**

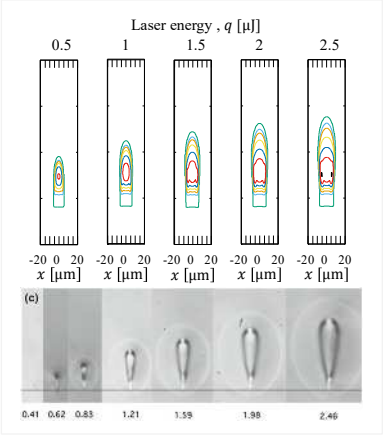
In this study, we developed a numerical simulator that reproduces the transformation inside a transparent solid caused by the advection and diffusion of laser light focused inside the solid. We found a correlation between the heterogeneous layer formed inside the solid and the spatial distribution of the refractive index obtained from the analysis. (refer to left figure below)

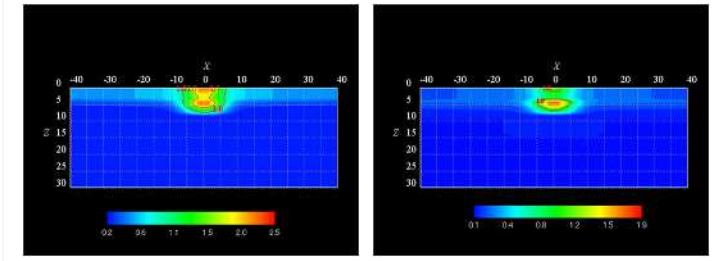
② **Development of laser dicing simulator for Si based multilayer film using pulsed laser**

This simulator allows the selection of optimal processing conditions for the simultaneous removal of multilayer films made of various compositions (metal, glass, resin), contributing to the desired processing accuracy and efficiency. An example of analytical results of the amount of ablation removal taking into account the temperature dependence of thermal and optical properties. (refer to right figure below)

③ **Refractive index analysis of Si based multilayer film using spectroscopy**

If the wavelength profile of refractive index of multilayer films with light-transmitting layer can be formulated, it will be advantageous for selecting the laser wavelength to be used in dicing processing. The wavelength profiles of laser beam absorbed in multilayer films are applied to estimate the spatiotemporal profile of the laser intensity in a numerical simulator.





Melting criteria　　Boiling criteria

2. Keywords

Laser dicing processing, Silicon based multilayer film, Numerical simulator, Spectroscopy

3. Remarks and Websites

In post-processing of semiconductor devices such as CMOS sensors, dicing processing using laser ablation phenomenon requires selection of optimal processing conditions according to model changes in multilayer structures. If we can elucidate complex and high-speed ablation phenomenon that is difficult to observe in situ and involves solid-liquid phase changes, we believe that even higher-precision processing can be achieved.

researchmap：https://researchmap.jp/fmtk_motomura

Laser dicing is key technology not only for single-layer structures of power semiconductors (such as SiC), but also for the singulation of CMOS sensor modules, etc. Developing a numerical simulator that reproduces complex laser ablation phenomenon will help us to correctly understand processing results and improve processing efficiency and accuracy.

Name	Job Title	Area of Expertise
NAKAHARA Hiroyuki	Professor	Aseismic Design for Building Structure

1. Main Research Topics



① Disaster Preventing Approaches through Seismic Retrofitting by CFT Braces on Existing RC Building

② Test and Analysis for Shearing Behavior of CFT Short Columns

③ Development and Practical Use of WGFST Members

④ Development of Maintenance-free Pontoon

2. Keywords

Building structure, Aseismic design, Concrete-filled steel tubular structure, Maintenance-free pontoon

3. Remarks and Websites

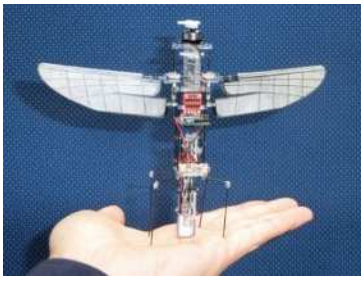
researchmap: https://researchmap.jp/handle0207108

Name	Job Title	Area of Expertise
NAGAI Hiroto	Associate Professor	Aeroelasticity, Aeronautics, Vibration

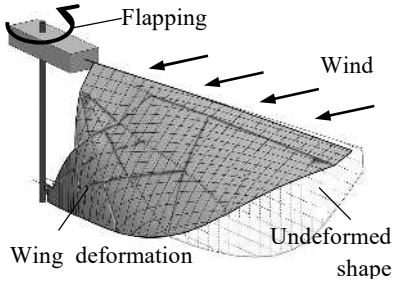
1. Main Research Topics: We primarily study the design and analysis of large-scale or flexible structures that experience fluid-structure interaction (FSI) across various engineering fields.

① **Development of Small-Sized Flapping Drones**

Birds and insects achieve excellent flight performance through flapping flight, despite their small size. Inspired by this natural mechanism, we are developing compact, bio-inspired flapping drones equipped with flexible wing structures. These drones are designed and analyzed using a multiphysics approach that integrates fluid dynamics, structural mechanics, mechanical design, dynamics, and control engineering. Unlike conventional rotary-wing drones, flapping drones offer improved safety and quieter operation, making them suitable for use in natural environments and human-centered spaces.







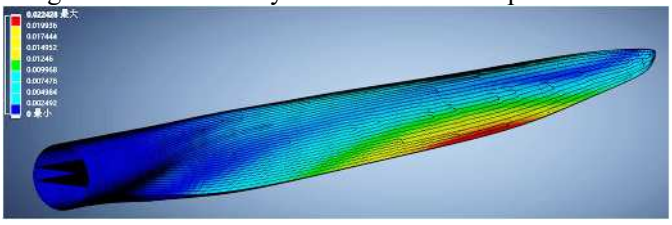
② **Fluid-Structural Interaction (FSI) Analysis of Large-Scale Structures**

Large-scale structures such as high-rise buildings, long-span bridges, and large wind turbines tend to become relatively flexible as their size increases, and thus are susceptible to fluid-induced vibrations such as vortex-induced vibration and flutter. In our laboratory, we analyze such vibration phenomena using fluid-structural interaction (FSI) techniques that couple computational fluid dynamics (CFD) with the finite element method (FEM). Our main research topics include:

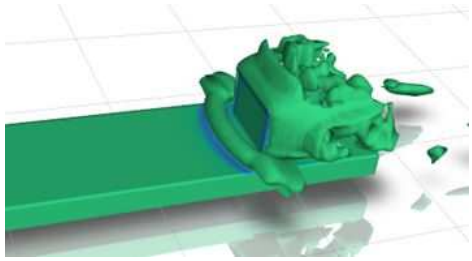
- Vibration analysis of large-scale structures subjected to both forced excitations (e.g., earthquakes and ocean waves) and flow-induced vibrations (e.g., vortex shedding)
- Simulation and prediction of aeroelastic responses in large-scale wind turbine blades
-

③ **Aerodynamic Analysis of Ships**

Wind-assisted propulsion technologies such as rigid sails and rotor sails have recently attracted attention in the maritime industry as a means of achieving carbon neutrality. We are conducting research on how ship motions and structural vibrations affect the aerodynamic performance of these wind-assisted propulsion devices. Additionally, we are investigating the influence of ship superstructure geometry on the airflow around ships, aiming to optimize aerodynamic design for fuel efficiency and environmental performance.



Deformation of large-scale wind turbine



Airflow around a ship superstructure

2. Keywords

Fluid-Structure Interaction (FSI), Structural Vibration, Aeroelasticity, Multidisciplinary Design Optimization (MDO), Bio-inspired Engineering, Flapping Drone Technology

3. Remarks and Websites

In our laboratory, we address fluid-structure interaction design and analysis across a wide range of engineering fields, including aircraft, ships, buildings, and wing turbines. We actively pursue interdisciplinary collaboration and practical applications across different research domains. If you are interested in our research, please feel free to contact us.

researchmap: https://researchmap.jp/nagai-hiroto

Laboratory: http://www.st.nagasaki-u.ac.jp/laboratories/nagai/

Name	Job Title	Area of Expertise
CHAN Iathong	Assistant Professor	Structural Engineering

1. Main Research Topics

① NUMERICAL MODEL FOR 3D STEEL MOMENT FRAMES

Most previous studies only considered the behavior of steel moment frames under unidirectional ground motions. Additionally, the numerical models of most previous studies considered the behavior of only beams and columns, and ignored the behavior of the panel zone of the beam–column connection.

Our research proposes a novel numerical model for studying steel moment frames under multi-directional loadings to consider the 3D elastoplastic behavior of beams and columns, as well as panels. The proposed numerical model was validated by analyzing cruciform subassemblies of beams, columns, and panels, and the analysis results were compared to the experimental results from previous studies. The results of the proposed numerical model corresponded well with the respective test results

② REQUIRED COLUMN OVERDESIGN FACTOR OF 3D STEEL MOMENT FRAMES

Steel moment frames are designed to ensure sufficient energy absorption capacity by achieving an entire beam-hinging collapse mechanism under severe earthquakes. Therefore, the column overdesign factor is stipulated in seismic design codes. Since square tube columns are often used for steel structure buildings in Japan, the two orthogonal planes of the structure are both designed as moment resisting frames. Considering the effect of bi-direction ground motions on the steel moment frames, the specified column overdesign factor is 1.5 or more in Japanese seismic design code. However, the required column overdesign factor of steel moment frames is obtained from analysis results conducted under unidirectional ground motions

Our research describes the results of the earthquake response analysis of 3D steel moment frames, and presents seismic demand for the column overdesign factor, depending on input direction and amplitude of the ground motion and width-thickness ratio of columns, required to keep the damage below the limit of plastic deformation of square tube columns.

③ SEISMIC STRUCTURAL REINFORCEMENT IN DEVELOPING COUNTRIES

In Japan, retrofit method with steel brace frame for RC structure are always used. Retrofitting with steel braced frame a lot of studs and anchor bolts are required to fix the steel frame and transmit the tensile stress of diagonal brace to the existing RC frame. However, this method needs heavy equipment and it is difficult to use particularly in rural area, constricted area or remote island.

For seismic retrofitting in the areas mentioned above, we have been developed a new seismic retrofitting method by using CFST (concrete-filled steel tubular) diagonal brace which act only compression, and propose a new hybrid pre-cast member composed of steel tube, cement grout and wood (WGFST) to satisfy the requests from developing area.

2. Keywords

3D steel moment frame; square hollow-section column; panel zone of beam–column connection; time-history response analysis; multi-directional ground motion; numerical model; multi-spring model; Composite members; Seismic retrofit; Brace member; CFST.

3. Remarks and Websites

We analyze the behavior of structures through loading experiments and numerical analysis to create better design methods and seismic resistance methods. We are also planning to develop construction method with good efficiency.

researchmap：https://researchmap.jp/dlucifer6

Name	Job Title	Area of Expertise
HARADA Akira	Assistant Professor	Dynamics of Machine

1. Main Research Topics

Even something very simple can exhibit unexpected behavior if handled in a clever way.Conversely, even something that is very complex can appear very simple when viewed from a different perspective.I am researching on methods for identifying the inherent characteristics of such systems and how to connect the identified characteristics to useful applications.

The main themes currently being addressed are listed below.

① **Application of metamaterial / bandgap principles in vibration control and seismic isolation**

In the world of electromagnetic waves, it has been noted that when the governing equation in a coupled system is transformed into an equation involving only the variables of the main system and the relationship between the variables of the secondary system (the equation of motion of the assumed system), the physical properties of the assumed system show negative values. This principle of metamaterials and band gaps can also be applied to the world of solid vibrations, demonstrating that it can be used for vibration control and seismic isolation purposes.

ex)Dynamics and Design Conference 2024

② **A Method for Creating a Reduced-Order Model for Nonlinear Vibration of a Distributed Parameter System**

I showed that it's possible to make a reduced-order model for weak nonlinear vibrations near linear natural frequencies by combining linear mode and POM (Proper Orthogonal Mode).

ex)Dynamics and Design Conference 2020

③ **Vibration control and seismic isolation methods from the viewpoint of wave propagation**

By utilizing the fact that the equation of motion for a spring-mass system is equivalent to the central difference approximation of the wave equation, I demonstrated that reflection does not occur and resonance does not occur by applying a control force so that the end where the traveling wave is reflected becomes equivalent to a continuous part in terms of mechanical conditions.

ex)https://doi.org/10.1299/transjsme.14-00629

④ **Parameter Identification of Orthotropic Anisotropic Laminates Using Optimization Techniques**

By appropriately setting the evaluation function, it was demonstrated that, theoretically, the fiber orientation angle and material constants of orthotropic laminated plates can be simultaneously identified.

ex)Dynamics and Design Conference 2021

2. Keywords

Dynamics of Machine, Distributed Parameter System, Nonlinear Vibration, Analysis Method

3. Remarks and Websites

researchmap: https://researchmap.jp/a_harada
Laboratory: https://www.st.nagasaki-u.ac.jp/laboratories/haradaakira/

Be firmly grounded in the fundamentals,
without forgetting the purpose of engineering,
in order to gain new insights,
I strive every day.

Name	Job Title	Area of Expertise
NAKAO Nobuhiko	Assistant professor	Mechanical Engineering

1. Main Research Topics

Bone is an important organ to support our body, and continually subject to mechanical forces. During walking, running and other exercises, daily forces change with time, and responding bone structures also do so. Metabolic activities of bone causing its structural changes result from activities of bone cells, for example, osteoblasts on the bone surface and osteocytes within calcified bone matrix. Osteoblasts and osteocytes sense the outer forces, and respond to those as sending biochemical signals. That is why researchers think that these bone cells are essential players in the mechanism of the structural changes of bone. My study aims to answer to the questions, “how osteoblasts and osteocytes sense the outer forces?”, and “how these cells respond to these forces”, focusing on subcellular elements, especially, biomolecules and their complexes.

① Analysis of mechanical properties of focal adhesions in osteoblasts

Osteoblasts play pivotal roles to new bone, where cells attach to the bone surface, and the extracellular forces from bone are input at attachment molecular complexes named as focal adhesions. Focal adhesions have structures which respond to the extracellular forces, supposedly with changes in their mechanical properties. These changes are closely related to cellular force-sensing, but are unclear in detail.
Thus, mechanical properties of focal adhesions were analyzed using cultured osteoblast cells derived from mice. By utilizing atomic force microscopy for molecular-level mechanical measurement, tensile-tests were performed for pre-formed focal adhesions on the cell surface. As a result, tensile stiffness of these molecular complexes was revealed to increase on the second timescale after the force application.

② Analysis of biochemical responses of focal adhesion-mediated osteocytes

Osteocytes regulate the activities of other bone cells (other osteocytes, osteoblasts, osteoclasts and so on). Osteocytes also have focal adhesions, and application of the excessive outer forces to them is suggested to cause programmed death named as apoptosis. Other previous studies suggest that apoptosis is important to reform the bone structures, but the relationship between magnitude of applied force and osteocyte death had been unclear.
In current experiments, using a magnetic tweezer, mechanical forces were applied to magnetic beads targeting focal adhesions of osteocytes isolated from the bone of mice. As a result, cells underwent apoptosis in the case of lager magnitude, while apoptosis did not occur in the case of smaller magnitude. Moreover, such apoptosis of osteocytes is revealed to need intracellular production of nitric oxide, a kind of small signaling molecule.

2. Keywords

bone cells, focal adhesions, biomolecules, molecular complexes, strength of materials, mechanical measurements

3. Remarks and Websites

My study is located in an interdisciplinary field between mechanical engineering (especially, material mechanics) and molecular and cell biology. In the future, I would like to expand the research subjects to various intracellular elements and their mutually interacting behaviors.

researchmap: https://researchmap.jp/nakao-nobuhiko
Laboratory: https://www.st.nagasaki-u.ac.jp/laboratories/nakao/

Name	Job Title	Area of Expertise
YASUTAKE Atsuko	Professor	Architectural Planning, Housing

1. Main Research Topics

Summary

The scope of my study is based on architectural planning, but it also extends to regional planning. We will propose new imagery of residential areas, regions, and cities by studying the history and origins of buildings and urban development. This research will be conducted through surveys of statistical data, examination of historical records, and field investigations. Our goal is to determine the architectural spaces that best address social issues such as population decline.

① SHRINKING MASTER PLAN IN DEPOPULATION CITY

In Japan, the number of housing units exceeds the number of households, posing significant challenges amidst population decline, vacant homes, and urban shrinkage. There is a pressing need to explore designs that utilize low-density urban environments and manage urban downsizing.

Our research laboratory focuses on former coal mining towns as pioneers of population decline. Many coal mines in Kyushu closed in the 1960s, leading to significant population decline due to outmigration of workers. We examine post-closure policies and their effectiveness to study the restructuring of cities. Building on this research, we investigate disadvantaged residential areas such as islands, sloped terrain, and suburban detached housing areas facing challenges of aging populations and vacant homes after children move out.

As part of experimental initiatives on sloped terrain, we explore the conversion of vacant homes into shared housing and assess the potential for student participation in local community management. Additionally, we initiate activities harnessing sloped terrains to explore new residential paradigms and evaluate community responses.

② LIVING ENVIRONMENT AFTER DISASTER

In recent years, natural disasters have become increasingly frequent. In Japan, when people are unable to remain in their homes after a disaster, temporary housing is provided. Our research focuses on the living environments of prefabricated temporary housing. Through surveys and behavioral studies with residents, we identify key challenges and propose solutions aimed at reducing the burden of environmental transition and fostering social interaction within these communities.

③ PRESERVATION OF THE NEGATIVE HERITAGES

Our research examines war and disaster-related remains from the perspective of community development, assessing their value as educational resources for citizens and as potential tourism assets. We investigate how these sites have been preserved and how they are currently used, while identifying the challenges involved. Since such sites rarely generate sufficient revenue as tourist attractions, we are exploring alternative methods of evaluation.

In Nagasaki—the last city to experience atomic bombing—we trace the post-war recovery process through studies of the Sakana-no-machi Housing Complex, a key project in the city's reconstruction. By analyzing this case, we aim to understand postwar housing recovery in Japan and explore its relevance for contemporary urban planning.

2. Keywords

Housing, Regional Planning, Post-disaster Reconstruction, historical building

3. Remarks and Websites

Looking ahead, our goal is to promote the positive reuse and management of vacant houses and buildings, while also focusing on the preservation and active tourism development of historical architecture and disaster-related heritage sites—often considered negative legacies. Through these efforts, we aim to contribute to sustainable and culturally rich urban and regional revitalization.

researchmap: https://researchmap.jp/yasutake8528521
Laboratory: https://www.st.nagasaki-u.ac.jp/laboratories/yasutake/

Name	Job Title	Area of Expertise
UCHIDA Takahisa	Associate Professor	Structural Engineering

1. Main Research Topics

① **A Study on Public Housing Complexes in Nagasaki City**

Public housing complexes were built to address the postwar housing shortage and have been constructed in large numbers across the country from the period of rapid economic growth to the present day. However, in recent years, due to factors such as a declining and aging population and the deterioration of buildings, the increasing number of vacant units in public housing complexes has become a nationwide issue. I'm conducting this research because I believe that, in order to make better use of existing public housing complexes, it is necessary to first assess their current status and then gain insights into strategies for addressing vacancies that are tailored to each specific complex.

1-A. A Typological Analysis of Public Housing Complexes in Nagasaki City

I'm focusing on housing complexes located near the city center within Nagasaki city limits that hold high potential for redevelopment. After assessing their current conditions—including age, vacancy rates, and transportation accessibility—we are attempting to categorize them. We believe it is necessary to categorize and analyze many of these housing complexes in Nagasaki City in order to identify redevelopment strategies that align with each complex's site conditions and the current state of its buildings.

1-B. A Study on Housing Units in the Former Uo-no-Machi Housing Complex

In the heart of downtown Nagasaki stands the Uo-no-Machi Housing Complex, built according to the "Type 48 (standard design for reinforced concrete public housing used nationwide)" One of its units has been restored and preserved. I believe that by reviewing the design history of the Uo-no-Machi Housing Complex through various historical documents, and by gaining an understanding of the social conditions and family structures of that era, we can deepen our understanding of both the Type 48 floor plan and this housing complex itself—insights that will prove valuable in proposing housing layouts suited to today's social context.

② **A Study on the Utilization of Vacant Houses on Slopes in Nagasaki City**

Due to its topographical characteristics, Nagasaki City features sloped areas near the city center lined with residential buildings. Among these, areas that were developed as residential zones long ago have seen a significant increase in dilapidated, vacant wooden houses. Since these sloped areas were developed as residential land before the Building Standards Act was enacted, they are often accessed only by stair-step paths or narrow roads too narrow for vehicles. As a result, many of these properties face difficulties not only in constructing new homes but also in demolishing vacant houses.

We are conducting research based on the belief that the effective utilization of these old vacant wooden houses and vacant lots near urban areas will lead to the revitalization of those specific neighborhoods and, in turn, contribute to the revitalization of the urban area as a whole.

2. Keywords

Architectural Design, Urban Planning, Public Housing Complexes, Measures to Address Vacant Homes
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3. Remarks and Websites

I hope that by sharing the results of our research on the utilization of vacant wooden houses in public housing complexes and on slopes with local governments and businesses, I can help reduce the number of vacant units in housing complexes within Nagasaki City and address the issue of vacant homes. Furthermore, we plan to develop renovation floor plans for housing units and design proposals for vacant units, and we look forward to seeing these renovation designs come to fruition.

researchmap: https://researchmap.jp/uchida.archi

Laboratory(architectural design office): https://www.uchida-archi.com/

Name	Job Title	Area of Expertise
SASAKI Sho	Associate Professor	Architectural design

1. Main Research Topics

This laboratory focuses on architectural design (planning and design). SASAKI Sho serves simultaneously as a faculty member of this university, the principal of the architectural design office INTERMEDIA, and the representative of the regional hub facility Mio. Through these roles, he actively engages in professional practice in real time. The laboratory is characterized by sharing this practical knowledge and experience with students, encouraging them to think through various challenges together and work collaboratively toward solutions. In particular, by deeply exploring the unique local context of Nagasaki, the laboratory seeks to envision new possibilities for architecture and regional development in the future.
Examples of key perspectives include the following:

・To consider the nature of architecture and regional communities based on Nagasaki's unique history, climate, culture, and present conditions
・To explore what architecture can contribute to regions like Nagasaki that face challenges such as population decline, aging society, and depopulation
・To recognize the potential for architecture and communities unique to Nagasaki to emerge as context-specific solutions
・To recognize the potential for such architecture and communities to become generalizable models applicable to other regions in Japan and around the world
・While the design office INTERMEDIA, led by SASAKI Sho, has already begun engaging with various regional challenges, this laboratory aims to broaden that engagement beyond professional practice by working with students from a research-oriented perspective

Specific Research Activities

① Research on Regional Hub Facilities
② JR Michinoo Station Revitalization Project
③ Former Ryotei (Traditional Restaurant) Restoration Project


HOGET


mio


JR Michinoo Station Revitalization Project

2. Keywords

Architecture, design, urban planning, vacant houses, vacant shops, historical buildings, renovation, community, depopulation, declining birthrate and aging population, local community

3. Remarks and Websites

I have been involved in numerous projects as an architect, focusing on the renovation and adaptive reuse of vacant houses and unused commercial properties. At Mio in Shimabara, I am engaged not only as a designer but also as an operator responsible for the facility's management and ongoing activities. With the establishment of this laboratory, it will become possible to engage with local communities in more diverse ways across different regions. As regional challenges such as population decline, aging societies, increasing vacant properties, and the weakening of community ties continue to progress throughout Japan, we hope that students will participate proactively as active stakeholders—recognizing themselves as part of the communities they study and support.

Reference Projects

HOGET https://hoget.jp/ **Mio** https://mio-shimabara.com/
JR Michinoo Station https://prtimes.jp/main/html/rd/p/000000005.000126742.html

researchmap： https://researchmap.jp/sasakisho
HP: https://www.intermedia-co.jp/

Name	Job Title	Area of Expertise
YAMAGUCHI Kohei	Associate Professor	Bridge Engineering / Maintenance Management Engineering

1. Main Research Topics

① **Establishing efficient maintenance methods by analysis of inspection data for airport infrastructure and bridges managed by local governments**



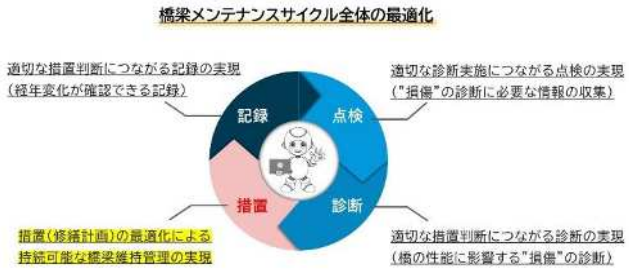


② **Development of bridge inspection and diagnosis support system using 3D data and image analysis**





③ **Establishment of an efficient bridge diagnosis method using generative AI**





④ **Estimation of internal defect shape in concrete using computed tomography and three-dimensional unsteady conduction analysis**

2. Keywords

Infrastructure, Bridges, Maintenance, Inspection and diagnosis, Municipal support

3. Remarks and Websites

Laboratory: : https://nagasakibridgelab.wixsite.com/mysite

Our lab. aims to tackle three pillars of themes in line with social needs: short-term, medium-term, and long-term. Our lab. focuses on the construction, renewal, and maintenance of social infrastructure in general, but mainly bridges. Our lab. also collaborates with our laboratory alone, management organizations (local governments, airport management organizations), and companies (NTT Domo Solutions, AGC, KOBLCO, etc.).

Name	Job Title	Area of Expertise
SASAKI Kenji	Associate Professor	Concrete Engineering

1. Main Research Topics

We are engaged in research on material and construction performance evaluation for enhancing the quality and productivity of concrete structures, developing low-carbon construction materials, and preserving historical structures.

Our research addresses each stage of concrete structures−from design and construction to maintenance and use−focusing on keywords such as "performance evaluation," "quality improvement," "extended service life," and "productivity enhancement." Furthermore, Nagasaki boasts numerous concrete structures recognized as historical assets, including Gunkanjima (Battleship Island) and atomic bomb ruins. We are also engaged in research aimed at their preservation and utilization.

① **Evaluation of material and construction performance of various concrete capable of contributing to improving quality and productivity**

Efforts are underway to utilize fly ash and crushed sand in concrete structures from perspectives such as extending service life, reducing environmental impact, effectively utilizing industrial by-products, and making effective use of locally sourced materials. However, to incorporate materials with limited or no usage history into concrete, it is essential to establish material and mix design methodologies while clearly defining construction performance and hardening characteristics (strength, shrinkage, durability, etc.). This research evaluates the effectiveness of fly ash blended with blast furnace cement in suppressing temperature cracking and improving durability in concrete. It also assesses the workability when crushed sand is used as fine aggregate. Furthermore, the research focuses on visualizing the concrete construction process using IoT sensors and developing methods to enhance the surface quality of concrete based on this visualization.

② **Development of Low-Carbon Construction Materials**

Concrete has been considered a material with a high environmental impact because the production of cement, its main constituent material, emits large amounts of CO_2. On the other hand, cementitious materials contain large amounts of calcium-based hydrates that react with CO_2, leading to their reevaluation as materials with high CO_2 fixation potential. Efforts to utilize them are actively underway. In this research, we are working on quality evaluation of low CO_2 emission concrete, establishing manufacturing methods for recycled aggregates and artificial crushed stone aimed at maximizing CO_2 fixation, and quality evaluation of concrete using CO_2 fixation materials.

③ **Study on assessment of present situation and conservation method of historical concrete structures**



To preserve structures of historical and cultural value, it is essential to accurately assess their current condition, elucidate the mechanisms of deterioration onset and progression, and establish highly effective preservation methods. This research focuses on evaluating the current material and structural integrity of historical structures on Hashima Island, such as revetment structures, production facilities, and residential facilities, to preserve and utilize them as cultural properties and World Heritage sites. It also involves assessing the performance of repair and reinforcement materials and examining repair and reinforcement methods that aim to balance authenticity preservation with effective conservation

2. Keywords

Concrete, Performance evaluation, Quality improvement, Service life extension, Productivity improvement, IoT sensors, Low-carbonization, Carbon neutrality, White carbon, Continuous fiber reinforcement, Historical structure

3. Remarks and Websites

We are available for collaborative research on concrete material and construction performance evaluation, development of low-carbon construction materials, application of new materials to concrete structures, and maintenance of concrete structures.

If you have any challenges related to the planning, design, construction, or maintenance of concrete structures, please feel free to contact us.

researchmap: https://researchmap.jp/concrete_kenjisasaki
Laboratory: https://www.st.nagasaki-u.ac.jp/laboratories/sasaki/

Name	Job Title	Area of Expertise
NAKAMURA Shozo	Professor	Design, Maintenance and Management of Steel Structures

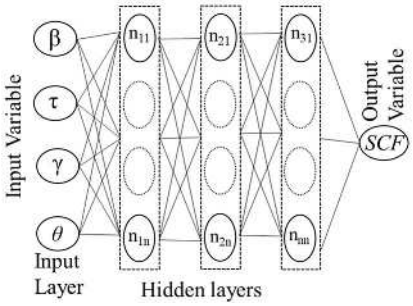
1. Main Research Topics

① Maintenance of Existing Structures

Through field surveys and remote monitoring of existing structures, combined cycle testing, etc., I am conducting research into deterioration prediction methods, remaining strength and remaining life assessments, correlation between environments and corrosion states, and durability assessments of various corrosion prevention methods. When serious damage is found in existing structures, I investigate its cause and develop countermeasures. I am also conducting research into the application of artificial intelligence (AI) to bridge design and inspection.



Combined cyclic corrosion test



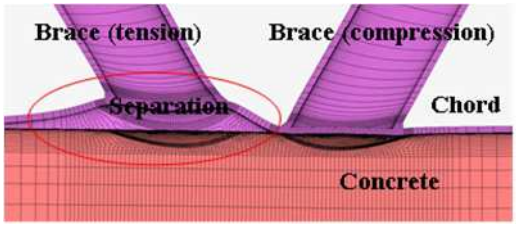
Artificial neural network model

② Design Method of Steel Bridges

I am conducting the following research on steel bridges using analytical methods such as the nonlinear finite element method.

- Effect of initial deflection on the buckling strength of welded box section members
- Stress concentration factors for fatigue design of concrete filled steel tubular (CFST) joints
- Effect of hysteretic characteristics of seismic isolation rubber bearings on bridge response

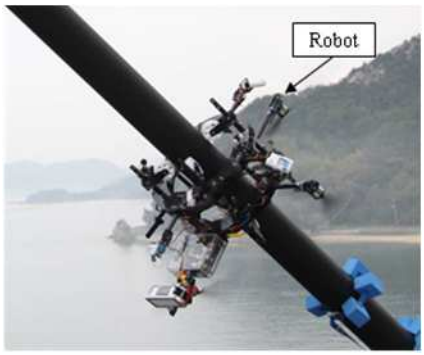
In addition, I am also conducting research into the rationalization of structures and design methods aiming at labor saving and cost reduction.



An analysis result of a CFST K-joint

③ Development of an inspection robot for cables in cable-stayed bridges

In order to dramatically improve the safety, efficiency, and economy of close-up visual inspection of cables, we developed a manually flying cable inspection robot for cable-stayed bridges that uses the cable as a guide, and applied it to inspect the cables of several actual cable-stayed bridges. Furthermore, in collaboration with other professors from the same graduate school, it was improved to an autonomous flying type, and also an image processing system that enables "splitting videos into still images and creating development diagrams" and "automatic detection of visible defects" was developed. We are currently investigating ways to expand the scope of application of this robot.



Inspection robot

2. Keywords

Steel structures, Maintenance and management of bridges, Structural design

3. Remarks and Websites

I have experience working for a private company (Kawasaki Steel Corporation), so most of my research is relatively practical. I also strive to provide technical support to national and local governments as a member of several committees.

researchmap: https://researchmap.jp/sh_nakamura_nu/
Laboratory: https://www.cee.nagasaki-u.ac.jp/~dokou/

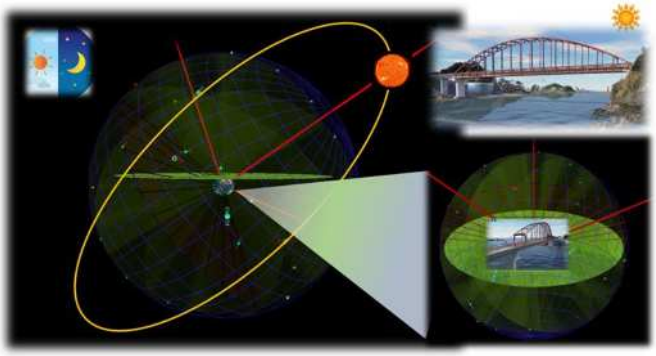
Name	Job Title	Area of Expertise
OKUMATSU Toshihiro	Professor	Maintenance Engineering/ i-Construction

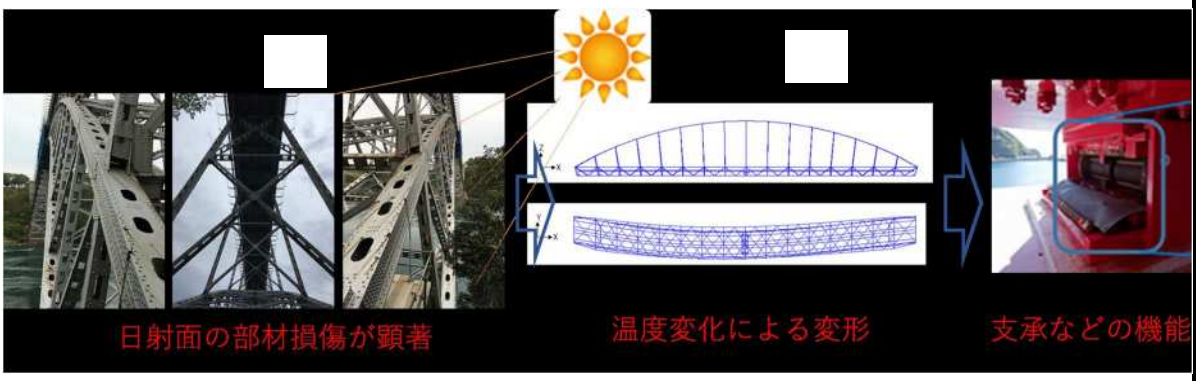
1. Main Research Topic

UAVs have been representative infra-monitoring tools or platforms nowadays. However, there remains some risks for controlling and positioning of the object, and this could consequently lead to secondary accident. We are now developing localization, visualization, and path planning systems for infra-structure monitoring, which consist of sensing techs, such as RTK-GNSS, TS, and SfM (Structure from Motion) techs. By above, Unmanned autonomous construction system using sensor network is under developing.

① **Autonomous control by using GNSS for bridge detailed inspection**
② **Research on the correlation with solar radiation and temperature of bridge**
③ **3D visualization of bridge support behavior by using stereogram**
④ **Unmanned autonomous construction system using sensor network**







2. Keywords

GNSS, Bridge maintenance, Bridge vibration monitoring, i-construction, Environmental vibration

3. Remarks and Websites

Field measurement and developing Autonomous system related civil engineering field are welcome with future considerations.

researchmap: https://researchmap.jp/read0097496
Laboratory: https://www.cee.nagasaki-u.ac.jp/

Name	Job Title	Area of Expertise
NISHIKAWA Takafumi	Associate Professor	Structural Engineering

1. Main Research Topics

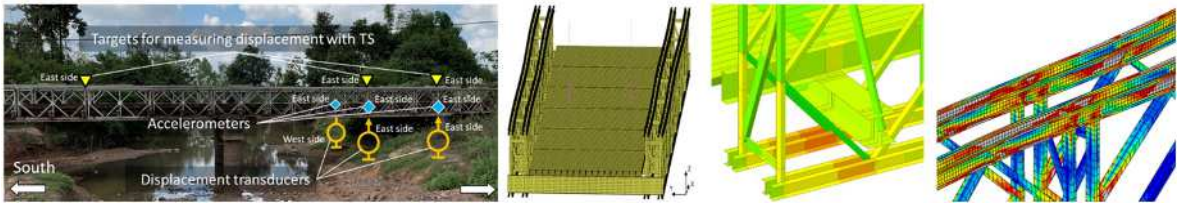
① Structural modeling for bridges based on sensing techniques

We are developing a method to create analytical models for structures such as bridges efficiently and accurately. We integrate optical measurement technology, including 3D laser scanning, image analysis, and vibration sensing, with highly accurate structural identification and machine learning.



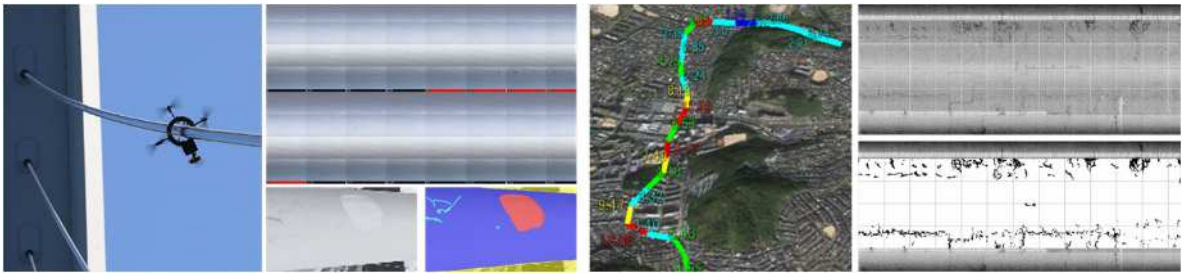
② Identifying structural characteristics of the Bailey bridge

A temporary-use bridge with prefabricated modular truss members, called a Bailey bridge, has often been used as a permanent bridge in many countries; however, there are no standards and methodologies for regular maintenance of this type of bridge. Hence, evaluating their structural soundness, such as the residual load-bearing capacity, is one of the significant challenges. This evaluation is necessary to make decisions regarding repair, reinforcement, and replacement. In this study, we are attempting to understand the structural characteristics of the Bailey bridge by conducting full-scale load testing, scale model tests, and structural analysis based on surveys.



③ Developing sensing methods for rational inspection of structures

We have developed various sensing technologies that advance structural inspections, such as image analysis for cable inspection robots on cable-supported bridges, road roughness estimation based only on the dynamic response of regular vehicles while driving, and robust and exact automatic pavement damage detection through analysis of drive records.



2. Keywords

Social infrastructure, Structural health monitoring, system identification, image processing, bridge maintenance

3. Remarks and Websites

① By integrating structural identification with statistical analysis, we have achieved higher accuracy.
② As modular temporary bridges are rarely used in Japan, our research is conducted in Laos, Mozambique, and other countries, in collaboration with local universities and government agencies.
③ In image analysis, we combine evolutionary computation-based filters with original techniques such as multi-resolution and autonomous tracking, enabling stable detection of nearly all visible damage.

We aim to develop practical structural health monitoring that supports new approaches to infrastructure maintenance. The outcomes are expected to contribute to international cooperation projects (e.g., JICA), strengthen bridge management in developing countries, and promote local industry through the introduction of Japanese technology.

researchmap: https://researchmap.jp/nishikawa1019
Laboratory: https://www.cee.nagasaki-u.ac.jp/~dokou/

Name	Job Title	Area of Expertise
SUZUKI Seiji	Associate Professor	Environmental Hydraulics River Engineering

1. Main Research Topics

① Development of the Real-time inundation area information provision system

In recent years, heavy rain disasters such as river flooding and slope collapses have become more severe in Japan, and there has been no end to the flood damage and human casualties caused by river flooding and inland flooding. In order to protect from flooding during a disaster, it is necessary to accurately understand the locations of flooding and the risk level of your current location. Therefore, we are developing a "Real-time Flood Area Information System" that could become the most useful evacuation support tool during disasters. The system we are developing is divided into three major phases in order to enable the provision of real-time flood information during floods. The first phase involves developing a disaster prevention app that efficiently collects data from the entire watershed, including photos and videos taken by many residents with their mobile phones during floods, and collecting a large amount of flooded photos and videos with location and time information. In the second phase, image data recording flood conditions is collected in real time, and data on the time and location of the image is acquired. AI applying image analysis technology is then used to automatically estimate flood depth. Based on the large amount of estimated flood depth data, real-time flood depth maps and maps of predicted flood depths several minutes later are created. In the third phase, the created real-time flood area information and predicted flood area maps are provided to registered residents of the river basin via an app, for effective use in supporting evacuation decisions and evacuation route selection.



Fig Real-time inundation area information system

② Development of hydrosphere environment management technology with machine Learning

Aquatic environments are formed by a complex interplay of not only physical but also biochemical phenomena. This complexity makes predicting aquatic environments extremely difficult. Therefore, we are attempting to use machine learning, which has been rapidly evolving in recent years, to predict aquatic environments and utilize it for aquatic environmental management. Using image data acquired from UAV, we are developing methods to accurately extract water areas and create elevation data (DEM) that take water areas into account, as well as a method to predict the occurrence of red tides using machine learning.

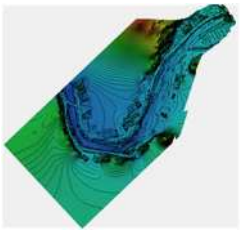


Fig DEM

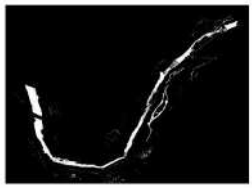


Fig Extraction of water area

2. Keywords

Disaster, inundation, water quality, machine learning, hydrosphere environment

3. Remarks and Websites

As water disasters become more severe and rapid changes in aquatic ecosystems become apparent, the importance of appropriate management and conservation of the water environment, including disaster prevention and mitigation, is increasing, and social demand for the development of low-cost, simple aquatic management technologies is expected to increase further.

researchmap: https://researchmap.jp/read0150870
Laboratory: https://www.cee.nagasaki-u.ac.jp/~suiken/

Name	Job Title	Area of Expertise
TANAKA Wataru	Assistant Professor	River Engineering, Biology

1. Main Research Topic

(1) Elucidation of the Relationship Between the Causes of Riverbed Topography at River Confluences and Biodiversity

Based on the confluence angle and tributary flow, we predict the factors that cause riverbed topography at river confluences. We also clarify the relationship between biodiversity at confluences and riverbed topography and elucidate the relationship between confluence conditions and biodiversity potential.

Specifically, we investigate the formation of temporary water bodies unique to confluence points after floods, which can occur due to differences in flow rates between the main river and its tributaries. Since these temporary bodies of water are utilized by fish for spawning, we are also examining their impact on biodiversity.

(2) Hydrological and biological evaluation of traditional flood control methods:

Traditional flood control methods used in Japan before the spread of modern engineering technology have withstood forces beyond expectations and are expected to be effective against the recent increase in severe disasters. We are evaluating the effectiveness of these methods and clarifying their impact on organisms compared to modern methods.

(3) Small-scale natural restoration of three-sided concrete rivers and rock-bed rivers:

Historical records and satellite imagery reveal that, following the 1982 Nagasaki Flood Disaster, river renovation using three-sided concrete rivers was carried out as part of the recovery efforts in Nagasaki City. Three-sided concrete sections and rock-bed rivers are prevalent in Nagasaki and tend to have monotonous environments, which reduces the diversity and abundance of organisms inhabiting them. Therefore, we are developing small-scale natural restoration methods for typical three-sided concrete rivers and bedrock-exposed rivers in Nagasaki. Specifically, we are installing permeable barriers called “barb structures” and monitoring their progress, as well as monitoring structures where the barriers themselves are formed by plants to automatically trap sediment while adjusting the barrier height.



Wand formed at the confluence point



Waterfront environment restoration by barb structures

2. Keywords

Flood disturbance, biodiversity, natural regeneration, aquatic ecology, ground beetle ecology

3. Remarks and Websites

Others

・Relationship between flood disturbance and species diversity of wandering beetles

・Elucidation of material cycles in floodplains and the sea

etc.

researchmap: https://researchmap.jp/susuma

Laboratory: https://www.cee.nagasaki-u.ac.jp/~suiken/

Name	Job Title	Area of Expertise
ITAYAMA Tomoaki	Professor	Water Environmental Engineering

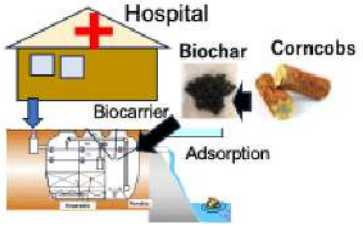
1. Main Research Topics

① Monitoring of toxic cyanobacteria in lakes and reservoirs, prediction of their occurrence, and development of ecosystem control and purification technologies



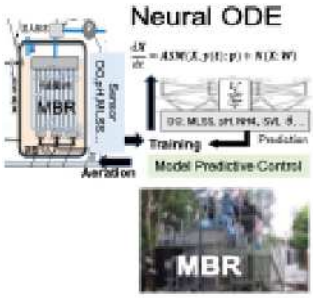
Excessive loading of nutrients such as N and P have caused eutrophication of lakes and reservoirs, leading to the proliferation of toxic cyanobacteria (toxic cyanobacteria) that produce toxins linked to liver cancer and other health issues. In developing countries with inadequate water treatment, this poses a direct health risk. Therefore, our laboratory studies on the methods to predict the occurrence of toxic cyanobacteria using IoT-based simple sensing, Bayesian statistics, deep learning, and molecular ecology. Additionally, we are exploring eco-friendly and low-cost purification methods using biochar. Moreover, theoretical foundations for ecosystem control techniques leveraging the predation of zooplankton, and practical technologies for reducing toxic cyanobacteria.

② Development of wastewater treatment technology for small hospitals in developing countries affected by water pollution caused by antibiotics and other substances



Hospital wastewater contains a high concentration of antibiotics and dangerous pathogens. In developing countries where much of this wastewater is discharged untreated, this poses significant health risks to humans and ecological risks to ecosystems. Additionally, not only antibiotics but also disinfectants and surfactants contribute to the increase of antibiotic-resistant bacteria in the environment. Therefore, a low-cost wastewater treatment system is essential for small-scale hospital wastewater treatment in rural areas of developing countries. We are also researching low-cost wastewater treatment methods that utilize the synergistic effects of inexpensive biological treatment methods and biochar derived from agricultural waste (such as corncobs), which possesses adsorption properties and serves as a microbial carrier. Additionally, we are advancing the implementation of IoT for remote monitoring and control.

③ Study on sensing and AI predictive control methods for wastewater treatment system



In biological wastewater treatment, it is extremely important to simultaneously reduce aeration volume and improve treatment efficiency while advancing automation of control systems. To this end, we are conducting research on sensing technologies for controlling activated sludge treatment, predictive methodologies such as time-series deep learning using AI predictions and neural differential equations that learn nonlinear dynamics, as well as model predictive control. In these efforts, we are utilizing a bench scale model wastewater treatment systems and a mini-plant-scale MBR (membrane bioreactor) system at Nagasaki University.

2. Keywords

toxic cyanobacteria, molecular ecology, wastewater treatment, ecological engineering, developing countries, hospital wastewater, antibiotics, surfactants, antibiotic-resistant bacteria (ARB), aqua informatics, sensors, AI, deep learning, Bayesian statistics

3. Remarks and Websites

We have successfully removed more than 95% of toxic cyanobacteria and cyanotoxins from Lake Victoria (Kenya) using a Biofence system using Biochar. Meanwhile, the use of biochar as a carbon sequestration technology is gaining global attention, and water treatment technologies utilizing biochar are particularly important in developing countries. Additionally, we have developed a Bayesian statistical method to predict the occurrence of toxic cyanobacteria in reservoirs. Furthermore, we are conducting water quality prediction for wastewater treatment using deep learning techniques and neural differential equations.

researchmap: https://researchmap.jp/read0080703-Itayama

Name	Job Title	Area of Expertise
JIANG Yujing	Professor	Rock Engineering, Geotechnics for Hazard Mitigation

1. Main Research Topics

Many critical facilities, from underground repositories for high-level radioactive waste to energy storage systems, road tunnels, underground spaces, and bridge foundations, are constructed within or on rock masses. Evaluating the mechanical and hydraulic properties of rock materials, as well as monitoring and assessing their behavioral changes during operation, is crucial and indispensable. Our research group has long been engaged in prototyping a series of mechanical testing apparatuses and improving a three-dimensional nonlinear stress-permeability numerical analysis model suitable for fractured rock materials, with ongoing applications to real-world projects.

Even slopes that are stable under normal conditions may face collapse risks due to rainwater infiltration. We are advancing the slope hazard monitoring technology utilizing wireless network communication, as well as the construction and practical implementation of a disaster prevention for steep slopes.

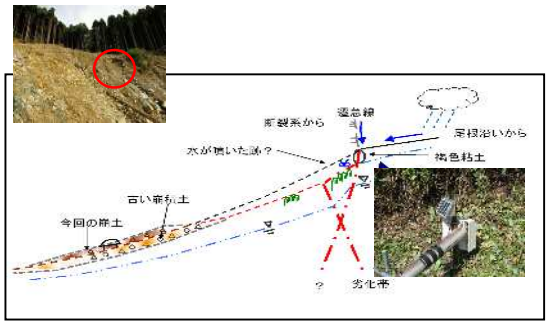
Fundamental research and technological development related to deep-sea methane hydrate (MH) production and marine environmental assessment are being actively pursued both domestically and internationally. Additionally, considering sand production mechanisms from MH layers during extraction, mutual interference between production wells, and the triggering conditions for large-scale submarine landslides, we are conducting research and development on efficient production technologies that consider marine ecosystems.

The main research themes are as follows:

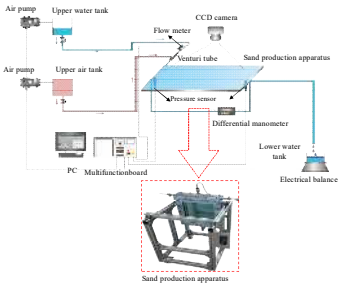
① **Evaluation technology of supporting safety and soundness of rock structures**
② **Prevention and risk mitigation of slope failures caused by heavy rainfall**
③ **Methane hydrate production technology and impact assessment on the seabed environment**



Inspection and diagnosis of tunnels



Remote monitoring of landslide



Sediment discharge control in deep-sea MH layers

2. Keywords

Rock structure, Maintenance and management, Hazard mitigation, Methane hydrate production

3. Remarks and Websites

Through collaborative and commissioned research, we have been involved in numerous practical projects. Examples include: Construction of underground structures for pumped-storage power plants (Kyushu Electric Power Co., Inc.), In-situ foundation behavior assessment for nuclear power generator installation (Kagoshima), Evaluation of fractured rock properties for new bridge foundations (Kumamoto), Development of disaster prevention/mitigation databases and hazard assessment for steep urban slopes (Nagasaki City), Slope behavior monitoring in landslide-prone areas (Nagasaki Prefecture).

While new construction projects are declining, there is growing demand for: Integrity assessment and repair/strengthening of existing infrastructure, Ground disaster prevention/mitigation in slope-heavy urban areas like Nagasaki, Countermeasures against large-scale sediment disasters caused by extreme weather events. Proven experience in remote monitoring technologies and risk management database development, Over 10 years of field investigations and diagnostics for road disaster prevention as a TEC-DOCTOR for the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) Kyushu Regional Development Bureau.

We actively engage in R&D and provide technical consultations to address these societal challenges.

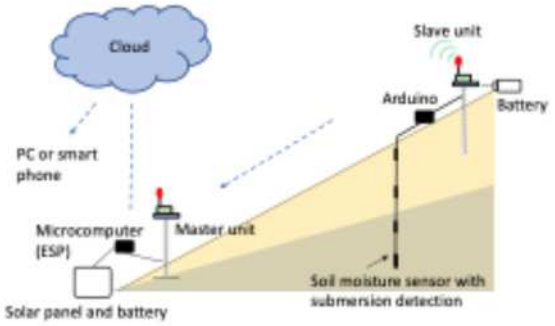
researchmap： https://researchmap.jp/read0043363
Laboratory： http://www.cee.nagasaki-u.ac.jp/~jiban/

Name	Job Title	Area of Expertise
OMINE Kiyoshi	Professor	Geo-Environmental Engineering

1. Main Research Topics

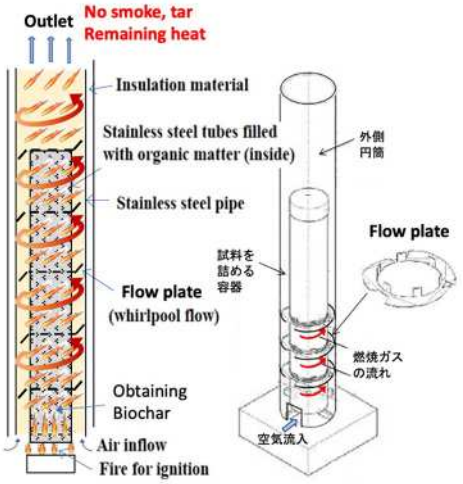
① Development of IoT ground deformation detection sensors for ground disaster

We develop an IoT ground deformation detection sensor that can visualize groundwater distribution on slopes by creating a simple sensor that can detect deformation and water inundation in the ground and combining it with low-power wide-area wireless communication (LPWA) that can operate for a long time with dry batteries. We aim to put this into practical use by using an inexpensive device that can visualize measurement results in real time via the Internet.



② Regeneration of organic waste into high-performance carbonized materials

We develop gasifier of organic waste without using fossil fuels, that regenerates a high-performance carbonized material, and achieves carbon negative, which reduces CO2 emissions. Using a newly developed pyrolysis gasification device, we are investigating the application of highly water-absorbent carbonized materials as a soft ground improvement material, porous carbonized materials as an adsorbent for deodorizing and purifying wastewater, and carbonized materials with low electrical resistance as electrodes for soil microbial batteries, as well as the application of these materials as water-retaining materials for desert greening and land degradation countermeasures.

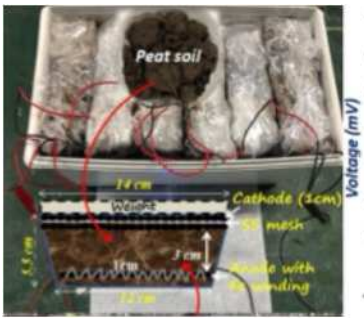


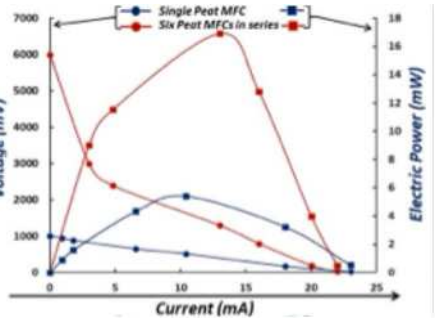
③ Mud dewatering technology that takes environmental impact into consideration

To effectively utilize mud with a high water content, a technology that can dewater without using energy is required. By combining drainage materials with a vacuum pump, we aim to improve the dewatering effect, while using a vacuum pump powered by a solar panel to realize a fossil fuel-free, environmentally friendly dewatering technology. We have confirmed its effectiveness through on-site dewatering tests using construction sludge and water purification sludge.

④ Development of soil microbial fuel cell

Soil microbial fuel cells are a new form of clean energy. We are developing compost-type microbial batteries that generate electricity through the metabolism of microorganisms during the composting of organic waste that generate electricity while cultivating plants. These batteries are being used to light up LEDs and as a power source for small sensors.





2. Keywords

Geoenvironmental engineering, Geodisaster prevention, Utilization of waste, Soil microbial fuel cell

3. Remarks and Websites

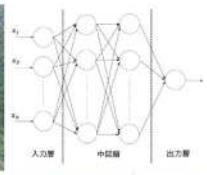
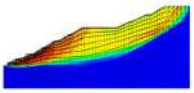
The project aims to solve global environmental problems such as landslides and land degradation caused by climate change, and to reduce and fix carbon dioxide emissions through the effective use of waste.

researchmap: https://researchmap.jp/read0043302

Laboratory: https://www.cee.nagasaki-u.ac.jp/~jiban/

Name	Job Title	Area of Expertise
SUGIMOTO Satoshi	Associate Professor	Geotechnical Engineering

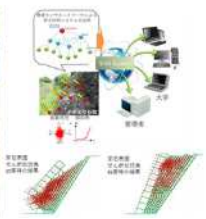
1. Main Research Topics


(1) **Research on evaluation of mechanical stability of slopes**

The purpose of this study is to develop an integrated solution system for slope disaster prevention. This is an attempt to estimate the ground information, determine whether monitoring is necessary based on the slope safety factor obtained from numerical simulation results based on the estimated ground information, identify locations where groundwater level and surface deformation should be monitored if necessary, and conduct field monitoring and data analysis based on these results in an integrated manner. The following are some of the examples of this project. We aim to elucidate the feasibility of a system that links three elements: (1) estimation and interpolation of ground information using AI technology, (2) seepage flow analysis and stability analysis of slopes applying the estimated ground information, and (3) remote monitoring based on the results of stability analysis.

(2) **Research on evaluation of mechanical stability of castle stonewalls**

The stone structures of castles, which are mainly composed of masonry walls, have been subject to collapse due to changes over time, which are believed to be triggered by large-scale earthquakes and repeated heavy rainfall in recent years. The stone structures of castles, which are mainly composed of blank masonry stonewalls, have been experiencing sudden collapses and deformation of the stonewalls due to changes over time triggered by large-scale earthquakes and repetitive heavy rains in some castles in Japan. Until now, the cultural value of these structures has been emphasized and there has been a tendency to be reluctant to reinforce and maintain them as structures, but the damage to Kumamoto Castle caused by the 2016 Kumamoto Earthquake has triggered calls for the restoration and repair of built stone structures from an engineering perspective. However, the mechanisms of the static and dynamic stability of these structures have not been clarified yet, and this study aims to clarify these mechanisms through the development and operation of a remote monitoring system for observing the deformation of built-up stone structures of castles, and through numerical simulations of stone wall models based on the discrete element method. The aim of this study is to clarify these issues through the development and operation of a remote monitoring system for observing the deformation of built-up stone structures of castles and through numerical simulation of stone wall models based on the individual element method.

(3) **Research on improvement of design values for ground anchors**



This research aims to improve the estimation method of circumferential frictional resistance of ground anchors in comparison with the existing design method for ground anchor construction. This research collects, organizes, and analyzes data from recent ground anchor construction projects, and proposes a new evaluation method for the frictional resistance τ of ground anchors. This will lead to appropriate maintenance and renewal of this method through effective use of ground investigation, improvement of design and construction quality, shortening of construction period, and cost reduction, aiming to extend the service life of the existing stock along roadside slopes.

2. Keywords

slope disaster / stonewalls / ground anchors / remote Monitoring / numerical simulation

3. Remarks and Websites

Since FY2023, I have overseen “Development of a method for extracting high-risk landforms for slope disaster prevention using new technologies” as one of the themes of “Construction of a smart infrastructure management system” under the Strategic Innovation Program (SIP: Phase 3) of the Cabinet Office. We are looking forward to hearing from you regarding joint research on the above-mentioned research themes.

researchmap: https://researchmap.jp/read0125663

Laboratory: https://www.cee.nagasaki-u.ac.jp/

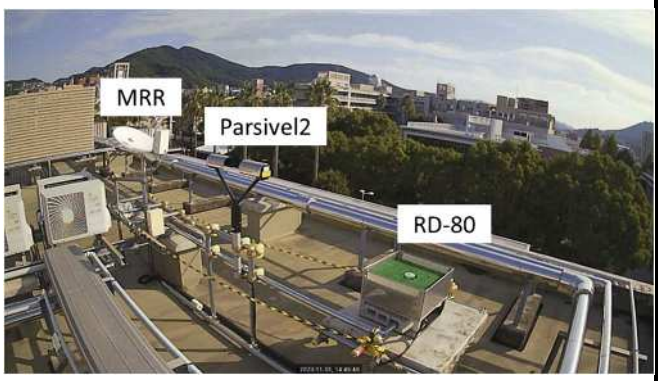
Name	Job Title	Area of Expertise
SETO Shinta	Professor	Radio Hydrology

1. Main Research Topics

① Satellite remote sensing of precipitation

We are involved in developing technology to observe global precipitation using precipitation radars and microwave radiometers board on satellites. The Japan Aerospace Exploration Agency (JAXA), in collaboration with the National Aeronautics and Space Administration (NASA), began operating the world's first spaceborne precipitation radar (PR) in 1997 (operations ended in 2015). As its successor, the Dual-frequency Precipitation Radar (DPR) has been in operation since 2014 and continues to operate today. Additionally, development has started on the spaceborne precipitation radar equipped with Doppler functionality (KuDPR).

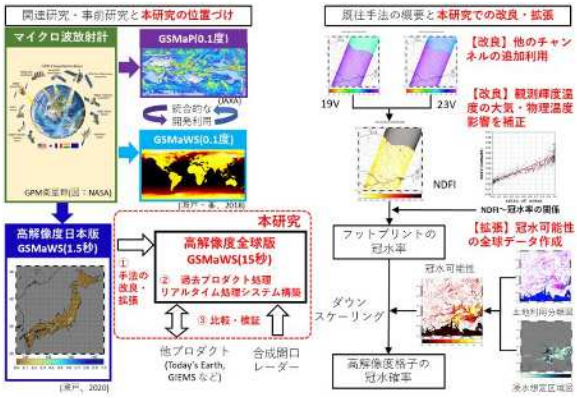
By combining the three-dimensional precipitation information obtained from the PR and DPR with high-frequency observations from multiple microwave radiometers such as AMSR2 and GMI, we have developed the Global Satellite Mapping of Precipitation (GSMaP). This system estimates global precipitation (excluding the polar regions above 60 degrees latitude) at a resolution of 0.1 degrees latitude/longitude (about 10 km) every hour. GSMaP is widely used in fields such as water resources and water-related disaster management, especially in Asian countries and other regions where ground-based precipitation observation methods are insufficient.



For about 20 years, Seto has been conducting joint research with JAXA, working to improve precipitation observation by means of precipitation radar and GSMaP. Since 2022, a compact precipitation radar (MRR) for verification purposes, as well as rain drop size distribution observation instruments (RD-80, Parsivel2), have been installed at Building 1, Faculty of Engineering, Nagasaki University. Based on these experiences, I hope to further research and apply satellite precipitation observation to water resources and disaster management in various regions around the world.

② Rapid detection method of flood inundation area

In various regions, floods caused by heavy rain have occurred, such as the July 2020 heavy rain (Kumagawa River) and the July 2018 heavy rain in western Japan (Hijikawa River, Takahashi River). Quickly estimating inundated areas is important for rescue operations and recovery support. However, since current estimations rely on aerial photographs and on-site observations, there are still challenges in terms of speed. It has been known that observations from satellite microwave radiometers can provide indicators that correlate well with the water surface area rate on the ground, but because their resolution is rather coarse—several kilometers or more—they have not yet been practically applied for these purposes. Seto is developing a method to quickly and at high resolution estimate inundated areas by first determining the flood susceptibility of each location using land use data and the results of pre-conducted flood simulations, and then combining that with observations from microwave radiometers.



2. Keywords

remote sensing、radar、microwave radiometer、precipitation、flood inundation

3. Remarks and Websites

researchmap: https://researchmap.jp/shintaseto
Laboratory: https://www.cee.nagasaki-u.ac.jp/~kankyo/

Name	Job Title	Area of Expertise
ISHIBASHI Tomoya	Associate Professor	Landscape Engineering, Urban History

1. Main Research Topics

① Historical study on urban formation and urban policy recommendations

This research clarifies the changes in urban policies and plans and the transformation of urban spaces, and makes proposals for future urban policies. Specifically, it analyzes and examines primary sources such as comprehensive plans of local governments, minutes of council meetings, and various articles related to cities. Related studies have been reported as follows.

https://doi.org/10.2208/jscejaie.70.1 , https://doi.org/10.2208/jscejipm.75.6_I_287 , https://doi.org/10.2208/jscejipm.76.5_I_495

② Proposal of a method for evaluating the value of important cultural landscapes while allowing for change and measures for applying this method to conservation and utilization plans

Fifteen years have passed since the implementation of the cultural landscape preservation system. Based on surveys and reports, including a comprehensive analysis of 71 previously selected cases, this study provides a detailed analysis of the characteristics of nine cases, including those related to mining and manufacturing under Selection Criteria 6. This study focuses on the development of a preservation and utilization plan for the “Ceramic and Agricultural Village Landscape of Hasami Town, Nagasaki Prefecture.” It involves investigations and discussions related to deriving the intrinsic value of the area, as well as the process of organizing key issues in committees coordinating these efforts. The study was conducted with funding from the Japan Society for the Promotion of Science (JSPS) Grant-in-Aid for Scientific Research (JP22K14340).

https://doi.org/10.2208/jscejj.23-00095

③ Multifaceted analysis of sustainable urban area size for disaster prevention and disaster mitigation and quality of life in era of declining population

This project involves classifying the basis for setting urbanization boundaries in Nagasaki's urban planning and analyzing the unique history of urban expansion in Nagasaki City. Similarly, it analyzes and compares multiple cities to study classification items and analysis methods effective for reverse line drawing. The project also plans to trial the construction of a database in collaboration with the Ministry of Land, Infrastructure, Transport and Tourism's 3D urban model project “PLATEAU.” This is a joint research project with a construction consulting company specializing in urban planning.

④ Practical research on the planning, development, and utilization of public space

Currently, we are involved in the redevelopment plan for nine neighborhood parks in the Yokoo district of Nagasaki City, and the parks will be redeveloped based on this plan. This project is being conducted as a commissioned study from Nagasaki City, and we are engaged in activities such as supporting resident workshops to discuss park redevelopment and creating models of the parks scheduled for redevelopment.



2. Keywords

Urban History, Cultural Landscape, Disaster Reduction and Urban Planning, Public Space Design

3. Remarks and Websites

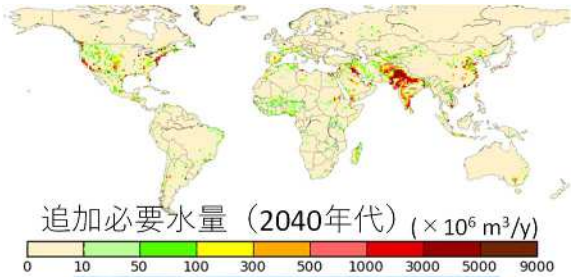
Drawing up a vision for the future of a city is an essential task for local governments, and we believe that discussions based on the historical context will lead to more effective policies. Improving the quality of public space will ultimately enhance the value of the city or region, and is expected to have a ripple effect on the promotion of settlement and tourism.

researchmap： https://researchmap.jp/tomoya_ishibashi

Laboratory： https://www.cee.nagasaki-u.ac.jp/~kankyo/

Name	Job Title	Area of Expertise
YOSHIKAWA Sayaka	Associate Professor	Land Use Change, Remote Sensing, Hydrology

1. Main Research Topics





① Assessment of Water Resources due to Climate Change and Land-Use Change on the global scale

We are estimating the water requirements from the past to the future on a global scale by organizing data on irrigated farmland areas and the spatio-temporal distribution of reservoirs. We also organize climate scenarios, socioeconomic scenarios, and other factors necessary for estimating water demand on the global scale.

② Relationship Between Extreme Rainfall and Temperature Rise

What is causing the recent increase in disasters caused by heavy rain? Global warming can be considered one key factor. How have temperature rises and heavy rainfall patterns changed in Japan? And to what extent can precipitation, which is the output of climate models used to assess the future impact of climate change, accurately represent these changes? This study aims to clarify these issues.

③ Development of common socio-economic scenarios for climate change impact assessments in Japan

Climate change is one of the biggest long-term challenges facing humanity. When predicting the impacts of climate change, scenarios based on assumptions about future conditions are commonly used. We are creating data (particularly on population, number of households, and land use in Japan) according with Japan's version of socioeconomic scenarios for the purpose of conducting nationwide unified the assessments of climate change and its applicability across multiple sectors in Japan.

④ Deforestation Dynamics and the Factors of Change in Amazon

Since the 1970s, Brazil's legal Amazon region has been hit by dramatic deforestation. Deforestation can cause long-term increases in temperature and decreases in evaporation and precipitation. However, as the world's largest producer of beef and soybeans, many countries, including Japan, rely on agricultural products from the Amazon. Using satellite remote sensing and statistical data, we are conducting research aimed at clarifying where and what crops are influencing land use changes, which countries they are exported to, and the connection between land use changes and the global market. We are also seeking to clarify the extent to which policies implemented during each administration have influenced land use changes. In both large-scale and small-scale agricultural and pastoral areas in the Amazon, irrigation has been initiated to increase crop yields, and efforts have also begun to clarify the impact of land use changes and irrigation activities on the water cycle.

2. Keywords

Land use/ Land cover, water resource, Remote sensing, socio-economic scenario

3. Remarks and Websites

Current projects

① Environment Research and Conservation Activities Strategic Research and Development Areas (I) S-24 (FY2025-2029)

② JSPS KAKENHI Grant-in-Aid for Scientific Research (B) (FY2025-2028)
'Global water resource assessment taking account soil salinity'

③ JSPS KAKENHI Grant-in-Aid for Challenging Research (Pioneering) (FY2024-2028)
'Does the global ESG trend pose a crisis to the future global food security? From the perspectives of Brazil and Japan'

researchmap：https://researchmap.jp/sayakayoshikawa

Laboratory: https://www.cee.nagasaki-u.ac.jp/~kankyo/

Name	Job Title	Area of Expertise
OHSHIMA Tamiko	Professor	Plasma Materials Science

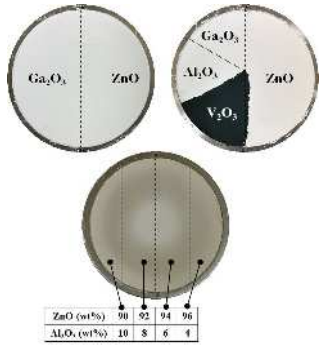
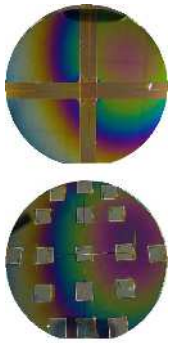
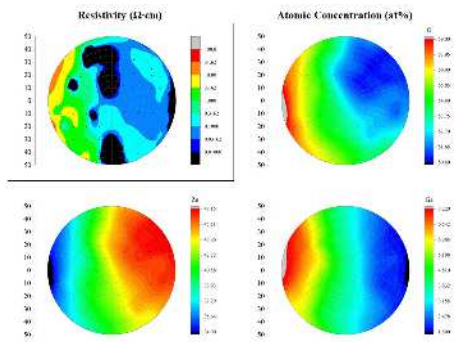
1. Main Research Topics

① Rapid and cost-effective material exploration using the powder sputtering method

In this approach, functional thin films are fabricated by directly using powder as the sputtering target material. Compared to conventional solid targets, powder targets offer several advantages:

- **Reduced target fabrication time**: By mixing powders, elemental combinations and composition ratios can be freely and widely adjusted. Moreover, since sintering is not required, targets composed of low-melting-point or multi-element materials can be fabricated in a short time.
- **Cost reduction**: For targets of the same size, powder targets can reduce costs by up to approximately 1/1000* compared to solid targets (*depending on the type of powder).

Additionally, powder targets are highly compatible with combinatorial thin film deposition. The spatial arrangement of powders within the target holder can be freely modified, allowing multiple powder types to be configured within a single cathode. This eliminates the need for large-scale equipment—only one cathode and power supply are required—and enables the fabrication of numerous composition-gradient films in a single deposition process. As a result, correlations between material composition and physical properties can be efficiently evaluated. By leveraging these benefits, we aim to establish methods for the rapid and cost-effective exploration and development of new and alternative materials.

Powder target	Composition-gradient film	Evaluation of material composition and properties
Free placement of single or mixed powders	Si wafers and quartz glass	Thickness, Resistivity, Composition, and Crystal structure, etc.
		

② Fabrication of High-Quality Carbon Nanostructures via Multi-Hollow Plasma CVD Method

We are synthesizing carbon nanoparticles (CNPs) using the multi-hollow plasma chemical vapor deposition (MHPCVD) method. This technique has previously demonstrated success in controlling the crystallinity, particle size, and deposition amount of silicon nanoparticles, and the key parameters influencing these controls have been identified. The objective of this study is to clarify the factors that control the crystallinity, particle size, and deposition amount of CNPs. In particular, crystalline CNPs are expected to enhance the performance of lithium-ion batteries. Therefore, we aim to clarify the structural control factors of CNPs through process optimization using the MHPCVD method.

2. Keywords

Sputtering, Powder Target, Combinatorial, Thin Film, Carbon Nano Particles

3. Remarks and Websites

My laboratory has conducted collaborative research on the exploration of electronic component materials. While solid targets are typically used for mass production, fabricating a new solid target each time the elemental composition or ratio is changed during the material exploration phase is both time-consuming and costly, often resulting in low target utilization efficiency. In this study, we aim to accelerate and reduce the cost of material exploration by directly using powder as the sputtering target. Once sufficient information is obtained, the solid target for mass production can be fabricated, thereby contributing to the shortening of the overall development timeline.

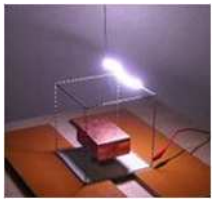
researchmap: https://researchmap.jp/tamiko_ohshima
Laboratory: https://plasma.eee.nagasaki-u.ac.jp

Name	Job Title	Area of Expertise
FUJISHIMA Tomoyuki	Associate Professor	Lightning Protection, Electrical Discharge

1. Main Research Topics

① Development of Simple Lightning Protection System for Electrical and Electronic Equipment Installed Outdoors

My laboratory is attempting to develop a low-cost, simple method of lightning protection to minimize damage from lightning to electrical and electronic equipment installed outdoors. Lightning protection cages and simplified lightning rods are devised and prototyped, and are currently conducting field tests to verify their effectiveness. Furthermore, we are working to improve communication performance by improving the cage shape and reducing the cost of simple lightning rods and grounding resistance.




Simulated lightning strike test on lightning protection cage

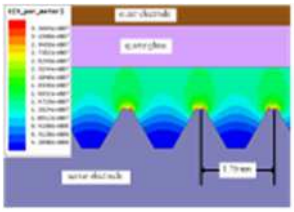


② Simplification and IoT integration of soil moisture measurement using the principle of ground resistance measurement

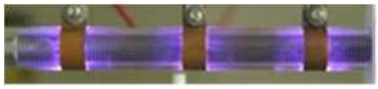
By applying the three-electrode method for measuring ground resistance, we have devised, prototyped, IoT-enabled, and implemented a system that can easily and with low power consumption monitor changes in soil moisture. By making it easier to obtain soil moisture data, we aim to contribute to smart agriculture.

③ Generation of ozone using a screw electrode ozonizer and environmental applications of ozone generated by electrical discharge

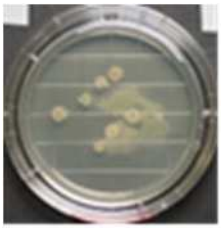
We are developing a system that efficiently generates ozone at concentrations and yields sufficient for practical use at a relatively low cost using dielectric barrier discharge (DBD). The generated ozone has strong oxidizing power and no residual toxicity, so we aim to apply it to environmental issues such as soil sterilization.



Electric field calculation



Discharge in ozonizer



Cultivation results of soil bacteria

2. Keywords

Simple lightning protection, Offshore wind power generation, Smart aquaculture system, Soil moisture measurement, Ozone, Dielectric barrier discharge

3. Remarks and Websites

We are primarily engaged in research and development of systems (lightning protection cages and simple lightning rods) that protect electrical and electronic equipment installed outdoors from damage caused by lightning strikes at the lowest possible cost.

Applying the knowledge gained from previous research on lightning protection, we are also considering measures to protect smart aquaculture systems and offshore wind power generation systems from lightning damage.

researchmap: https://researchmap.jp/read0185025

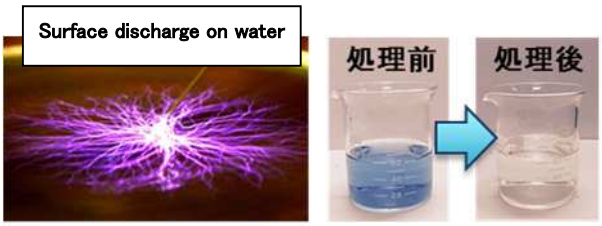
Name	Job Title	Area of Expertise
FURUSATO Tomohiro	Associate Professor	High Voltage Pulsed Power Engineering

1. Main Research Topics

Our laboratory specializes in high voltage, plasma, and pulsed power. These technologies are applied across cross-disciplinary fields—including electric power and energy, electronics, the environment, agriculture, food, and medicine—and contribute to the creation of new industrial applications. Our research covers both the active use of discharge plasmas (e.g., wastewater treatment) and the prevention of discharge plasma initiation (high-voltage insulation).

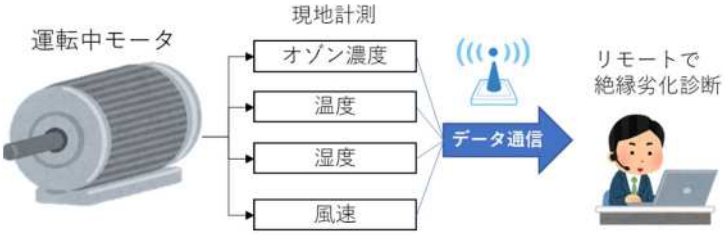
For generating discharge plasmas, we are equipped with pulsed-power supplies that temporally compress energy and release it in short bursts, as well as AC high-voltage sources for insulation studies, enabling us to produce discharge plasmas under a wide range of conditions. Below are some of our laboratory's research themes."

① Basic research on water treatment by surface discharge plasma on water using pulsed power



Water pollution from industrial effluents and domestic wastewater leads to severe environmental degradation, making the development of water purification technologies essential for a sustainable society. Our laboratory is working to improve water quality by generating 'artificial lightning' (discharge plasma) on the water surface using high-voltage and pulsed-power techniques. Because no chemical additives are used, this approach is attracting attention as an environmentally friendly technology.

② Insulation degradation diagnosis technology for industrial motor



At present, large industrial motors (hundreds of kilowatts or more) used in equipment such as pumps, compressors, and fans at power plants, petrochemical plants, and steelworks ensure safety through periodic teardown inspections. However, because disassembly is costly and time-consuming, there is a strong demand for convenient inspection methods that do not require disassembly. In this research, we are developing an online insulation-degradation diagnostic system that utilizes ozone concentration corrected for environmental factors. (Japanese Patent No. 7560367)

2. Keywords

Discharge plasma, pulsed power, high voltage, insulation diagnosis

3. Remarks and Websites

Key Features & Research Achievements

- Development of wastewater purification technology using water-surface discharge plasma generated by pulsed power
- Development of high-voltage insulation diagnostic technology for large industrial motors via ozone monitoring (Japanese Patent No. 7560367)
- Insulation design for power semiconductor devices

Prospects

- Pursue research on the decomposition and sequestration (fixation) of CO_2 using discharge plasmas.
- Advance insulation diagnostics by leveraging data science (AI).

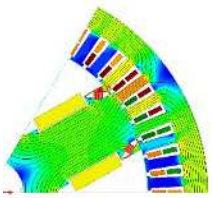
researchmap: https://researchmap.jp/furusato/
Laboratory: https://pulsep.eee.nagasaki-u.ac.jp/

Name	Job Title	Area of Expertise
ABE Takashi	Professor	Electric Machinery, Power Electronics

1. Main Research Topics

Our research focuses on the conversion, control, and efficient utilization of electrical energy to address various energy and environmental challenges expeditiously. We are advancing investigations into novel principal motors and high-performance motor drives and control systems by integrating academic and technological expertise in electrical machinery, power electronics (PE), and automatic control. Presently, we are pursuing research with the objective of applying these technologies to automobiles, ships, home appliances, and other domains.

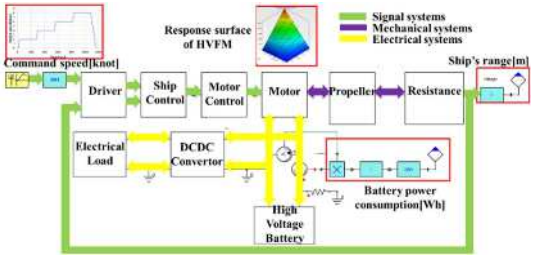
① Research on high-performance motors





The research and development of a "half-wave rectified variable field flux motor" introduces an innovative magnetic flux generation principle that surpasses the capabilities of high-performance permanent magnet motors currently employed in various applications. This motor allows for the magnetic flux to be freely adjusted according to specific requirements. The design emphasizes high efficiency, high torque, and low vibration, utilizing the finite element method. Additionally, the development includes application-specific drive systems and control methods, alongside application-oriented system simulations that evaluate the entire electric drive system through simulations.

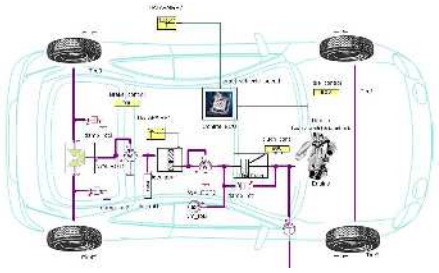




② Motor drive system development and system simulation

In the development of application-oriented motors, it is imperative to select, enhance, and develop diverse control and power conversion methodologies. Within our laboratory, we are engaged in research endeavors such as the "Development of a High-Efficiency Drive System for Small IPM Motors," which achieves high efficiency through portable battery operation, and the "Performance Enhancement of Switched Reluctance Motors," which leverages reluctance torque generated by the rotor's salient pole shape, obviating the need for permanent magnets. Additionally, we are advancing a "digital twin system" that facilitates fault diagnosis and prediction by employing simulation models of various electric drive systems.





2. Keywords

New principle motors, High performance motor drives, Model-based development

3. Remarks and Websites

We are developing motors and drive systems with new structures and principles that achieve high efficiency, high torque, and excellent control performance under various operating characteristics and usage environments, such as environmentally friendly electric drive systems for electric vehicles and battery-powered ships, as well as battery-driven home appliances.

researchmap: https://researchmap.jp/abet_map
Laboratory: http://www.eee.nagasaki-u.ac.jp/labs/pec/abe-otomo-lab/index.html

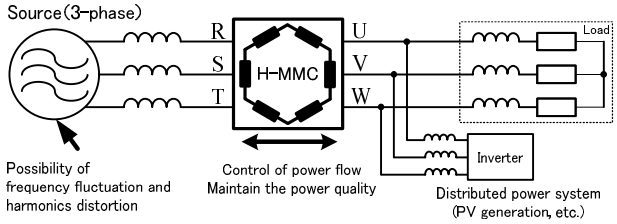
Name	Job Title	Area of Expertise
HAMASAKI Shin-ichi	Associate professor	Power Electronics, Control Engineering

1. Main Research Topics

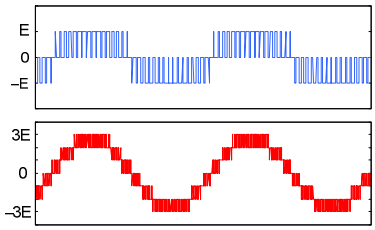
My main research topic is new circuits and control methods for power converters in power electronics, as well as their applications.

① Research on novel power converter system based on modular multi-level converter

The modular multilevel converter (MMC) is a circuit connection in which inverters are modularized into multiple stages. Research and development are currently underway on this technology, which is expected to be next-generation power conversion system that can reduce distortion in voltage waveforms through high voltage and multilevel output. In this research, I am studying the circuits and control of a new power conversion system based on the MMC, as well as its applications. As application examples, I am proposing the power flow controller using the hexagonal MMC (H-MMC) that performs three-phase AC-AC conversion to manage power transmission in the power grid, the power conditioner for mega solar power plants that performs DC-AC conversion, and an MMC integrated with a power storage device that can manage power by incorporating a power storage device.



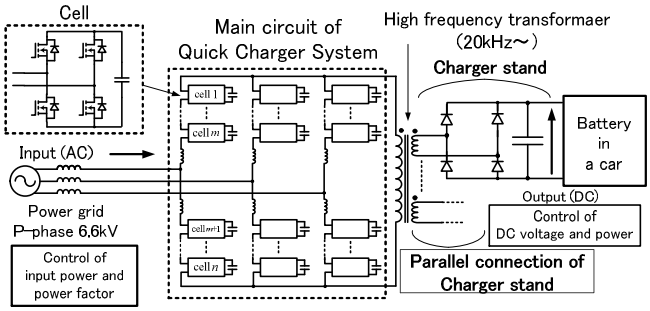
Power flow controller using H-MMC



Multi-level low-distortion voltage waveform

② Research on novel circuit and its control for quick charger system of electric vehicle

Research and development are being conducted on electric vehicle quick chargers to improve their efficiency and size to shorten charging times and popularize charging system infrastructure. In this research, we are researching a new circuit method and its control method that applies MMC as the system that can be expected to improve the efficiency and size of quick charger system. The proposed system supplies power directly from high voltage of 6.6 kV via the transformer, and by handling the large amount of power due to the high voltage, it is possible to manage and operate multiple charging stations as a single system, which is expected to improve efficiency and size.



③ Research on improving performance for power compensation system applying digital control

Power systems are becoming more complex due to the distributed installation of distributed power sources and energy storage devices. To ensure proper power management, various power compensation devices such as reactive power compensators, power flow controllers, and active filters are being researched and developed. In this research, we propose a new control method that applies digital control to the control of these power compensators to speed up response and thereby stabilize the power system to respond to fluctuations in the complex power network.

2. Keywords

Power conversion system, Multi-level converter, Quick charger, Digital control

3. Remarks and Websites

Modular multilevel converters are expected to be power converters capable of handling high voltages and large power, and their applications are diverse. The system proposed in this research is expected to have a wide range of applications in addition to the examples above.

In addition to the multilevel converter circuits shown above, I am also available to consult with you on circuit configurations and control methods, from basic systems using general inverters to applications.

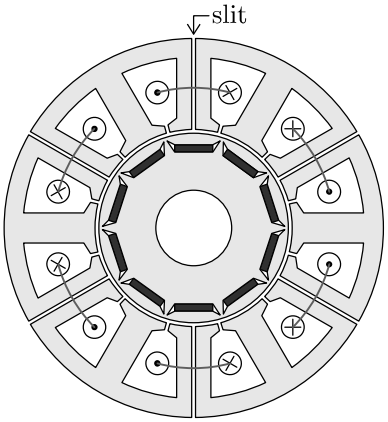
researchmap: https://researchmap.jp/read50176006
Laboratory: https://www.eee.nagasaki-u.ac.jp/labs/asca/

Name	Job Title	Area of Expertise
YOKOI Yuichi	Associate Professor	Electrical Machinery, Nonlinear Dynamics

1. Main Research Topics

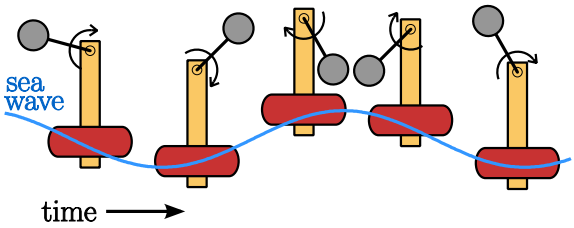
① Development of high-performance motors and generators

More than half of the total electricity consumed in Japan is used by motors. Additionally, under government policy, the adoption of electric vehicles powered by motors and wind power—one of the most promising renewable energy sources—is being accelerated. Against this backdrop, improving motor and generator performance, including efficiency, torque quality, and torque/power density, is becoming increasingly important. This research aims to enhance the performance of motors and generators by adopting ***concentrated winding***, a winding method for the coils that has not been widely used until now. Concentrated winding shortens the length of the wire, which can reduce losses and improve efficiency, as well as enhance torque and power density by reducing the overall size. However, conventional motor design methods are not directly applicable to this type of winding. Therefore, we are developing and proposing various new design techniques specifically for motors and generators using concentrated winding, with the goal of improving their performance. The right-hand figure shows a slit stator motor that we have developed to improve both efficiency and torque.



② Development of rotating-pendulum wave-energy converters

Nagasaki University is actively engaged in the development of ocean energy. This research aims to commercialize a wave power generation system that harnesses wave energy—a form of ocean energy abundantly available anywhere on the sea surface. Once realized, this system will enable the use of electrical energy in any marine area. The wave power generation mechanism under investigation utilizes the nonlinear characteristics of a nonlinear dynamical system known as a ***parametric pendulum***, which converts one-dimensional vibrations into rotational motion. In the proposed ***rotating-pendulum wave energy converter***, the vertical motion of ocean waves is treated as one-dimensional vibration, which causes the pendulum to rotate. Electricity is then generated by a rotary generator attached to the pendulum. This generation mechanism allows the mechanical pendulum and generator to be enclosed and isolated from seawater, significantly reducing the risk of failure due to salt damage. Furthermore, since the system only requires mooring for installation, it offers the advantages of lower installation costs and expanded applicability across various sea areas.



2. Keywords

Motor, Generator, Concentrated Windings, Wave power generation, Parametric pendulum

3. Remarks and Websites

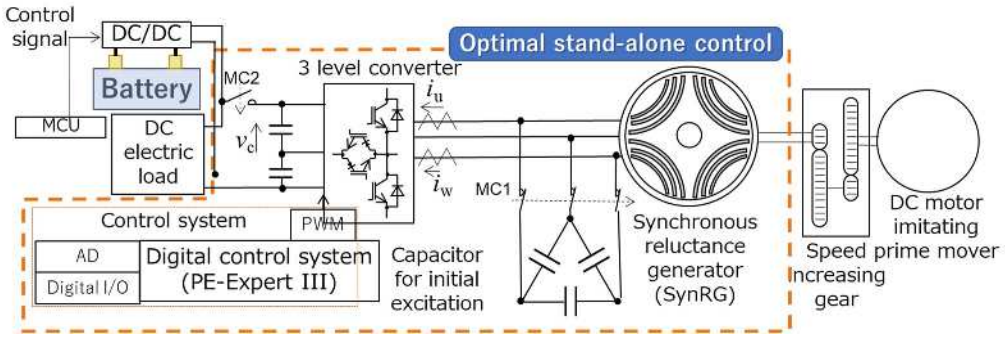
In the development of motors and generators, we first understand the fundamental principles, and then validate them through simulations and experiments. To date, we have conducted joint research with industry on motors for electric vehicles and generators for wind power systems. The rotating pendulum-type wave energy conversion system is also being advanced as part of my role as a concurrent faculty member at the Nagasaki University Institute for Marine Industry.

researchmap: https://researchmap.jp/u1.yokoi
Laboratory: https://motor.eee.nagasaki-u.ac.jp

Name	Job Title	Area of Expertise
DAIDO Tetsuji	Assistant Professor	Motor Drive, Power Electronics

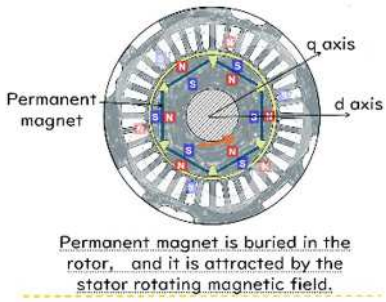
1. Main Research Topics

① Control of a high-efficiency distributed generation system using synchronous reluctance generators



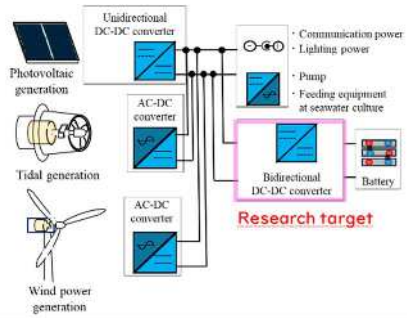
Synchronous reluctance generators (SynRG) do not incorporate rare-earth materials, thereby eliminating concerns related to the stability of their raw material supply. In addition, it is free from thermal demagnetization and its maintenance is easy. In recent years, the application of detailed finite element method analysis has significantly enhanced both the efficiency and power factor of SynRG.The conventional control method for SynRG uses the equivalent electrical circuit of SynRG. However, this equivalent circuit cannot consider local magnetic saturation, which reduces the prospected performance of SynRG. Therefore, this study considers an equivalent circuit that considers local magnetic saturation. This study aims to improve the maximum torque per ampere control of the SynRG.

② Encoder-less IPMSM control by means of PWM carrier -synchronized high frequency signal voltage injection



Pulse width modulation (PWM) carrier-synchronized with high-frequency signal voltage injection is a method for estimating the rotor position at a standstill and very low speed. This study has proposed a novel compensation method for the nonlinear voltage distortion of a voltage source inverter. In light of the recent advancements in microprocessor capabilities, this study investigates the application of minor sampling techniques to enhance the accuracy of rotor position estimation.

③ Designing and producing a non-isolated DC/DC converter for a battery energy storage



Offshore standalone power supply systems that exclusively utilize renewable energy sources require batteries to maintain a balance between power generation and consumption. The efficient regulation of battery charging and discharging is dependent on the use of a DC/DC converter. This research is centered on a non-isolated DC/DC converter, with its design and fabrication being conducted independently.

2. Keywords

Motor drive, Semiconductor power conversion, Power electronics

3. Remarks and Websites

In my research, I employ both computer simulations and experimental setups. I place particular importance on independently designing and constructing these experimental setups.

researchmap: https://researchmap.jp/pepep

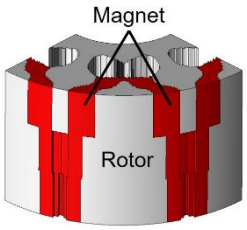
Laboratory (Japanese only): http://www.eee.nagasaki-u.ac.jp/labs/asca/top.html

Name	Job Title	Area of Expertise
OTOMO Yoshitsugu	Assistant Professor	Computational Electromagnetism, Design Optimization

1. Main Research Topics

① Topology optimization of rotating machines

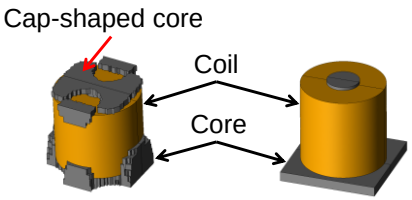
In the optimization of rotating machines, we need to consider various constraints while maximizing the motor performance. To address the above optimization problem, we have developed the topology optimization method, which freely determines the magnetic core and permanent magnet shapes without introducing shape parameters. Recently, we focus on developing the 3-D topology optimization method because this approach can directly improve the 3-D magnetic effect in the motor such as the end effect. The optimized rotor obtained using the 3-D topology optimization is exhibited in the figure.



Optimized 3-D rotor

② Topology optimization of wireless power transfer devices

The improvement of the magnetic coupling between Tx and Rx coils is crucial to enhance the power transfer efficiency of wireless power transfer (WPT) devices. In this study, we have developed the topology optimization method for WPT devices considering both magnetic and circuit properties. The optimized WPT coils obtained using the topology and parameter optimizations are shown in the figure. The key feature of the optimized coil obtained using the topology optimization is the cap-shaped magnetic core. This shape leads to achieving the power transfer efficiency over 90 %.



Topology optimization Efficiency: 94 %
Parameter optimization Efficiency: 82 %

③ Development of novel approaches for computational electromagnetism

The topology optimization of electric machines requires the long computation time to obtain the optimal shape. To address this problem, we have developed the novel approaches for computational electromagnetism (e.g. Homogenization method, Circuit analysis method, and Machine learning).

2. Keywords

Electrical machines, computational electromagnetism, shape optimization, topology optimization, rotating machines, wireless power transfer

3. Remarks and Websites

We have proposed the novel approaches to realize the superior electric machines using the topology optimization. In future works, we plan to develop the novel 3-D optimization strategies to apply the multi-physics problems.

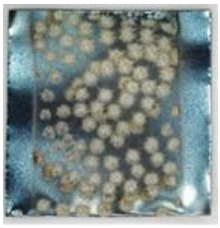
researchmap: https://researchmap.jp/yoshitsugu_otomo
Laboratory: https://www.eee.nagasaki-u.ac.jp/labs/pec/abe-otomo-lab/index.html

Name	Job Title	Area of Expertise
NAKANO Masaki	Professor	Magnetics

1. Main Research Topics

The researcher is engaged in the development of "small permanent magnets" through a "bottom-up approach utilizing film deposition." The objectives of this research are twofold: (1) to contribute to the advancement of novel devices, and (2) to aid in the miniaturization and enhancement of performance of magnets incorporated into existing devices. Three examples are provided below.

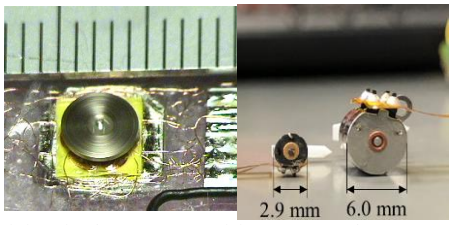
Topic 1. Development of Micromagnets Using the Laser-Induced Forward Transfer Technique (photo on the right)



Patterned micromagnet

Micromagnets intended for future applications, such as "insect-shaped microdrones" and "cell separation patterning magnets," necessitate integration with flexible substrates. However, conventional techniques that require high-temperature heat treatment are inadequate. The researcher has independently developed the LIFT method, which facilitates the direct transfer of magnetic materials of any shape at room temperature. The aim is to integrate this method with a multi-material manufacturing process to develop technology for embedding magnetic functions into next-generation medical devices, IoT devices, and other applications.

Topic 2. Development of Rare-Earth Micromagnets Fabricated Using the High-Speed Film Deposition Method for Small Device Applications

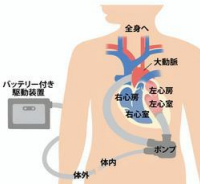


Miniaturized motors comprising PLD=made magnets

To generate a magnetic field within a specified volume, the magnet itself must possess a certain volume, which constrains its miniaturization. This study proposes a method for fabricating micromagnets using a distinctive "high-speed pulsed laser deposition" technique. By exploiting the advantages of this method for thick-film deposition to generate magnetic fields, the researcher contributes to the progression of "ultra-small device development" (photo on the right), which is anticipated to experience increased demand in the future.

Topic 3. Development of Platinum-Based Magnet Ribbons by Combining High-Speed PLD and Exfoliation Phenomena

Internal micropump



By focusing on the phenomenon where Fe-Pt magnets deposited on silicon substrates using the aforementioned high-speed pulsed laser deposition (PLD) method readily delaminate from the substrate, the researcher has produced Fe-Pt magnet ribbons for use in blood circulation micropumps (photo on the right). In addition to demonstrating excellent biosafety, these ribbons have also exhibited superior mechanical properties, as evidenced by tensile strength and cantilever tests. Research is ongoing, including the lamination of rare-earth magnets.

2. Keywords

Micro magnets, LIFT (Laser Induced Forward Transfer) technique, PLD(Pulsed Laser Deposition)method, Miniaturized devices

3. Remarks and Websites

In collaboration with multi-material manufacturing processes, we aim to develop this technology as an integrated formation and implementation technology for magnetic functions in next-generation medical devices and IoT devices.

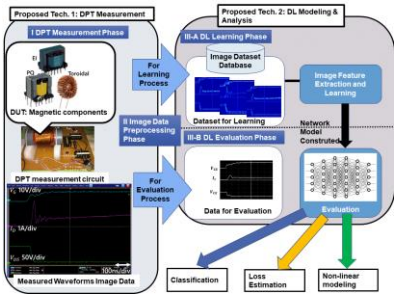
researchmap: https://researchmap.jp/read0185023/
Laboratory: https://www.eee.nagasaki-u.ac.jp/labs/magnet/index.html

Name	Job Title	Area of Expertise
ISHIZUKA Yoichi	Professor	Electronic Circuits and Integrated Circuit Engineering

1. Main Research Topics

① Research on high-speed response and flexible control of power conversion circuits with diversifying requirements

We are developing power electronics design support technologies driven by power requirement data for direct current-driven loads such as data centers and lighting equipment.



② Research on integrated power conversion circuits

The performance improvement of processors such as CPUs and GPUs requires a stable supply of operating voltage under any operating condition. Globally, research is advancing to achieve stable power supply near the processor by integrating power conversion circuits with CPUs, referred to as Power SOC. In this laboratory, we are conducting research utilizing unique ideas such as MHz-driven digital control circuits and high-density implementation technology within this research field.

③ Research on Bidirectional Power Conversion Systems with Batteries

We are conducting research on high-power-efficiency bidirectional power conversion circuits for the effective utilization of renewable energy generated under limited conditions, focusing on further reduction of conversion losses and generalization.

④ Research on solving social issues through the utilization of IoT/AI and sensor network technologies



This research primarily focuses on the development of outdoor remote monitoring systems utilizing IoT/AI technology. In collaboration with Associate Professor Tomofumi Sugimoto, we have been developing systems for slope disaster prevention and preservation. Currently, we are expanding our research to include stability assessment of damaged stone walls at Kumamoto Castle and advanced cultivation techniques for open-field farming through joint research with the Nagasaki Prefectural Agricultural Experiment Station.

⑤ Research on in-vivo low-invasive stimulation/sensing for medical research

In the field of medical research, efforts are underway to measure and analyze various information from living organisms using small animals. However, there are many obstacles in this process that hinder the efficient implementation of research.

We are collaborating with the Inoue Tsuyoshi Laboratory at the Faculty of Medicine to address these issues from an engineering perspective. Through the development of low-invasive stimulation/sensing technologies and the proposal of new methods, we aim to support the smoother and more effective advancement of medical research.

2. Keywords

Electronic circuits, integrated circuits, IoT/AI

3. Remarks and Websites

researchmap: https://researchmap.jp/read0055707

Laboratory: https://pemsic.eee.nagasaki-u.ac.jp

*We also conduct education, research, and hub formation through the Center for Advanced Micro-Device Research (CAMRIS) at Nagasaki University's Integrated Production Science Division. For more details, please visit: https://camris.ist.nagasaki-u.ac.jp

Name	Job Title	Area of Expertise
MARUTA Hidenori	Associate Professor	Industrial Electronics

1. Main Research Topics

① **Edge-Shallow Neural Network Control of DC-DC converter**

DC-DC converter has an essential role in a wide range of electronic devices. With the rise of IoT devices, DC-DC converter is required not only to provide a stable power supply but also to provide a superior function for complex control to meet various demands.

Recent advancements in microcomputers have made it possible to perform complex signal processing and control at the very edge of IoT networks. This enables to form edge computing, where tasks that were previously impossible can now be carried out in edge-level computing resources. Our research is developing a new control method that leverages these advancements. We investigate the use of neural network, a most popular and practical type of AI, for such purposes. The training part that requires a large amount of computing resource and processing power is handled by powerful cloud resources via a network connection. Meanwhile, the inference or prediction part, which is the faster and requires less intensive computation burden is done directly on the edge device. This approach allows us to achieve superior levels of stability and fast response. The system can also adapt to changing conditions and external disturbances through its learning capabilities.

② **MPC and AI for Design and Control of DC-DC Converter**

Model based designing and controlling of complex systems requires models of individual systems and integrating them into one complete model. However, even if individual models are accurate, the precision of the overall model can decrease due to inconsistencies caused by connections or the propagation of disturbances throughout the system. Furthermore, in real operation, there is model uncertainty due to factors like component-level tolerances.

This research combines Model Predictive Control (MPC) with system identification to correct model inaccuracies. It is realized by using the prediction of the model and observed data to adjust discrepancies in the parameters in the model. Since a perfect or ideal model is impossible to obtain, the system is treated as a black box to a certain extent. We are currently developing specific methods that use AI techniques for estimation to improve the system's performance.

③ **Methodology of Anomaly Detection and Fault Diagnosis for Industry**

Detecting anomalies or faults from data is a difficult task for computers, while often easy for humans. This is because to give a quantitative definition of “anomaly” is challenging; which humans often rely on experience and intuition. In such cases, standard AI methods frequently fail to achieve high accuracy.

This research explores methods for detecting abnormal states, such as anomalies and faults, directly from data. Our specific examples are:

- Detecting smoke or fire from video data (surveillance footage).
- Detecting faults in a DC-DC converter from its observed values.

By combining model-based and AI-based approaches, we aim to develop a method that reflects the unique characteristics of the systems and to provide a superior function for several specific purposes.

2. Keywords

Power conversion, Model based method, AI, Anomaly, Fault detection

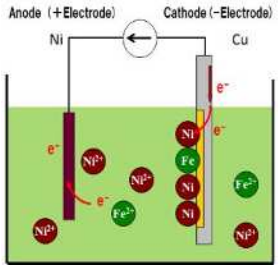
3. Remarks and Websites

researchmap： https://researchmap.jp/h_maruta
Laboratory: https://sites.google.com/view/maruta-lab/

Name	Job Title	Area of Expertise
YANAI Takeshi	Associate professor	Magnetic Materials and Their Applications

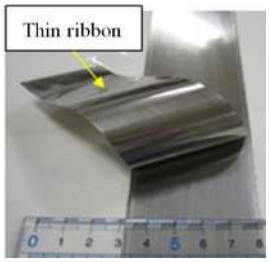
1. Main Research Topics

① Development of soft and hard magnetic thick films prepared using electroplating and electroless plating methods



We are studying preparations of magnetic materials for small magnetic devices using electroplating and electroless plating methods. Our research focuses on improving their magnetic properties and studying effective additives into the plating baths. Our laboratory can produce magnetic films with thicknesses in the range of approximately 1 to 20 μm in just a few minutes.

② Fabrication of soft magnetic ultra-thin ribbons



Power semiconductors such as SiC and GaN have become more widely used, leading to increases in the power and operating frequency of power electronics devices. Magnetic materials are essential components in these devices, used as core materials in transformers and reactors. We are developing soft magnetic materials with high saturation magnetic flux density for high-power applications.

③ Computer simulation of soft magnetic properties

We are investigating the application of induced magnetic anisotropy using external stress to improve high-frequency magnetic properties. As part of this investigation, we are developing a computer simulation method for studying magnetic properties. Based on micromagnetic theory, we are using parallel calculations with GPUs to perform multi-element analysis and determine magnetic properties in a short time.

④ Others（Novel electrolyte）



In wet processes such as electroplating and electroless plating, water is often used as a solvent. As water is decomposed to H_2 and O_2 gases when high voltage is applied during electroplating, some elements are difficult to obtain from an aqueous solvent. To address this issue, we are investigating the preparation of magnetic films using deep eutectic solvents. Additionally, we are also investigating the plating from solid electrolytes (gel plating) to reduce waste liquid.

2. Keywords

Magnetic films, electroplating, electroless plating, high frequency, power electronics, computer simulation

3. Remarks and Websites

With the rapid progress of power electronics technologies, there has been growing concern for several years now about the shortage of suitable magnetic materials for these applications. Recently, these concerns have become even more pronounced, and we strongly feel the increasing demand. We are working hard to meet these expectations through materials development in several areas, including metallic magnetic thin ribbons for high-frequency use, small magnetic films for medical applications, and soft magnetic films for sensors and other devices. If any of these topics interest you, please feel free to reach out to us.

researchmap: https://researchmap.jp/read0125661
Laboratory: http://www.eee.nagasaki-u.ac.jp/labs/magnet/index.html

Name	Job Title	Area of Expertise
YAMASHITA Akihiro	Assistant Professor	Laser Ablation, Magnetic Materials, Electronic and Electrical Materials

1. Main Research Topics

In this research, magnetic thin and thick films based on Fe, such as Nd-Fe-B and Fe-Co, are fabricated using Pulsed Laser Deposition (PLD), a method capable of forming films with thicknesses ranging from a few nanometers to several hundred micrometers. By optimizing laser irradiation conditions and target materials, we aim to develop magnetic films with excellent magnetic properties. Magnetic properties and microstructures of the fabricated films are evaluated using various characterization techniques.

With the miniaturization of electronic devices, there is increasing demand for high-performance and miniaturized magnetic materials. Our laboratory is developing magnetic films using PLD, which enables deposition over a wide thickness range from thin films to thick films. Below are several representative studies:

① **Development of Rare-Earth Thick Film Magnets for MEMS Applications Using PLD**

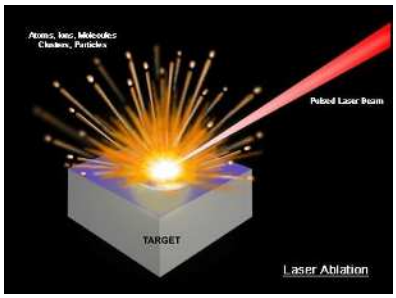
To explore MEMS (Micro-Electro-Mechanical Systems) applications, rare-earth-based magnetic films are deposited onto semiconductor substrates such as silicon and glass, and their magnetic and mechanical properties are evaluated.

② **Fabrication of Multilayer Nanocomposite Magnet Films Using Multi-Target PLD**

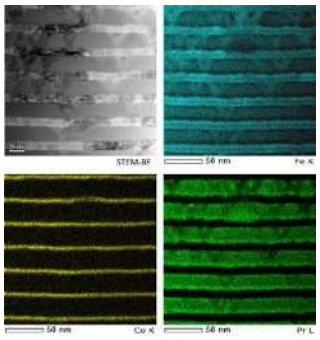
By combining multiple target materials, we fabricate multilayer nanocomposite magnetic films with periodic structures ranging from a few nanometers to several micrometers.

③ **Deposition Control by Magnetic Field Application to Plasma Plume during PLD**

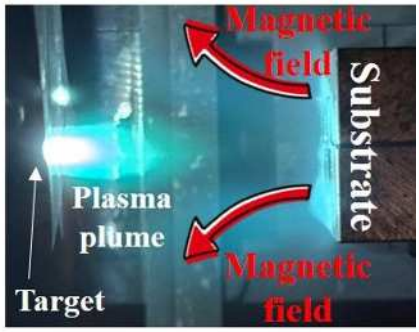
We investigate the effects of applying an external magnetic field to the plasma plume during deposition on the deposition rate, composition, and microstructure of metal films.



Schematic illustration of the laser ablation process
source: APPLIED SPECTRA official website



Cross-sectional TEM image of a multilayer sample fabricated using multi-target PLD



Deposition under an applied magnetic field

2. Keywords

Laser ablation, Magnetic materials, PLD method, Thin film, Micro Electro Mechanical Systems

3. Remarks and Websites

Our laboratory is engaged in the fabrication of magnetic films, which are being explored for applications in compact motors and MEMS devices, such as energy harvesting devices and microactuators.
Recently, we have also been working on the deposition of various metal and semiconductor materials using laser ablation techniques, expanding our research beyond magnetic films.

researchmap: https://researchmap.jp/aki-yama
Laboratory: http://www.eee.nagasaki-u.ac.jp/labs/magnet/index.html

Name	Job Title	Area of Expertise
TANAKA Toshiyuki	Professor	Electromagnetic Wave Application Engineering

1. Main Research Topics

We are developing non-destructive and non-invasive testing devices that use electromagnetic waves and are also conducting research into electromagnetic compatibility (EMC) countermeasures.

① **Development of radar for detecting horizontal cracks on highways and bridges**

It is known that horizontal cracks occur inside the concrete of highways and bridges due to the frequent passage of heavy vehicles. Concrete is paved with asphalt, and horizontal cracks in the concrete cannot be seen with the naked eye, so regular inspections are important. In regular inspections, the asphalt is generally removed, and the concrete is destroyed to check for horizontal cracks. However, this method is time-consuming and expensive. Therefore, we are developing a radar device that can detect horizontal cracks non-destructively from above the asphalt.

② **Estimating rebar diameter using commercial radar.**

Using a concrete radar, it is easy to check whether the rebar is present or not. However, to investigate the durability of a concrete structure, the exact size of the rebar (rebar diameter) and its position (cover depth) are required. These accurate values cannot be obtained by normal use of radar. Therefore, our laboratory is developing an algorithm to non-destructively and simultaneously estimate the diameter of rebar in concrete, the cover depth of rebar, and the electrical constants of concrete.

③ **Development of blood vessel detection radar to assist laparoscopic surgery**

In laparoscopic surgery, the time it takes to drill a hole in the fat and deliver the medical equipment to the affected area cannot be ignored. This is because blood vessels are present in fat, and it is necessary to enter the area without damaging the blood vessels. For this reason, an antenna is placed on the laparoscopic forceps and emits electromagnetic waves from the antenna. The emitted electromagnetic waves are reflected by blood vessels, and by analyzing the received electromagnetic waves, it is possible to determine whether or not there are blood vessels nearby. This is expected to significantly reduce the time required for laparoscopic surgery.

④ **Distinguishing between natural and artificial teeth**

We are developing a device that can distinguish between natural teeth and dentures made of ceramics, zirconia, etc. This system uses a dielectric probe to instantly measure the electrical constants of an object and distinguish between natural and artificial teeth in real time. An important theme is the creation of a dielectric probe that can be used for teeth of various shapes.

⑤ **Monitoring the salinity of seawater**

We are developing a system that can observe the salinity of seawater in real time. Even if the seawater is deep at aquaculture sites, we can check the salinity without having to pump the seawater up. We also aim to simultaneously check the degree of pollution of seawater.

⑥ **Electromagnetic compatibility (EMC) measures**

Whenever electric current flows, unwanted electromagnetic waves are generated. Unwanted emitted electromagnetic waves can sometimes cause other electronic devices to malfunction. Therefore, we are developing a simple device for detecting leaked electromagnetic waves and a power supply circuit that does not emit unwanted electromagnetic waves.

2. Keywords

Electromagnetic wave applications, non-destructive testing, non-invasive diagnosis, electromagnetic compatibility (EMC)

3. Remarks and Websites

We aim to develop non-destructive testing equipment and non-invasive diagnostic equipment that utilize electromagnetic waves that do not currently exist. We will also conduct feasibility testing to see if this is possible in principle. We welcome inquiries about testing and diagnosis.

researchmap: https://researchmap.jp/read102593
Laboratory: https://www.eee.nagasaki-u.ac.jp/labs/emlab/study/staff/tanaka/

Name	Job Title	Area of Expertise
FUJIMOTO Takafumi	Associate Professor	Antenna Engineering

1. Main Research Topics

Radio waves play an important role in transmitting information, but recently, they have come to be utilized in fields other than communication, such as the medical field and energy field. In our laboratory, we conduct research and development on "antennas," which are the most important devices for utilizing radio waves, through simulation and measurement experiments.

① Development of Compact High-Performance Antennas for Communication

We conduct research and development on compact planar antennas with high performance characteristics such as broadband characteristics and multi-band operation.

Compact Circularly Polarized Antenna for UWB

We have developed a planar antenna with a circular polarization frequency bandwidth of over 80%. The circular polarization frequency bandwidth is at world-class level.



Top view　　Bottom view

Multiband Printed Antenna

We have developed a planar antenna that can be used in three frequency bands (2.45 GHz band, 3.5 GHz band, and 5 GHz band). By adopting a multilayer structure, we have enabled operation in three frequency bands while also achieving antenna miniaturization.



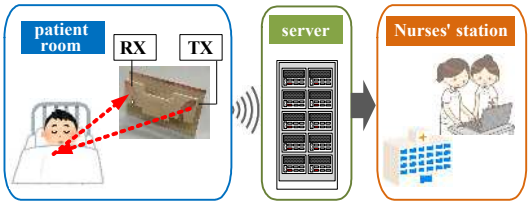
Final design　Upper　Middle　Lower

② Development of Planar Antennas for Radio Wave Applications

We conduct research and development on compact planar antennas for the purpose of utilizing radio waves in new fields such as medical applications.

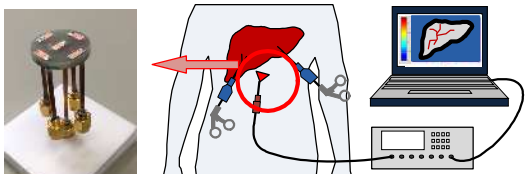
Body Movement Detection and Monitoring System

We are developing antennas for non-contact monitoring of patient body movement, bed exit, respiration, and heartbeat in hospitals and nursing care facilities.



Radio Wave Endoscopic Antenna System

We are developing radio wave endoscopic antennas capable of detecting blood vessels inside fatty tissue.



2. Keywords

Broadband antennas, Planar antennas, Radio wave applications, Medical applications, Sub-6 5G

3. Remarks and Websites

- The radiation characteristics required for antennas depend on the application. We can design and develop antennas according to specific applications.
- We possess multiple electromagnetic field analysis software packages for antenna design. We are also capable of measuring antenna characteristics up to 43 GHz.
- In addition to the above, we also conduct research on Sub-6 5G antennas, 28 GHz band 5G antennas, and antennas for wireless power transmission (rectennas).

researchmap: https://researchmap.jp/read0185026
Laboratory: https://www.eee.nagasaki-u.ac.jp/labs/emlab/study/staff/fujimoto/

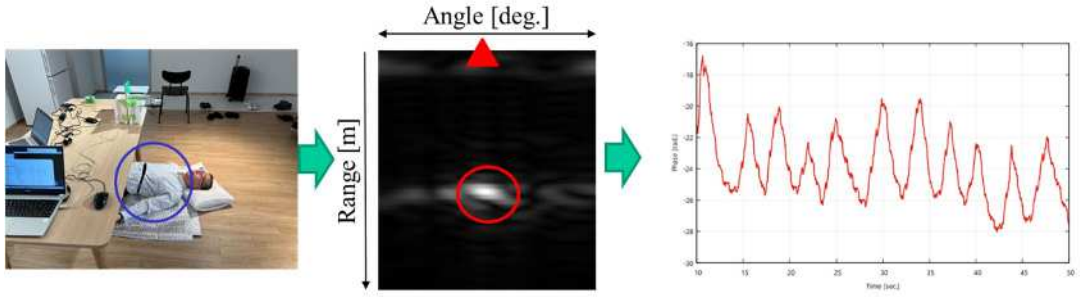
Name	Job Title	Area of Expertise
MORIYAMA Toshifumi	Associate Professor	Microwave Remote Sensing

1. Main Research Topics

Microwaves can propagate through space regardless of day and night or weather, and have been used for radar to observe a target remotely. Radar is now used in many applications, including preventing car collisions, detecting suspicious individuals at home, and monitoring the heart rate and respiration. In this research, I consider to observe the small displacement of objects and structures and to image the objects by radar.

① Real-time monitoring of small displacement, including heartbeat and respiration of human

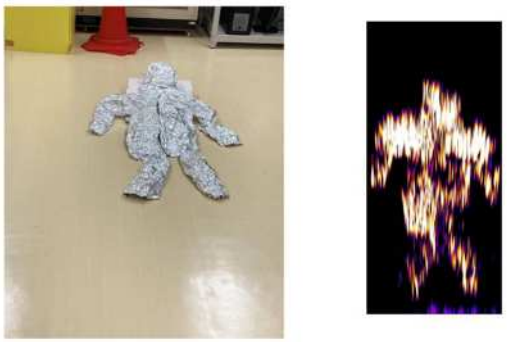
This research focuses on a technology for radar observation of the human heartbeat and respiration in real time without contact. Another application of this technology is to measure abnormal vibrations in infrastructure (such as buildings and bridges). The following figure shows an example of measuring heartbeat and respiration.



Experimental situation　　MIMO measurement　　Measured phase waveform

② Millimeter-Wave Imaging with GB-SAR

In this research, I am developing technology to detect landslide and hazards by imaging using millimeter-wave ground-based synthetic aperture radar (GB-SAR). It will contribute to safety and security for human activity. The image on the right shows a millimeter-wave radar image of aluminum foil imitating a human body.



アルミホイルの人体モデル　　79GHz GB-SAR画像

2. Keywords

MIMO FM-CW radar, Synthetic Aperture Radar processing, Small displacement

3. Remarks and Websites

This research can non-contact real-time displacement measurement and daily fluctuations of structures such as buildings and bridges in the infrastructure and civil engineering fields, and non-contact measurement of human breathing and heartbeats in the medical field. It can also be applied in the field of security, such as detecting suspicious individuals. We would appreciate your consideration of collaborative research.

researchmap: https://researchmap.jp/read0147500
Laboratory: http://www.eee.nagasaki-u.ac.jp/labs/emlab/moriyama/index.htm

Name	Job Title	Area of Expertise
Guan Chai Eu	Assistant Professor	Antenna and Wave Propagation

1. Main Research Topics

Commercial services for the fifth-generation mobile communication system (5G) were launched throughout the world in 2020, setting the stage for the rise of new industries and applications. At the same time, debates around the 6G communication network design for Beyond 5G/6G are gaining momentum. As we progress toward the continued development of Society 5.0, which supports sustainable communication, there is an increasing demand for high-frequency devices with broader bandwidth, higher performance, and more compactness.

My research aims to meet these industry demands by developing novel communication system components such as antennas, Reconfigurable Intelligent Surfaces (RIS) reflectors, and high-frequency devices.

■ My Research Topics

① Development of Circular Polarized Antenna for High-Capacity Communication System

We are pursuing research on wideband smart antennas for next-generation mobile communication systems, having a focus on Beyond 5G. I am working on designing smart antennas for high-speed, high-capacity wireless communication in the Sub-6 GHz bands (3.7 GHz and 4.5 GHz). Also, I am conducting research in areas such as frequency selectivity and polarization diversity in the antenna to meet demands from the industry.

② Development of Reconfigurable Intelligent Surface Reflector

To establish a connection between non-terrestrial networks (NTN) and terrestrial networks (TN), polarization consistency must be maintained across the network. My research intends to study the conversion mechanism from linear to circular polarization in Reconfigurable Intelligent Surfaces (RIS) reflectors, as well as to create RIS reflectors that can serve as interfaces for seamless wireless communication between NTN and TN.

③ 360° Phase Shifter

Phase shifters are used to concentrate antenna radiation in a certain direction by producing incident waves whose phase was shifted by a specific angle in relation to the input signal. We have developed a compact phase shifter that can control the phase of the incident waves continuously from 0 to 360 degrees.

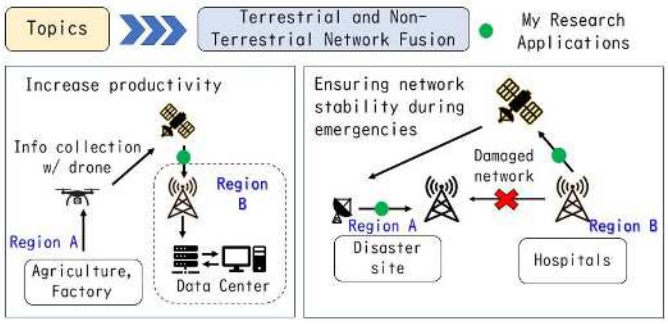


Figure 1 Network connection between TN and NTN.

2. Keywords

Local 5G、non-terrestrial network、circularly polarized antenna、RIS reflector、high-frequency devives.

3. Remarks and Websites

Research Achievements: My research outcomes are published in academic journals and international conferences. For more details, please visit the following research map link below.

Future Outlook: The number of B
eyond 5G-related IoT devices and the AI market size will continue to grow in future. In response to the growing demands of smart agriculture and automated/semi-automated factories, we are focusing on the development of communication devices operating in the microwave band.

For those considering research collaboration, let's work together on the following topics to develop high performance passive microwave-band devices and antennas: (1) Wide Bandwidth. (2) Multifunctional antenna. (3) Size miniaturization. (4) Optimization of other performance characteristics.

researchmap： https://researchmap.jp/guance

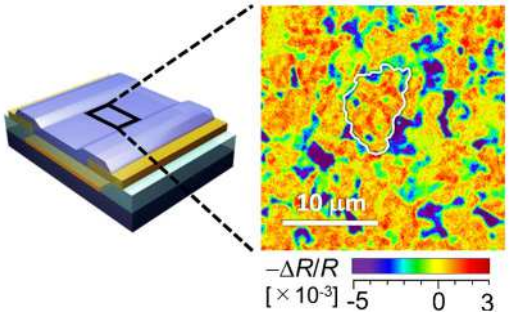
Name	Job Title	Area of Expertise
MATSUOKA Satoshi	Associate Professor	Organic Electronics, Optical Physics

1. Main Research Topics

Organic electronics and optical devices composed of functional organic molecules, such as flexible electronics and optical communication devices utilizing the flexibility of organic molecular crystals and the nonlinear optical response of the anisotropic molecular structure, respectively, have been developed for the next-generation information and communication technology. I investigate for improving the device performance by visualizing the spatial distribution of charge carriers and electric polarizations by means of the optical imaging technique.

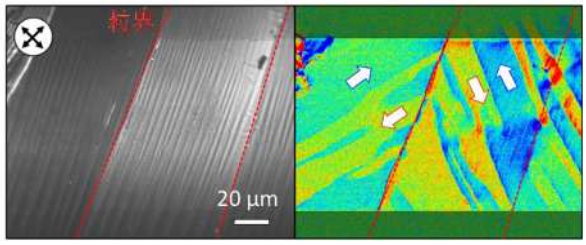
① **Visualization of charge carriers in Organic FETs**

I developed an optical gate modulation imaging technique which allows to visualize the charge carrier distribution in the organic semiconductor layer of organic field effect transistors. By means of the technique, I successfully observed the inhomogeneous carrier distribution in a polycrystalline organic semiconductor layer and revealed the anomalous electro-optic response in a single-crystal semiconductor layer.



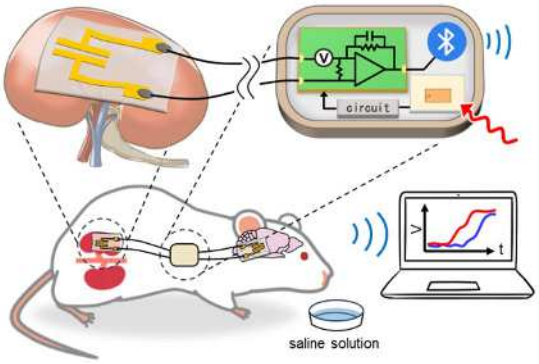
② **Visualization of electric polarizations using nonlinear optical responses and development of optical devices**

I observed the spatial distribution of electric polarizations in organic ferroelectric materials and electro-optic polymers by means of the field modulation imaging technique utilizing the nonlinear optical response induced by the broken inversion symmetry of organic molecules. It was demonstrated that the micro-meter scale ferroelectric domains and the reversal mechanism in ferroelectric films. The polarization orientation in the electro-optic polymer waveguide of the optical modulator can be evaluated by the technique, which encourages technological innovation with improving the device performance.



③ **Development of implantable sodium ion sensor device**

I investigated implantable sodium ion sensor devices for understanding the mechanism of the phenomena caused by excessive sodium intake in the body on biological functions. Flexible polymer sensors and wireless communication devices are utilized to measure the dynamics of living organisms without interference of natural movements.



2. Keywords

Organic field effect transistor(FET), Organic ferroelectric, Electro-optic polymer, Optical modulator

3. Remarks and Websites

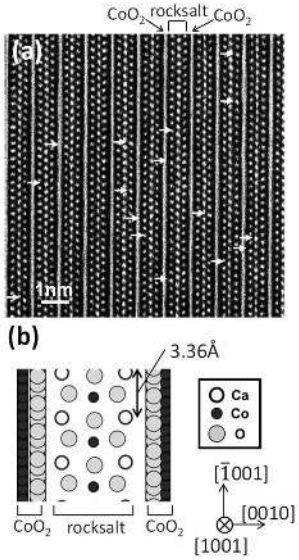
researchmap: https://researchmap.jp/matsuoka-s_1122

Name	Job Title	Area of Expertise
MORIMURA Takao	Professor	Crystal Structure Analysis

1. Main Research Topics

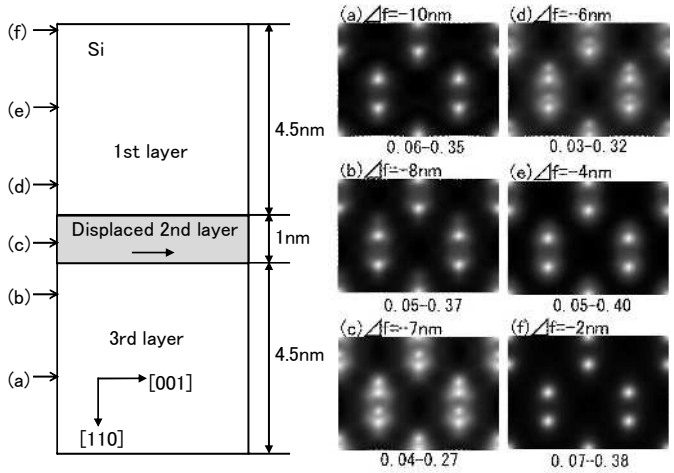
① Development and Structural Analysis of Thermoelectric Materials

We fabricate thermoelectric materials using methods such as spin-casting liquid quenching, sintering, and vapor deposition. We develop high-performance thermoelectric materials by combining physical property measurements, such as the Seebeck coefficient, electrical conductivity, and dimensionless figure of merit, with structural analysis using scanning transmission electron microscopy (STEM). The figure on the right shows an experimental STEM image of the Sr-doped misfit-type layered oxide $Ca_3Co_4O_9$ (a) and a projection from the [110] direction (b). In (a), Ca and Co atoms are observed as bright spots. Sites occupied by heavier Sr atoms are observed as brighter spots, as indicated by the arrows. This suggests that the added Sr is substituted and distributed within the misfit-type layered oxide $Ca_3Co_4O_9$, contributing to improved thermoelectric properties.



② Development of a Simulation Method for Scanning Transmission Electron Microscopy image

Quantitative analysis of STEM images requires solving the Schrödinger equation and simulating the images. In this research, we are developing a new STEM image simulation method by applying the Bloch wave method, which is advantageous for periodic structures, to crystals containing defects. The figures show schematic Si with the second layer slightly displaced in the [100] direction (left) and a simulated image (right) when an electron beam is incident from the [110] direction. By changing the objective lens focus Δf, images can be obtained near the depths indicated by the arrows, suggesting that 3D structural analysis is possible.



2. Keywords

thermoelectric material, Scanning transmission electron microscopy, Electron diffraction theory, Bloch wave method

3. Remarks and Websites

We are conducting research that lead to the development of high-performance materials through atomic-level structural analysis. Our goal is to clarify the mechanism behind the high thermoelectric properties. We are also conducting collaborative research on SiC defect structural analysis through Center for Advanced Microdevice Research in the Interest of Society (CAMRIS) in Nagasaki University.

researchmap: https://researchmap.jp/read0172791/
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/kessho/

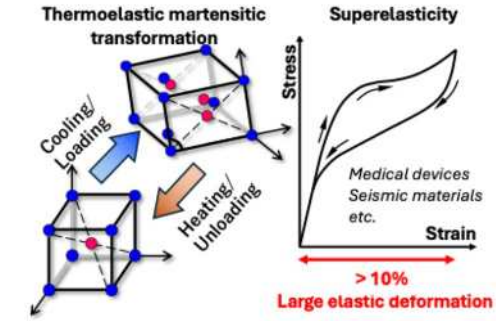
Name	Job Title	Area of Expertise
AKAMINE Hiroshi	Associate Professor	Functional Alloys, Electron Microscopy

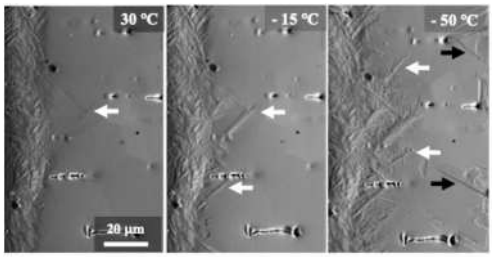
1. Main Research Topics

① Phase Transformation Mechanisms in Next-Generation Shape Memory Alloys

Shape memory alloys (SMAs) exhibit unique functionalities such as the shape memory effect, in which a deformed material recovers its original shape upon heating, and superelasticity, which allows elastic deformation exceeding 10%—far beyond that of conventional metals. These properties originate from a solid-state phase transformation known as the thermoelastic martensitic transformation. While SMAs are already widely used in consumer products and medical devices, further improvements in performance and cost-effectiveness could significantly expand their applications to fields such as civil engineering, architecture, and solid-state refrigeration.

We aim to elucidate the mechanisms of phase transformations through microstructural analyses, thereby developing novel SMAs and/or enhancing shape memory properties. Emphasis is placed on in situ observations under external fields such as thermal cycling and mechanical loading, which allow direct visualization of phase transformation processes.



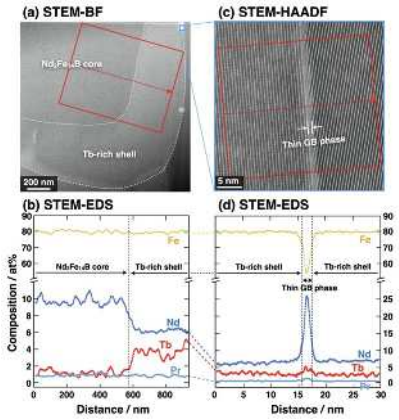


Direct observation of phase transformation upon cooling (Akamine et al. 2023)

② Microstructural Analysis Using Electron Microscopy

Electron microscopy is an important analytical technique for the development of advanced materials and devices based on nanotechnology. Modern electron microscopy enables nanoscale analysis of lattice defects, chemical composition, crystallographic orientation, and electronic states. Through electron microscopy-based characterization, we are actively engaged in collaborative research on the development of a wide range of functional materials.

- Deformation behavior of titanium alloys
- Grain boundary structure of neodymium magnets
- Microstructure of PLD-grown thick-film magnets
- Microstructure of fluoride-based ion battery materials



Microstructure analysis by STEM (Itakura et al. 2024)

2. Keywords

Shape memory alloys, Phase transformation, Electron microscopy

3. Remarks and Websites

We actively welcome collaborative research involving microstructural characterization using scanning electron microscopy (SEM) and transmission electron microscopy (TEM). In addition, evaluations of mechanical properties—such as tensile testing, thermal analysis, and electrical resistivity measurements—provide valuable insights for the development of advanced materials. Please feel free to contact us if you are interested.

We are also aiming to advance research on the practical implementation of shape memory alloys (SMAs) in society. Current interests include SMA-based actuators, solid-state cooling systems driven by thermal cycling, and structural applications in the fields of architecture and civil engineering. We welcome inquiries from those interested in collaboration.

researchmap: https://researchmap.jp/akhr-rmap
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/kessho/

Name	Job Title	Area of Expertise
OHGAI Takeshi	Professor	Metallurgy

1. Main Research Topics

The physical properties of metallic materials are determined by their microstructure, including grain size, lattice defect density, and the dispersion state of precipitates. The constituent phases of this microstructure change in such a way as to reduce Gibbs free energy, ultimately settling into a thermodynamically stable phase. This thermodynamically stable phase is uniquely determined by the alloy composition and temperature, and its database is summarized in a phase diagram. While the properties of these thermodynamically stable phases have already been elucidated, the properties of non-equilibrium phases during phase transformations, where atomic diffusion is insufficient, remain largely unknown and hold the potential to exhibit exceptionally superior properties. One method for producing these non-equilibrium phases is the solid solution preparation method using rapid cooling from the liquid or gas phase, but this requires high-temperature and high-vacuum conditions. On the other hand, the aqueous solution electrolysis method allows for the reduction of hydrated metal ions at room temperature and pressure, enabling the easy production of thermodynamically non-equilibrium phases. Below, I introduce research themes related to the production and property evaluation of non-equilibrium phases using the aqueous solution electrolysis method.

① **Electrochemical Synthesis of Nanochannel Structured Metal Oxide Films**

I have developed anodized aluminum oxide thick filters with numerous nanochannels which can be applied to a template material for developing a novel functional device.

② **Development of Metallic Multilayered Nanowires Array with CPP-GMR Response**

Using a pulsed current electrodeposition technique from an aqueous solution, I have fabricated a multi-layered nanowire array with alternating layers of ferromagnetic and antiferromagnetic metals. The multi-layered nanowire exhibited a giant magnetoresistance effect with applying current in perpendicular to the layered interfaces (see Fig. 1).

③ **Characterization of Iron-group Metal Based Amorphous Alloy Films Electrodeposited from Aqueous Solutions**

I have synthesized iron-group metal based amorphous alloy thick films by applying an induced co-deposition technique from an aqueous solution. The amorphous alloy thick films exhibited excellent mechanical performance with high-strength, high-corrosion-resistant, and catalytic properties.

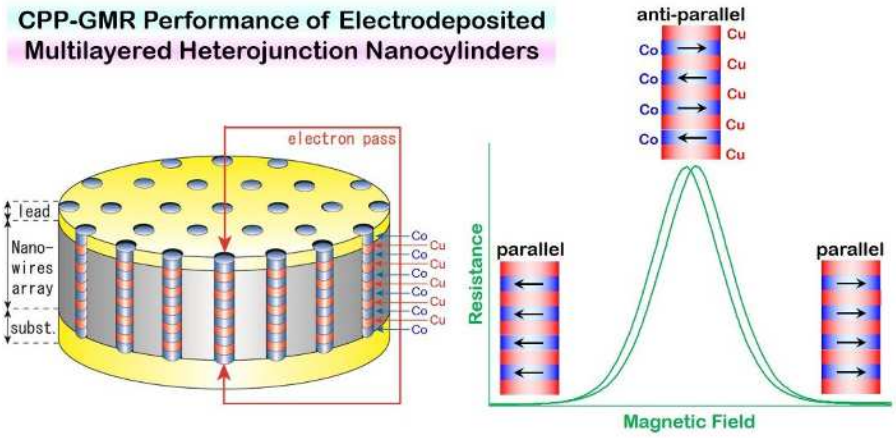


Fig.1 Electrochemical synthesis and characterization of metallic multilayered nanowires array with CPP-GMR (current perpendicular to plane giant magnetoresistance) response.

2. Keywords

Metallic materials, Metallic nanomaterials, Electrodeposition, Anodization, Metal surface finishing, High strength alloys, Magnetoresistance, Corrosion-resistance alloys

3. Remarks and Websites

I am currently developing new functional metallic materials with non-equilibrium phases utilizing metal surface treatment technology, mainly using an electrodeposition technique from aqueous solution.

researchmap: https://researchmap.jp/read0118950

Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/soshiki/index.html

Name	Job Title	Area of Expertise
YAMAMOTO Masataka	Assistant Professor	Materials Science of Metals

1. Main Research Topics

① **Balancing electrical conductivity and mechanical strength in Copper alloys**

With the recent advancement of electronic devices, the development of high-performance copper alloys, which serve as the base material, has become an important technology. In particular, the development of copper alloy wires with higher strength and conductivity is desired for applications such as lead wires, conductive spring materials, and DVD pickup wires. Generally, there is a trade-off between the conductivity and strength of copper alloys. The copper alloy currently in use is Cu-Be (copper-beryllium) alloys, but concerns about the toxicity of beryllium and its environmental impact have raised the need for alternative materials. I am focusing on Cu-Ti (copper-titanium) alloys, which have lower conductivity than Cu-Be alloys, and conducting research on techniques to improve conductivity while maintaining strength. Specifically, I am investigating the effects of adding third elements and aging heat treatments on the conductivity and strength of Cu-Ti alloys.

② **Fabrication of lightweight, high-strength metal-based composite materials**

One of the important issues to meet the demand for energy saving is to reduce the weight of transportation equipment. We are working on the development of metal-based composite materials with high strength by combining aluminum alloys and magnesium alloys with ceramic fibers and particles such as silicon carbide and alumina. In order to achieve the ideal strength, it is necessary to reduce casting defects. The purpose of this study is optimization of the casting process for fabricating the ideal metal-based composite materials.

③ **Increasing the strength and workability of magnesium alloys**

Magnesium is the lightest of all practical metals, but its low strength makes it unsuitable for use as a structural material. Furthermore, increasing its strength reduces its workability, limiting its range of application to small components. To resolve this dilemma, I am working to refine the crystal grains of magnesium alloys by devising casting methods, aiming to achieve both strength and workability.

2. Keywords

Copper alloy, Electrical conductivity, Mechanical strength, Magnesium alloy, Crystal refinement

3. Remarks and Websites

Although copper has a longer history than iron, systematic knowledge about the mechanisms of precipitation strengthening and electrical conductivity has yet to be developed. With the trend toward more advanced electrical equipment in automobiles and smaller electronic devices, the results of this research are expected to make a significant contribution to these areas.

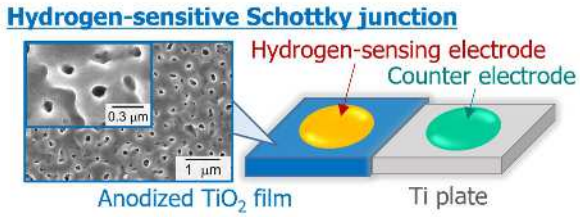
researchmap: https://researchmap.jp/-ym
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/soshiki/

Name	Job Title	Area of Expertise: Functional Materials Chemistry, Chemical Sensors
HYODO Takeo	Professor	

1. Main Research Topics

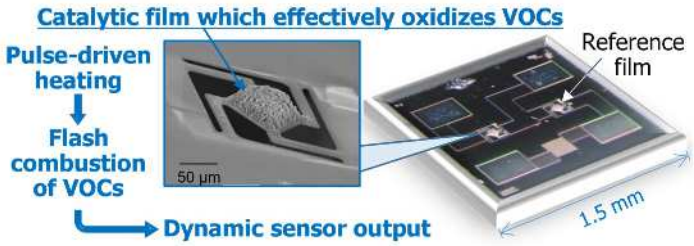
(a) Highly sensitive and selective diode-type hydrogen sensors

The barrier height of the Schottky junction, which combines an anodically oxide film (e.g., TiO_2) with a noble metal such as Pd and Pt, is very sensitive to hydrogen under gaseous atmosphere. We have developed high-performance hydrogen sensors by their optimization of the composition and/or microstructure.



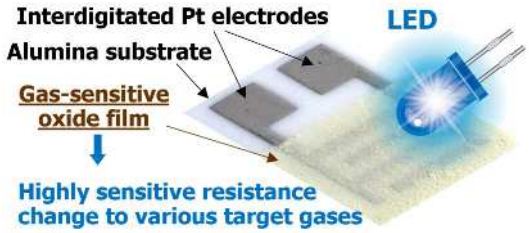
(b) Adsorption/combustion-type VOC microsensors based on MEMS platforms

Modern microelectromechanical systems (MEMS) technology provides a micro platform for various gas sensors. An adsorption/combustion-type gas sensor with a catalyst film and a reference film, which are formed over Pt heaters, can high-sensitively detect various volatile organic compounds (VOCs, e. g., toluene) by the flash combustion of the VOCs adsorbed on the catalyst surface.



(c) Light-driven semiconductor-type gas sensors operable at room temperature

General semiconductor gas sensors operate at elevated temperatures, while the effective light irradiation to the gas sensors by a light-emitting diode (LED) makes them detect some gases even at room temperature. The compositional and microstructural optimization of the oxide film significantly improves the gas-sensing properties.



(d) Others

A variety of highly functional materials and devices, such as “oil-quality sensors” and “functional porous microspheres and electrodes” has been developed in our laboratory.

2. Keywords

Chemical sensors, Gas sensors, Oil-quality sensors, functional ceramics, mesoporous and macroporous materials, Electrochemistry, Semiconductor, Solid electrolyte, Hydrogen, Carbon monoxide, VOCs

3. Remarks and Websites

We conduct a number of research projects using funding from the Japan Society for the Promotion of Science (FY2021–FY2023: Grants-in-Aid for Scientific Research B "Highly sensitive and selective sensing technology for biogases based on dynamic adsorption combustion" and FY2024–FY2026: Grants-in-Aid for Scientific Research B "Development of ultrasensitive, highly selective, and rapid-response hydrogen-monitoring devices"), other competitive funds, and joint research grants. Please see the following websites for our various research results.

- **researchmap:** https://researchmap.jp/TH_nagasaki?lang=en
- **Lab. HP:** http://www.cms.nagasaki-u.ac.jp/lab/zaika/
- **ORCiD:** https://orcid.org/0000-0003-1605-5623
- **Google Scholar:** https://scholar.google.com/citations?user=5yPHuqoAAAAJ&hl=ja
- **J-Global:** https://jglobal.jst.go.jp/en/detail?JGLOBAL_ID=200901017381080194

Name	Job Title	Area of Expertise
UEDA Taro	Associate Professor	Electrochemistry, Gas Sensors

1. Main Research Topics

(1) Development of Highly Sensitive Gas-Sensing Materials

Sensing materials for high-performance gas sensors have been developed. We have developed semiconductor-type sensors and electrochemical-type sensors capable of detecting combustible gases and carbon monoxide (CO). Detection of trace levels of volatile organic compounds (VOCs) emitted from human breath and skin is a primary objective.

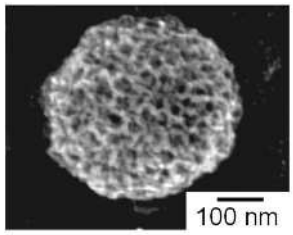


Fig. 1. pr-SnO_2 particle.

Example 1: Porous Tin Oxide (pr-SnO_2) Particle

Porous SnO_2 particles were synthesized by ultrasonic spray pyrolysis using a precursor solution containing tin ions and polymeric microspheres as a template (diameter: 70 nm), followed by thermal decomposition and crystallization (Fig. 1). The co-addition of noble metals and metal oxides significantly enhanced the sensor response to acetone.

https://doi.org/10.3390/chemosensors12080153 (Open Access)

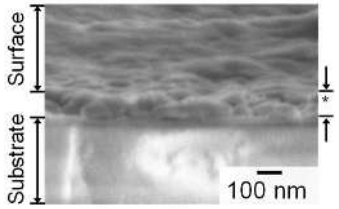


Fig. 2. Au-based thin film electrode*.

Example 2: Au-Based Thin Film Electrodes

Thin film electrodes were fabricated by spin-coating method using a solution containing gold and cerium ions onto a solid electrolyte substrate, followed by high-speed rotation and thermal treatment. The fabricated sensor exhibited highly sensitive detection of toluene (Fig. 2).

https://doi.org/10.1016/j.snb.2024.136217 (Open Access)

(2) Elucidation of Sensing Mechanisms

Understanding sensing mechanisms is essential for the development of high-performance gas sensors. Gas adsorption behavior and surface reaction activity of sensing materials have been investigated using diffuse reflectance infrared Fourier transform spectroscopy (DRIFT) and electrochemical measurement techniques, respectively.

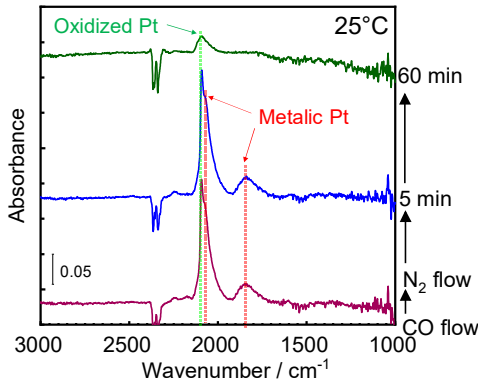


Fig. 3. DRIFT analysis of CO oxidation.

Example 3: Analysis of CO Oxidation Behavior

Efficient CO oxidation was promoted by highly dispersed metallic Pt, as evidenced by the disappearance of CO adsorbed on metallic Pt over time, in contrast to the persistent adsorption observed on oxidized Pt (Fig. 3).

https://doi.org/10.1007/s10853-023-08655-5

Example 4: Analysis of Toluene Oxidation Behavior

Electrochemical impedance measurements were conducted, and the electrochemical activity at the interface was evaluated from the resulting Nyquist plots. A smaller diameter of the semicircle reflects a higher electrode reaction activity. The significant decrease in diameter upon exposure to toluene indicates electrochemical oxidation of toluene at the interface (Fig. 4). https://doi.org/10.1016/j.snb.2024.136217 (Open Access)

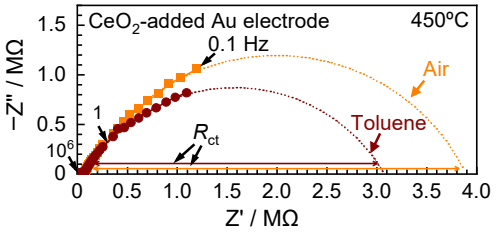


Fig. 4. Electrochemical analysis of toluene oxidation.

2. Keywords

Gas sensors, Functional ceramics, Solid electrolyte, Volatile organic compounds

3. Remarks and Websites

The development of gas sensors capable of analyzing exhaled breath and skin-emitted gases opens up new possibilities for early detection of diseases such as diabetes and cancer. It also enables efficient screening of patients with infectious diseases, such as malaria, in tropical regions. This technology is expected to greatly contribute to solving medical and health problems in the world.

researchmap: https://researchmap.jp/taroueda
Laboratory: http://www.cms.nagasaki-u.ac.jp/lab/zaika/zak.htm

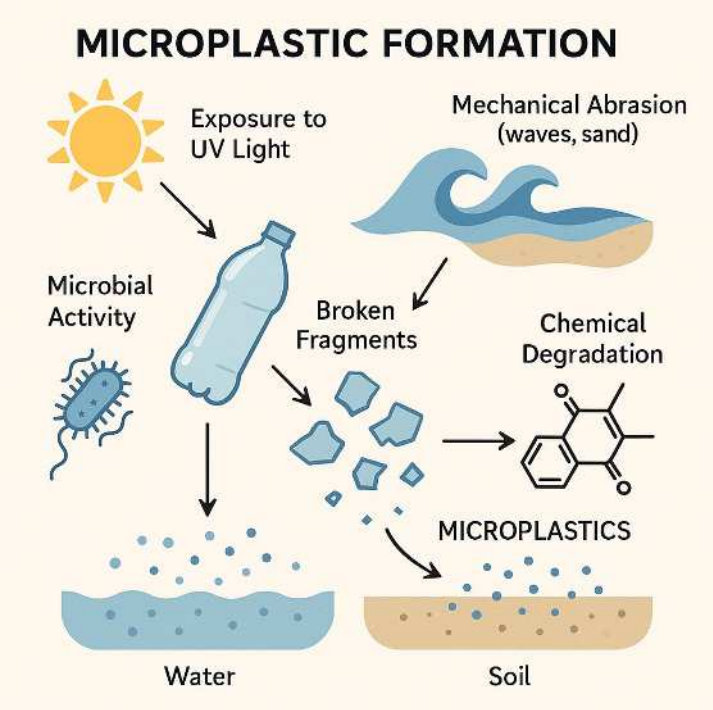
Name	Job Title	Area of Expertise
NAKATANI Hisayuki	Professor	Polymer Engineering

1. Main Research Topics

① **Elucidation of the mechanism of microplastic generation**
- Research on how polymer materials become microplastics in the environment from the perspectives of photodegradation and biodegradation.
- Evaluate the effects of UVA (ultraviolet rays) and microbial degradation.

② **Development of microplastic collection and recycling technologies**
- Explore the possibility of biological treatment of plastics through selective decomposition experiments using mealworms (insects).
- Evaluate the decomposition behavior of composite materials such as GFRP (glass fiber reinforced plastic).

③ **Design and certification evaluation technology for environmentally friendly polymer materials**
- Creation of polymers with photodegradability and biodegradability.
- Control of degradation behavior in the environment through functionalization.



Mealworms feeding on polystyrene foam!



2. Keywords

Microplastics, biodegradation, mealworms, recycling

3. Remarks and Websites

Innovative decomposition evaluation utilizing biological organisms, development of light decomposition and recycling technologies for difficult-to-decompose materials such as GFRP, and evaluation of behavior in actual environments.

researchmap: https://researchmap.jp/read0111962
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/kobunshi/

Name	Job Title	Area of Expertise
DAO THI NGOC ANH	Associate Professor	Chemistry and Materials Science

1. Main Research Topics

This laboratory uses a special biodegradable biopolymer, silk protein, to develop nanomedicines. Silkworm silk has a long history in the fabric industry and recently received great attention for biomedical applications. Silk protein was found to possess very potential characteristics for biomedical research, for example, stimulating cell proliferation, high biocompatibility, biodegradability and anti-inflammatory. We can produce many types of silk materials for pharmaceutical use, including nanoparticles, films, fibers, and hydrogels.

① **Creation of silk nanoparticles as a versatile drug carrier**

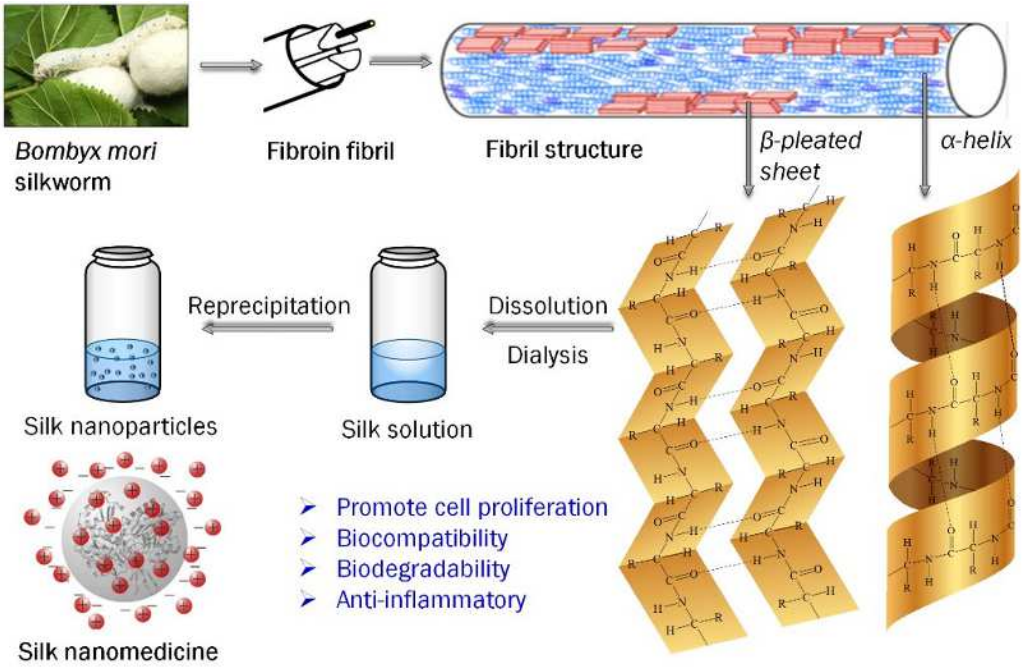
In this study, we aim to develop methods to fabricate silk nanoparticles with tunable surface charges and secondary structures for a wider range of drug applications with drug control release.

② **Multi-functionalized silk nanomedicine**

With the complexity of cancer and its treatments, it is essential for expanding the functionalities of silk nanoparticles to improve pharmaceutical effectiveness, including active targeting, imaging, and controlled drug release. In this research, we modify silk protein and its materials with various agents to enhance their functionalities in drug delivery.

③ **Silk hydrogel and film for localized cancer therapy**

Chemotherapy is a routine clinical practice for treating high-grade malignant glioma, but local chemotherapy for delivering therapeutic payloads effectively and sustainably is still in pre-clinical development. Silk hydrogel and film has been demonstrated to be well-tolerated *in vivo* with minimal inflammation or host immune response when implanted directly into tissues.



2. Keywords

nanomaterials, polymer chemistry, drug delivery, biosensors, cancer therapy

3. Remarks and Websites

We are conducting research using funding from competitive and collaborative research funds, such as the Japan Society for the Promotion of Science's Grant-in-Aid for Scientific Research B (until FY2029 and the JGC-Saneyoshi Scholarship Foundation's Research Grant (until FY2025).

Research is a great way to contribute to society, while you can have fun discovering the secrets of the universe. We conduct various interesting studies using biopolymers and we welcome your participants.

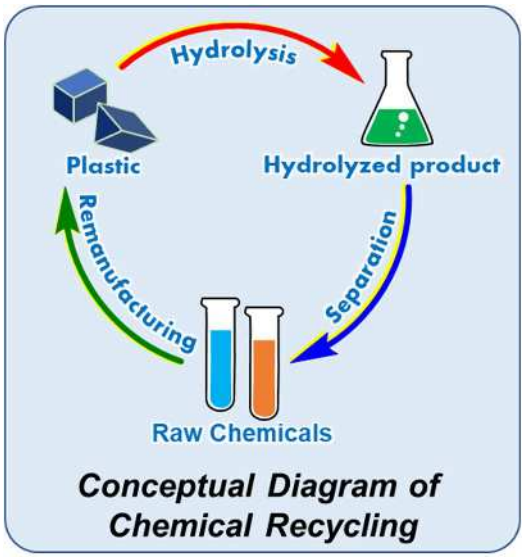
researchmap: https://researchmap.jp/anhdao
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/kobunshi/

Name	Job Title	Area of Expertise
MOTOKUCHO Suguru	Assistant Professor	Polymer Chemistry, Environmental Materials Science

1. Main Research Topics

Chemical Recycling of Polyurethane

Currently, chemical recycling of polyurethane (PU) products remains a major challenge. Conventional degradation methods often suffer from uncontrollable side reactions, making it difficult to recover the original raw materials in high yield. As a result, practical implementation of closed-loop or horizontal recycling—where recycled materials are used to produce products of the same quality—has not yet been realized.



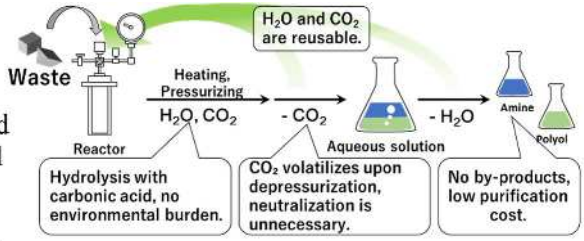
Conceptual Diagram of Chemical Recycling

In this study, we have developed a novel depolymerization process that uses carbonic acid, generated from water and carbon dioxide, as a catalyst. This method enables the quantitative recovery of reusable amines and polyols from model polyurethane without forming any unwanted byproducts.

Key features of our process include:

- Use of carbonated water as the catalyst—extremely low environmental impact
- Carbon dioxide naturally evaporates after the reaction, eliminating the need for a neutralization step
- The reaction proceeds under mild conditions, close to room temperature and atmospheric pressure

We have further applied this technique to commercial polyurethane foam (PUF) products with practical formulations. Using the recovered amines and polyols, we successfully regenerated PUF, thereby achieving complete horizontal recycling of polyurethane materials.



This research not only contributes to sustainable materials circulation, but also provides a highly practical technological platform for companies aiming to develop environmentally friendly products and reduce production costs.

2. Keywords

Chemical Recycling, Polyurethane, Carbon Dioxide, Building a Sustainable Society

3. Remarks and Websites

Patents

WO2025017988A1 Method for polyurethane foam

Topic

https://www.pu-forum.com/en/lecturers/#session2

researchmap : https://researchmap.jp/motokucho
Laboratory : https://www.cms.nagasaki-u.ac.jp/intro/organization.htm

Name	Job Title	Area of Expertise
KAMADA Kai	Associate Professor	Inorganic Materials

1. Main Research Topics

Current research focuses on the functionalities of low-dimensional ceramics (nanodots, nanowires, nanosheets), with particular emphasis on the synthesis and synergistic functions of inorganic–bio hybrid materials. In particular, we aim to create novel composite materials by chemically or physically combining ceramic nanoparticles (as inorganic components) with functional proteins such as enzymes (as biomolecular components).

Our goal is to develop materials that integrate the mechanical robustness of ceramics with the precise functionalities of biomolecules, and to construct innovative reaction systems that utilize energy transfer (light or heat) between inorganic materials and biomolecules within the composites. Additionally, we are developing new antibacterial and antiviral coating materials that leverage the bactericidal effects derived from the anisotropic shapes of two-dimensional sheet-like ceramics.

① **Photo-assisted activity control of enzyme bound to layered semiconductor**
A method has been developed to control the catalytic activity of enzymes bound to layered semiconductors by irradiating the semiconductor with light energy and transferring that energy to the enzyme. This is proposed as a novel approach to enzyme activity regulation.

② **Photocatalytic reaction of semiconductor using light energy emitted by photoenzyme or photoprotein**
By binding semiconductors to luminescent enzymes or proteins, I am developing a new photocatalytic system that does not require external light sources, using the light energy emitted by these biomolecules to excite the semiconductor.

③ **Antibacterial or antivirus coating materials based on layered ceramics**
Two-dimensional sheet-like layered ceramics possess rigid and extremely sharp fragments. I am developing liquid-based materials that form antibacterial or antiviral films by leveraging the physical impact of these fragments on microbes and viruses.

2. Keywords

Low dimensional nanostructured ceramics, inorganic-bio hybrids, antibacterial/antivirus coating

3. Remarks and Websites

researchmap： https://researchmap.jp/7000002048
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/nanokaimen/

Name	Job Title	Area of Expertise
NAKAGOE Osamu	Assistant Professor	Surface Chemistry, Catalytic Chemistry

1. Main Research Topics

① **Preparation of Cu nanoparticle loaded TiO_2 photocatalyst and improving photocatalytic activity for water splitting**

Photocatalytic hydrogen formation from water splitting reaction is the one of the most attractive topics for sustainable energy supply because of zero carbon emission process. However, the hydrogen formation has not been applied in industrial process due to its slow rate of the photocatalytic water splitting reaction. Especially, TiO_2, which is one of the most popular photocatalyst is inefficient and impractical for commercial application to photocatalytic hydrogen formation without modification of cocatalyst such as noble metal, although it is abundant, cost effective, and clean for environment on account of lacking of ionic leaching with self-oxidation. Noble metal, such as Pt, Au, and Rh, loading to TiO_2 can improve photocatalytic performance. Instead of Pt, Cu is good candidate for cocatalyst of TiO_2 because it has a pretty low cost compared to Pt, less than 1/3000 and about half of photocatalytic performance. Moreover, tuning size, oxidation state, and shape of Cu nanoparticle on TiO_2 improve photocatalytic performance owing to adjustment of its electronic properties, such as energy level, work function etc.

In this study, size tunable Cu nanoparticles were prepared by thermal reduction process of Cu precursor with amino-2-propanol (AmIP) as surfactant. The ratio between AmIP and Cu^{2+} determined size of nanoparticle. Cu loaded TiO_2 catalysts (Cu/TiO_2) were obtained with impregnation method. As the result of photocatalytic water splitting reaction, as prepared catalysts had 1/3 the rate of hydrogen formation of Pt. It is expected that optimization of size and loading amount of Cu lead to enhance the rate of hydrogen formation.

② **Synthesis of CaO fine particle and application in Biodiesel fuel catalyst**

Biodiesel fuel (BDF), a substance defined as fatty acid methyl ester, is already required in the EU as a 10% or greater component of fuel for public transportation. BDF is produced by transesterification of fats and oils with methanol, using a homogeneous sodium methoxide as a catalyst. While sodium methoxide is highly active, there are disadvantages for washing BDF with water, including the removal of alkaline wastewater and the production of soap as a side reaction. In contrast, the use of solid base catalysts omits the water washing process. However, calcium oxide, a commonly used solid base, has a large particle size and low specific surface area, resulting in a significantly low reaction rate than homogeneous solution catalysts. Therefore, we synthesized 50-nm calcium oxide particles, approximately one-twentieth the size of those produced by conventional alkaline precipitation methods, in a polyacrylic acid solution. In this synthesis, a calcium carbonate precursor was formed within a random coil of size-controlled polyacrylic acid, and nanoparticles were then obtained by thermal decomposition in vacuum. So far, polyacrylic acid used as a template has been removed by oxidation in air, but by using accelerated oxidation removal using a combination of ozone and hydrogen peroxide, we aim to suppress particle growth and further improve performance.

2. Keywords

Heterogeneous catalysis, nanoparticle, nanocomposite, photocatalyst, solid state acid base catalyst

3. Remarks and Websites

I can prepare metallic and oxide nanoparticle, nanocomposite, and porous material it for heterogeneous catalyst and adsorbent since my research subject is surface chemistry and catalytic chemistry. Actually, I have collaborated photocatalytic application in water treatment with a private company.

researchmap:

Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/nanokaimen/

Name	Job Title	Area of Expertise
SANO Hideaki	Research associate	Inorganic Materials

1. Main Research Topic

① Synthesis of alloys and composites from glycol derivative metal compounds

A glycol-derived metal compound has been developed as a complementary or alternative material to conventional metal alkoxides, enabling the facile synthesis not only of pure metals and ceramics, but also of alloys and composite materials.

Generally, metal alkoxides exist as solids or liquids at room temperature and become gaseous upon thermal decomposition, which makes it difficult to control the composition and morphology of the resulting metals or ceramics. In contrast, this glycol-derived metal compound remains solid even at high temperatures during thermal decomposition, allowing for easier shape control. By adjusting the decomposition atmosphere, it is possible to selectively produce metals, carbides, nitrides, or oxides. For example, YAG:Ce^{3+} phosphor ceramics, which typically require high-temperature sintering around 1600°C, can be prepared at a relatively low temperature of 1300°C (see Fig. 1).

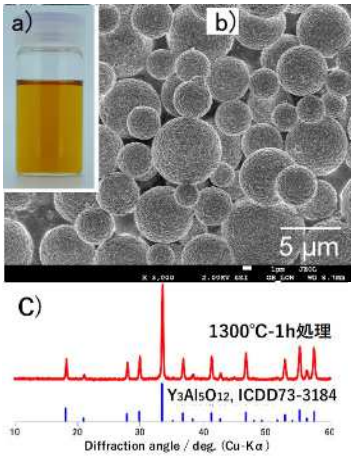


Fig.1 Prepared metal-containing glycol-derived solution (a), YAG:Ce^{3+} phosphor ceramics fabricated using porous spherical PMMA particles heat-treated at 1300℃ for 1h (b) and X-ray diffraction profile of the ceramics (c).

② Research of the efficient reaction process by interface control

We are working on efficient reaction processes to produce desired oxide and non-oxide ceramics using low temperatures and short firing times, with minimal energy. To achieve this, we are developing methods that use nitrogen-containing monomers to help reduce and nitride the materials. We are also exploring ways to improve reactions by using templates with large surface areas, which allow more effective contact between materials. This technology is being applied to areas such as dental materials and carbon materials made from biomass.

1) S. J. Shi, V. Sivasankar, K. Omine, J. Li, H. Sano and M. Ahmed. 2025. “Immobilization of Microorganisms Using Carbon Carriers – Promoting the Reduction of Cr (VI) in the Cement Leachate.” *Sustainable Materials and Technologies* **45**(March): e01478. doi:10.1016/j.susmat.2025.e01478.
2) P. Z. W. M. Moh, O. Nakagoe, N. N. Hlaing, Y. Tabuchi, K.Kamada, H. Sano, and S. Tanabe. 2024. “Role of Mn in the Ni-Mn/SBA-15 Catalyst for Hydrogen Production by Biomass Steam Reforming at Relatively Low Temperature.” *Journal of Physical Chemistry C* **128** (18): 7518–28. doi:10.1021/acs.jpcc.4c00613.
3) H. Sano, K. Omine, M. Prabhakaran, A. Darchen and V. Sivasankar, “Groundwater fluoride removal using modified mesoporous dung carbon and the impact of hydrogen-carbonate in borehole samples”. *Ecotoxicology and Environmental Safety*, **165**, 232–242 (2018). doi.org/10.1016/j.ecoenv.2018.09.001

2. Keywords

Glycol derivatives, metals / alloys, carbides, nitrides, oxides, composites, shape control

3. Remarks and Website

We actively engage in collaborative research not only with other departments and courses within the Faculty of Engineering, but also with private companies. Our main research focus is on the development of materials related to metals and ceramics, both in nano and bulk forms. Thanks to access to many shared research instruments at Nagasaki University (https://nushare.ura.nagasaki-u.ac.jp/index.php), we also conduct joint research projects that focus solely on material evaluation.

Looking ahead, we plan to build a more efficient framework for materials development using materials informatics and artificial intelligence (AI). Beyond the traditional boundaries of our laboratory, we support external research needs by utilizing the inter-university equipment network (https://chem-eqnet.ims.ac.jp/). Our current projects include the development of equipment and control/analysis software for catalytic reactions related to CO_2 fixation, as well as fatigue testing systems for dental implants.

researchmap：https://researchmap.jp/quasers/

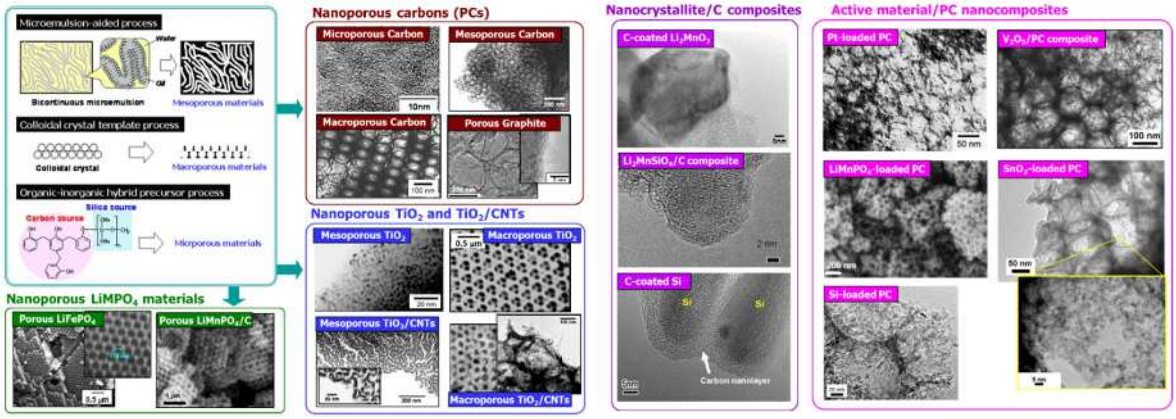
Name	Job Title	Area of Expertise
MORIGUCHI Isamu	Professor	Inorganic Materials Chemistry, Electrochemistry, Colloid & Interface Chemistry

1. Main Research Topics

Development of innovative materials and technologies that contribute to environmental conservation and efficient use of energy through the elucidation of science related to nano-interfaces and nano-spaces. The overview is shown below.

① Creation of novel functions via nano-interface and nano-space control

Synthesis of various nanoparticles, nanoporous materials and nanocomposites of carbons and metal oxides by soft chemical processes to investigate new functions such as adsorption&catalysis, charge-discharge functions and CO_2-reduction.



② Development of innovative energy storage devices

Aming for high-performance storage devices which are applicable to electric power grid-connection system, electric vehicles, energy regeneration, instantaneous power outage (low) backup, power assistance, and power tools, etc.

Development of advanced electrode materials for high performance Li- or Na-ion batteries, safe and stable all-solid-state batteries, electric double-layer capacitors, Li-ion capacitors, and other hybrid capacitors.

Recent major publications

Nat. Energy, **10**, 847 (2025); *J. Phys. Chem. C* **, 129**, 11905 (2025); *J. Mater. Chem. A*, **13**, 13962 (2025); *Carbon*, **235**, 120088 (2025); *Chem. Lett*., **53**, upae208 (2024); *Nat. Commun*., **15**, AN1708 (2024); *ACS Appl. Mater. Interfaces*, **15**, 30600 (2023); *Chem. Eng. J*., **429**, 132424 (2022); *Sci. China Tech. Sci*, **65**, 1 (2022); *ACS Appl. Energy Mater.*, **4**, 13841 (2021); *Nano Select*, **2**, 2121 (2021); *ACS Appl. Mater. Interfaces*, **12**, 43042 (2020); *J. Coll. Interface Sci.*, **552**, 412 (2019); *Sci. Rep*., **8**, AN8747 (2018); *Nanoscale*, **9**, 15643 (2017); *J. Phys. Chem. C*, **120**, 25717 (2016); *Nat. Commun*., **6**, AN6544 (2015); *Chem. Commun*., **50**, 7143(2014); *ACS Nano*, **8**, 3614(2014)

2. Keywords

Carbon neutrality, Nanotechnology, Soft chemical process, Energy storage devices, Li-ion battery, Na-ion battery, All-solid-state battery, Electric double-layer capacitor, Li-ion capacitor, Adsorption and separation, CO_2

3. Remarks and Websites

Research topics available for joint research

Development of CO_2 and other gas adsorption and separation materials, Analysis of structure and interface of nanomaterials, Development of Li-ion and Na-ion batteries as well as all-solid-state battery electrode materials, Development of EDLC and Li-ion capacitor electrode materials, etc.

researchmap： https://researchmap.jp/I.Moriguchi
Laboratory： https://www.cms.nagasaki-u.ac.jp/lab/bukka/A/top.html

Name	Job Title	Area of Expertise
YAMADA Hirotoshi	Associate Professor	Solid State Electrochemistry

1. Main Research Topics

Development of all-solid-state batteries (ASSBs)

To practically realize all-solid-state batteries (ASSBs), which are the candidates of next-generation batteries, our group focuses on materials, processes, and designs of ASSBs. We have developed technologies to fabricate bulk-type ASSBs using oxide-based solid electrolytes and demonstrated that the ASSBs can be operated at room temperature. We further study the multiscale phenomena in the range from atoms/ions to whole ASSBs, in order to improve the battery performances like power density and cycle-ability, etc.

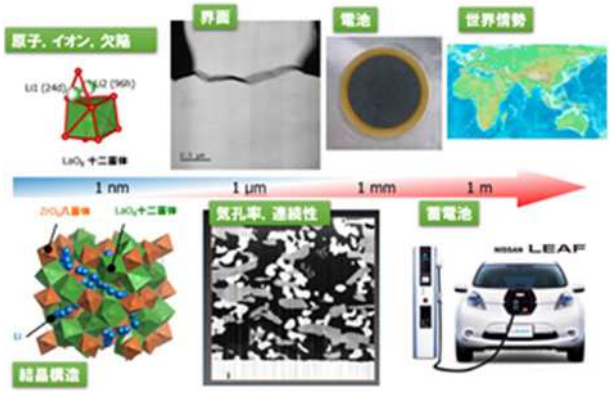


Figure Phenomena and their scales on the development of ASSBs.

1. Preparation of electrochemically active interface between active materials and solid electrolytes.

We develop methods to fabricate interfaces between active materials and solid electrolytes, which consists of different elements in each phase. Such interfaces must be densely packed without element interdiffusion. We carry out fundamental studies on the phenomena at the interfaces, which leads designs ideal electrode architectures and processes. The materials, architecture, and processes are simultaneously optimized.

Ad ditionally, we also focuses on mechanical properties of ASSBs, because the ASSBs contain internal stresses and strain caused by the fabrication and battery operation. Such strain induces fracture of interfaces in the ASSBs, which causes deterioration of battery capacity. We investigate the strain and the fracture of interfaces buried inside the ASSBs and improve cycle- ability of ASSBs.

2. Development of all-solid-state lithium metal batteries.

Lithium metal is known as ultimate anode because of its low electrode potential and large capacity. However, it is very difficult to reversibly charge/discharge lithium metal anode. We investigate causes of the difficulty and develop lithium metal anodes with high capacity, high power and high cycle-ability.

3. Study of influence of local structure of solid electrolytes on their ionic conduction.

Highly conductive solid electrolytes are necessary to fabricate practical ASSBs. We investigate influence of the local structure of solid electrolyte crystals on their ionic conduction and develop new solid electrolytes.

2. Keywords

All-solid-state batteries, solid electrolytes, interface

3. Remarks and Websites

We carry out whole studies on oxide-based ASSBs from the viewpoint of materials, processes, and architectures. The fields of the studies are widely spread in the multi-discipline sciences not only on solid state chemistry and electrochemistry but also analytical chemistry and material mechanics.

researchmap: https://researchmap.jp/0000-0003-0733-6992
Group website: https://www.cms.nagasaki-u.ac.jp/lab/bukka/B/

Name	Job Title	Area of Expertise
URITA Koki	Associate Professor	Surface Chemistry, Nanomaterial Science

1. Main Research Topics

① **Research on Rare Resource Recovery Using Electrochemical Methods**

To build a sustainable society, securing energy resources and achieving carbon neutrality are global challenges. Many countries are beginning to shift toward environmentally conscious policies, making the stable supply of rare resources increasingly important. In this context, we have initiated research on the recovery of rare resources (such as Li) from waste Li-ion batteries (LIBs) and production scraps using electrochemical methods. These methods are derived from capacitive deionization (CDI) technology, which has long been used in seawater desalination processes. Our current goal is to achieve a Li-ion separation efficiency of 90%.

② **Material Design for Air Separation and CO_2 Capture**

Improving energy efficiency in combustion furnaces can be achieved through the use of oxygen-enriched air. Carbon molecular sieves (CMS) are materials capable of separating oxygen and nitrogen from air. However, if the barrier layer at the pore entrance of CMS is excessively thick, the permeation rate of oxygen molecules decreases, leading to reduced air separation performance. To address this, we are exploring air separation by forming ultra-thin barrier layers through electrochemical oxidation of activated carbon, which introduces oxygen-containing functional groups near the pore entrances.

Achievement: Enhanced O_2 selectivity of carbon molecular sieves by electrochemical oxidation for air separation, Carbon, 235, 120088 (2025) [Open Access].

③ **Local Structural Analysis of Materials for Energy Storage Devices**

Porous carbon materials, due to their electrical conductivity, nanoscale porosity, and high specific surface area, are widely used as electrode materials in rechargeable batteries and electric double-layer capacitors (EDLCs). In systems involving chemical reactions between electrolyte ions and electrodes—such as LIBs—active materials like SnO_2 and sulfur, which promise high capacity, undergo significant volume changes upon reaction with Li ions. By controlling the reaction space within the nanoscale pores of carbon electrodes, cycle stability can be improved. To answer the question, “What types of nanopores are effective for reactions between active materials and electrolyte ions?”, we observe electrode materials (e.g., sulfur-loaded carbon nanotubes, S@CNT) during discharge using transmission electron microscopy (TEM), identifying pore sizes that facilitate charge-discharge reactions.

Additionally, for EDLCs, we have identified optimal pore sizes and shapes by quantitatively evaluating pore structures via gas adsorption methods and characterizing pore morphology using TEM.

2. Keywords

Porous carbon, Air separation, Resource recovery, Electron microscopy, Adsorption

3. Remarks and Websites

- **K. Urita**, C. Urita, H. Tanaka, F. Vallejos-Burgos, H. Notohara, T. Araki, K. Horio, H. Furukawa, M. Yoshida, I. Moriguchi, "Tuning carbon black surface morphology via controlled thermal treatment atmosphere" App. Surf. Sci., 710(30), 163907 (2025).
- S. Wang, F. Vallejos-Burogs, A. Furuse, H. Otsuka, M. Nagae, Y. Kawamata, T. Ohba, H. Kanoh, **K. Urita**, H. Notohara, I. Moriguchi, H. Tanaka, J. P. Marco-Lozar, J. Silvestre-Albero, T. Hayashi, K. Kaneko, "Ambient pressure storage of high-density methane in nanoporous carbon coated with graphene" Nat. Energy, 10, 847-856 (2025).
- **K. Urita**, T. Ishida, K. Marubayashi, H. Tanaka, M. Hamasaki, Y. Yamane, J. Miyawaki, H. Notohara, I. Moriguchi, "Enhanced O2 selectivity of carbon molecular sieves by electrochemical oxidation for air separation" Carbon, 235, 120088 (2025).

researchmap: https://researchmap.jp/read0150871
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/bukka/A/top_e.html

Name	Job Title	Area of Expertise
Notohara Hiroo	Assistant professor	Electrochemistry, Nanostructural Analysis

1. Main Research Topics

Elucidation of charge-discharge mechanisms in carbon nanospaces.

With the expanding range of applications for energy storage devices, there is an increasing demand for higher performance secondary batteries. In lithium-ion secondary batteries, it is particularly important to develop electrode materials that can stably operate with high-capacity active materials such as Sn and SnO_2. It is known that when electrode active materials are supported within carbon nanospaces, they exhibit charge-discharge characteristics different from those in the bulk state and achieve high charge-discharge reversibility. However, the detailed mechanisms underlying these phenomena are not yet fully understood.

Our research group has been synthesizing composites in which electrode active materials are loaded within carbon nanospaces. In addition to conventional structural analyses such as XRD and SEM, we have been investigating the structure and charge-discharge mechanisms of these materials at the nanoscale by combining techniques such as gas adsorption isotherm measurements, scanning transmission electron microscopy (STEM), and electron energy loss spectroscopy (EELS).

In our recent studies, we elucidated the structural changes that occur during charge-discharge processes within nanospaces by STEM. We demonstrated that when SnO_2 nanoparticles are supported in the inner space of single-walled carbon nanotubes, the structural changes during charge-discharge differ from those of a bulk SnO_2 particle (see figure).

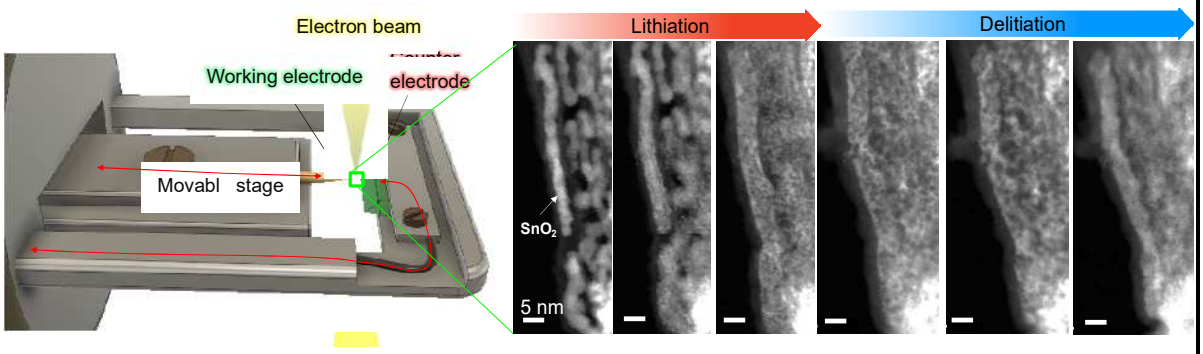


Fig. a) Schematic images of battery setup on TEM holder for in-situ STEM observation, b) Snapshots of STEM images of SnO2 embedded single-walled carbon nanotubes during initial lithiation and delithiation process.

2. Keywords

All-solid-state battery, Nanoporous carbon, nanoparticle/porous carbon composite, in-situ STEM

3. Remarks and Websites

My research interest lies in elucidating unique phenomena originating from nanostructures, not limited to battery materials. I hope to uncover the underlying mechanisms and apply these findings to broader technological developments.

researchmap: https://researchmap.jp/notohara?lang=ja
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/bukka/A/top.html

Name	Job Title	Area of Expertise
TSUGAWA Tatsuki	Assistant Professor	Inorganic Materials Chemistry

1. Main Research Topics

2D materials possess a high aspect ratio relative to their molecular-scale thickness and exhibit unique properties distinct from those of conventional bulk materials. These characteristics enable structural control and functional design at the nanoscale, and are expected to be applied in a wide range of applications, including next-generation electronic devices, electrodes, and sensors. In this study, we focus on the development of graphene oxide (GO) –based materials and promote research ranging from fundamental studies to applications in the environmental and energy fields.

① Functionalization of Graphene Oxide via Control of Oxygen Functional Groups

GO is obtained by oxidizing graphite powder followed by exfoliation into single layers (Fig. 1). This material contains various oxygen functional groups, such as hydroxy, epoxy, carbonyl, and carboxy groups, which impart diverse properties. In this study, we aim to develop high-performance functional materials by controlling the composition of oxygen functional groups introduced during the oxidation process, thereby optimizing the material properties according to specific applications.

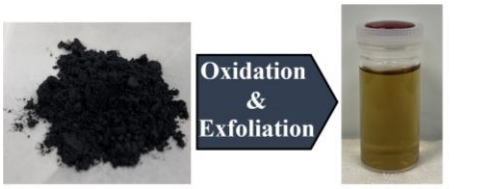


Fig. 1 Flowchart for the synthesis of GO

② Development of Multifunctional Membranes Using 2D Materials

2D materials, including GO, exhibit excellent dispersibility in solvents and enable the formation of uniform, large-area film formation via solution processes such as spin coating and vacuum filtration. Furthermore, by controlling defect density, interlayer spacing, interfaces, and the degree of oxidation/reduction, it is possible to impart a variety of functionalities, including selective permeability for molecules and ions, superior barrier property, proton conductivity, and electrical conductivity.

In this study, we design and laminated membranes based on these 2D materials, aiming not only to achieve high selectivity in ion and gas separation membranes, but also to develop anticorrosion coating films, transparent conductive films that combine optical transparency and electrical conductivity, and solid electrolyte membranes for high-performance fuel cells (Fig. 2). Through these efforts, we aim to contribute to the development of high-performance devices in the environmental and energy fields.

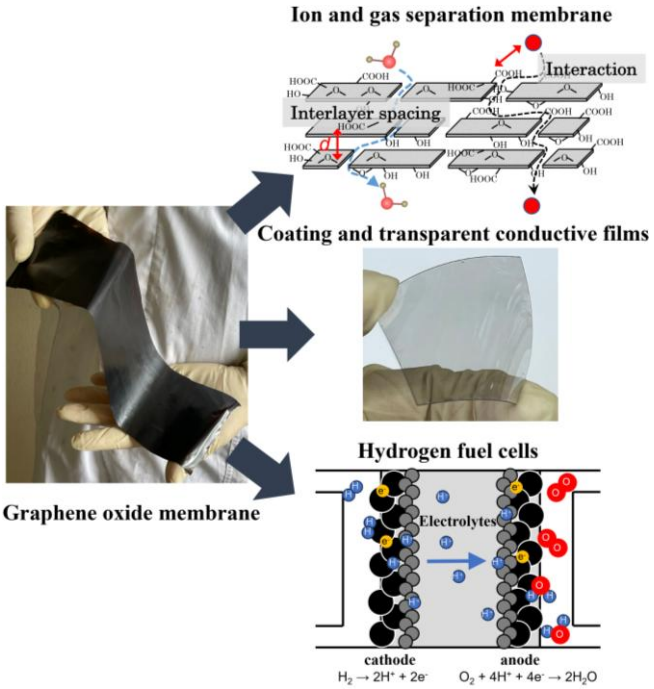


Fig. 2 Applications of GO membranes

2. Keywords

Graphene oxide, 2D materials, Proton conductivity, Barrier membrane, Separation membrane, Transparent conductive film, Hydrogen fuel cells

3. Remarks and Websites

We focus on the functionalization of graphene oxide through nanostructure control, integrating material synthesis, structural characterization, property evaluation, and device applications. We aim to advance sustainable carbon materials science and promote practical implementation in the environmental and energy sectors through industry collaboration.

researchmap: https://researchmap.jp/21039357-TSUGAWA
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/zaika/zak.htm

Name	Job Title	Area of Expertise
SAKUDA Eri	Professor	Photochemistry

1. Main Research Topics

① Synthesis and Photophysical Properties of photofunctional compounds using main group elements

This study focuses on the creation of luminescent compounds by skillfully utilizing the characteristic excited-states of typical elements. For example, when organic compounds bridged by boron atoms are crystallized in various solvents, different crystal forms are obtained. By investigating the correlation between crystal systems/structures and luminescence, we were able to clarify the relationship between the boron environment and its luminescent properties (Figure 1).

Furthermore, the creation of luminescent complexes with substituent sites on the typical elements that exhibit different emission colors based on the surrounding environment was also investigated, along with their luminescent characteristics (Figure 2). Such luminescent compounds can be utilized in devices such as organic light-emitting diodes (OLEDs). Moreover, because their emission color is highly sensitive to environmental changes, these compounds hold promise for use as environmental-responsive sensors.

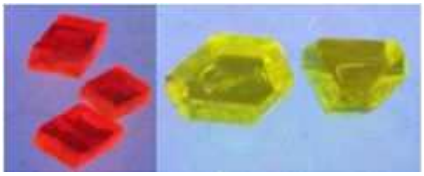


Figure 1: Examples of compounds whose emission color changes depending on the crystal system.

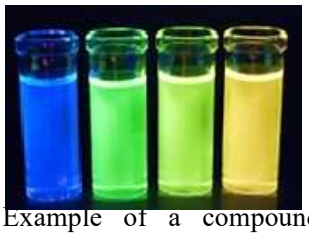


Figure 2. Example of a compound showing emission color change depending on solvent polarity

② Construction of energy conversion systems by utilizing the main group elements

In this study, we are also attempting to convert carbon dioxide into a valuable carbon resource by utilizing the excitation energy of compounds containing main-group elements and metal complexes. Most of the CO_2 photoreduction catalysts reported so far rely on rare metals, which pose challenges in terms of cost and resource scarcity. Therefore, the development of a CO_2 photoreduction system that utilizes main-group elements instead of expensive metals could contribute to the construction of a new artificial photosynthetic system that does not depend on rare metals.

2. Keywords

Photochemistry, Main group element, Metal complex, Energy conversion

3. Remarks and Websites

researchmap： https://researchmap.jp/sakueri
Laboratory： https://www.cms.nagasaki-u.ac.jp/lab/sakutai/
Dynamic Exciton:Emerging Science and Innovation： https://dynamic-exciton.jp/

In Research Project 1, the luminescent materials are expected to be applicable to displays and organic electroluminescent (EL) devices. In addition, their use as environmentally responsive sensors and in vivo probes is also envisioned. Meanwhile, Research Project 2 holds promise for applications in artificial photosynthesis systems and the development of systems that convert carbon dioxide into valuable carbon resources.

Name	Job Title	Area of Expertise
ARIKAWA Yasuhiro	Professor	Coordination Chemistry

1. Main Research Topics

Compounds in which a metal ion is coordinated by organic or inorganic molecules, called ligands, are known as metal complexes. Using such metal complexes can convert stable small molecules such as hydrogen, nitrogen, oxygen, and carbon dioxide into valuable compounds or extract energy from them. In our laboratory, we particularly focus on the reduction of nitrogen and sulfur oxides, as well as their oxo-anions, to achieve detoxification and transformation into useful compounds. We also work on the conversion of carbon dioxide into valuable chemicals using visible light.

① **Development of multi-electron reduction reactions of small molecules**

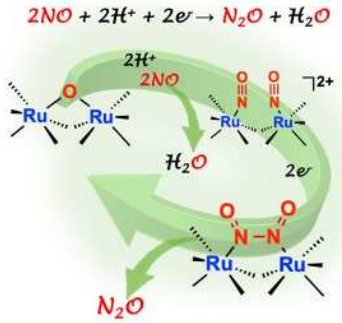


Fig. 1 NO Reduction Cycle

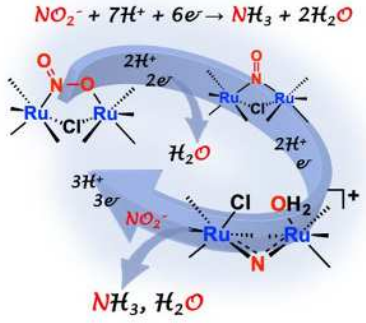


Fig 2 NO_2^- Reduction Cycle

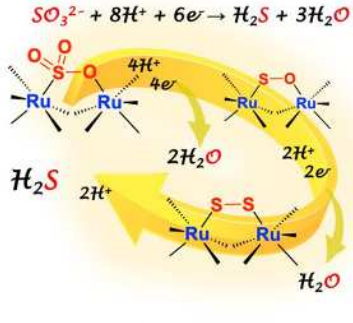


Fig. 3 SO_3^{2-} Reduction Cycle

In our laboratory, we use a dinuclear ruthenium complex, in which two ruthenium metal ions are bridged by pyrazolate ligand, to achieve three distinct reduction cycles:

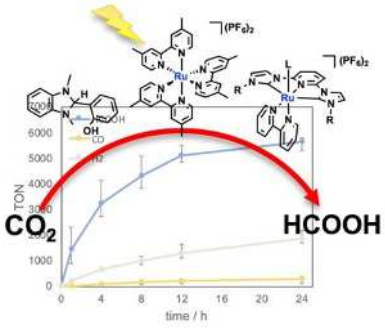
i) Conversion of two molecules of nitric oxide (NO) into nitrous oxide (N_2O) through 2 electron and 2 proton reduction (Figure 1) ($2\ NO + 2\ H^+ + 2\ e^- \rightarrow N_2O + H_2O$). Nitric oxide (NO) is readily oxidized in air to form toxic nitrogen dioxide (NO_2), but by reducing NO to nitrous oxide (N_2O), it can be detoxified.

ii) Conversion of nitrite ions (NO_2^-) to ammonia (NH_3) via a 6electron and 7 proton reduction (Figure 2) ($NO_2^- + 7\ H^+ + 6\ e^- \rightarrow NH_3 + 2\ H_2O$). This transformation is relevant to mitigating nutrient enrichment (eutrophication) in soils and water systems.

iii) Conversion of sulfite ions (SO_3^{2-}) to hydrogen sulfide (H_2S) via a 6 electron and 8 proton reduction (Figure 3) ($SO_3^{2-} + 8\ H^+ + 6\ e^- \rightarrow H_2S + 3\ H_2O$). This reaction is closely related to the global sulfur cycle.

② **Conversion of CO_2 into valuable chemicals using visible light**

Approximately half of the sunlight that reaches the Earth's surface is visible light. Therefore, if we can utilize the energy of visible light to convert CO_2 into valuable compounds, it could contribute significantly to building a sustainable society. In our research, we have successfully converted CO_2 primarily into formic acid (HCOOH) by employing complex catalysts.



2. Keywords

metal complex, nitrogen oxides, sulfur oxides, oxoanions, carbon dioxide, reduction reaction, artificial photosynthesis

3. Remarks and Websites

On Earth, there exists a natural process known as the nitrogen cycle. In this cycle, abundant nitrogen molecules in the atmosphere undergo various transformations through oxidation and reduction reactions. Among these processes, the reduction of nitrate ions to molecular nitrogen is particularly important and is referred to as denitrification. Our research focuses on this denitrification process. Specifically, we investigate the reduction of nitrogen oxides (such as NO and N_2O), sulfur oxides (such as SO), and their corresponding oxoanions (NO_3^-, NO_2^-, SO_3^{2-}) using metal complexes. In addition, we also study the visible-light-driven conversion of CO_2.

researchmap: https://researchmap.jp/arikaway

Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/sakutai/

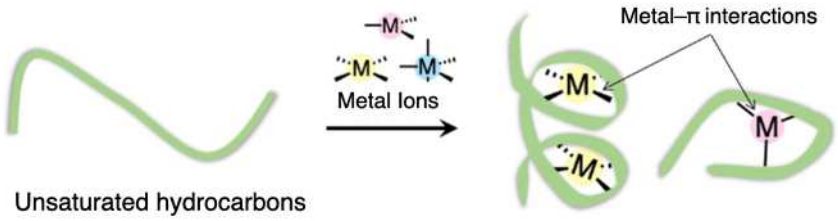
Name	Job Title	Area of Expertise
OMOTO Kenichiro	Assistant professor	Coordination Chemistry Supramolecular Chemistry

1. Main Research Topics

My research focuses on the construction of supramolecular metal complexes—metal complexes with unique higher-order structures such as helices, rings, and sheets—by utilizing coordination bonds formed around metal ions to fix and assemble organic molecules. In particular, I aim to develop novel types of supramolecular metal complexes based on flexible coordination bonds that have not been widely exploited, such as metal–metal bonds and metal–π interactions. Furthermore, by integrating molecular design concepts from soft materials such as biological membranes and liquid crystals, I aim to create stimuli-responsive materials that combine both rigidity and flexibility.

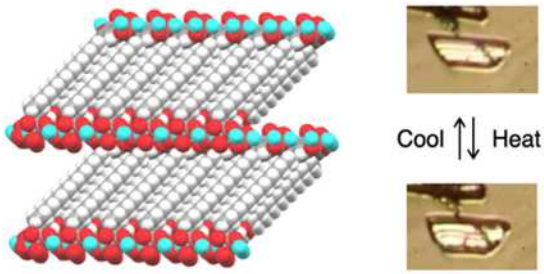
① **Metal-mediated folding of unsaturated hydrocarbons**

Several metal ions, such as Ag(I), are known to form coordination bonds (metal–π interactions) with C=C bonds of unsaturated hydrocarbons. In this study, I aim to develop methods for controlling and fixing the 3D structures of linear hydrocarbons bearing multiple C=C units through complexation with metal ions via metal–π interactions. The resulting complexes are expected to exhibit metal-dependent stereochemical structures and corresponding reactivities.



② **Development of Stimuli-Responsive Coordination Polymers via Incorporation of Soft Molecular Assemblies**

I am exploring the design of stimuli-responsive crystalline materials by incorporating soft molecular assemblies—such as those found in lipid bilayers and liquid crystal compounds—into the crystalline structures of coordination polymers. In particular, by embedding long alkyl chains into coordination polymers, I aim to induce thermal phase transitions within the crystal lattice, thereby enabling the control of small molecule adsorption/desorption and molecular transport in response to external stimuli.



2. Keywords

Supramolecular chemistry/Host–guest chemistry/Coordination chemistry/Coordinationpolymers

3. Remarks and Websites

researchmap：https://researchmap.jp/omoto_kenichiro
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/sakutai/
Project：KAKENHI, Grant-in-Aid for Scientific Research (C), JP23K04768

In Research Project 1, I aim to pioneer new possibilities in the development of novel reactions and photofunctional materials based on linear unsaturated hydrocarbons and metal clusters. Research Project 2 explores potential applications such as gas adsorption materials by utilizing the crystalline structures of metal complexes.

Name	Job Title	Area of Expertise
MURAKAMI Hiroto	Professor	Polymer Chemistry, Supramolecule

1. Main Research Topics

① Development of Functional Polyurethane Elastomer (Fig. 1)

We focus on establishing a synthesis method for a novel polyurethane closslinked by polyrotaxane and investigating their various properties such as thermal, viscoelastic, and mechanical properties. The crosslinking points in polyurethane significantly influence its elastomeric properties. Meanwhile, the polyrotaxane has a topological structure where multiple ring molecules are mechanically interlocked by a linear polymer axis. These ring molecules can freely translate and rotate along the axis polymer. We expect that the unique characteristic of polyrotaxane plays important roles to create polyurethanes with excellent vibration isolation, self-healing, and cushioning properties.

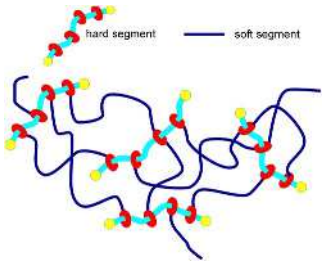


Figure 1. Cartoon of polyurethane closslinked by polyrotaxane.

② Development of Easily Peelable Pressure Sensitive Adhesive (Fig. 2)

In the technical development of adhesives, achieving both high adhesiveness and easy peelability is a crucial challenge. Furthermore, recyclability is also important from an environmental conservation perspective. Therefore, we are developing adhesives that are easily peelable using heat as a trigger and are reusable.

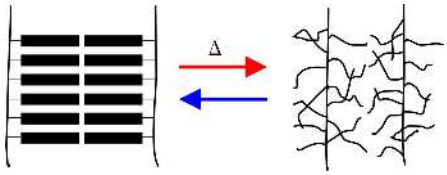


Figure 2. Mechanism of Easily peelable using heat as a trigger.

③ Development of Electrochromic Devices with Nonvolatile Solvents (Fig. 3)

To suppress damage to electrochromic (EC) devices, which can be caused by solvent evaporation, degradation of EC materials and counter electrode compensation materials, or physical cracks, we utilize viologen (V)-type ionic liquids as EC materials and ferrocene (Fc)-type ionic liquids as counter electrode compensation materials. We expect that liquefying these materials will not only resolve these issues but also allow for a higher concentration of EC substances, leading to the possibility of thinner EC devices and faster response times.



Figure 3. An electrochromic device constructed by a mixture of ferroceneion and viologen ionic liquids.

2. Keywords

Polyurethane, Pressure Sensituve Adhesive, Photochromic, Ionic Liqiud

3. Remarks and Websites

researchmap: https://researchmap.jp/hmrm090310051105
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/douteki/jp/index.html
Research ①: We have successfully developed highly extensible polyurethane elastomers. Our goal is to continue developing diverse functional polyurethane elastomers, not limited to polyrotaxane-based materials.
Research ②: In collaboration with industry partners, we're developing easily peelable acrylic and silicone adhesives.
Research ③: We have achieved multi-color electrochromism and are exploring applications for display devices like electronic paper.

For more information, please feel free to get in touch.

Name	Job Title	Area of Expertise
TAHARA Hironobu	Associate Professor	Electrochemistry, Functional Physical Chemistry

1. Main Research Topics

① Development of Redox-Active Ionic Liquids and Functional Deep-Eutectic Solvents

Ionic liquids are salts composed of cations and anions that remain liquid at room temperature. Because they are scarcely volatile even under high-temperature or low-pressure conditions, they can be used as electrolytes without concern for evaporation. Leveraging their excellent ionic conductivity, we are developing new functional ionic liquids.

Our first focus is the creation of redox-active ionic liquids capable of reversible electron transfer. Some of these compounds exhibit electrochromism, changing color in response to their redox state. The display device shown in Fig. 1(a) employs a redox-active ionic liquid and can be colored or bleached with the voltage of a single alkaline battery.

Our second focus is the development of deep-eutectic solvents that liquefy host materials. By liquefying host molecules at high concentrations, we aim to incorporate poorly soluble guest molecules in equally high concentrations. A deep-eutectic solvent is a liquid obtained by mixing two or more high-melting-point substances, resulting in a pronounced depression of the melting point. Taking advantage of this behavior, we liquefy the host material itself, as illustrated in Fig. 1(b), to create a universal solvent capable of dissolving otherwise insoluble compounds.

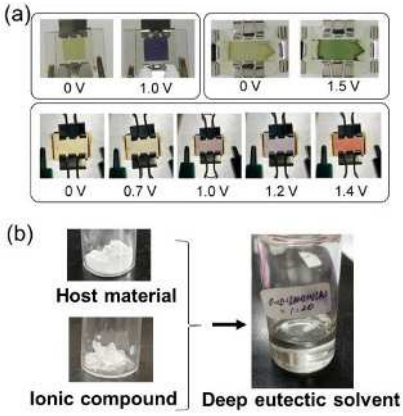


Fig. 1 (a) Coloration of electrochromic devices based on Redox-Active Ionic Liquids. (b)Deep eutectic solvent based on host material.

② Optical Responses of Metal and Semiconductor Nanoparticles

Metal and semiconductor nanoparticles ranging from a few to several hundred nanometers exhibit unique optical absorption and scattering phenomena known as Mie resonance and localized surface plasmon resonance (LSPR). Downsizing bulk metals, which ordinarily show only metallic luster, or semiconductors with low absorption coefficients, transforms them into materials with strong light absorption. Such nanoparticles can be applied in energy-conversion materials for photo-thermal, photo-electric, and thermo-electric technologies. We are pursuing the theoretical design of light-energy conversion and sensing materials based on nanoparticle technology.

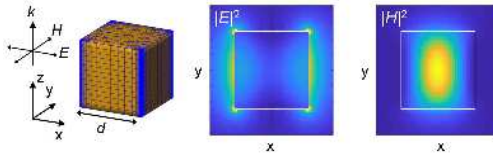


Fig. 2 Electric field distributions around a PbS nanocube.

2. Keywords

ionic liquid, electrochromism, deep eutectic solvent, surface plasmon resonance, Mie resonance, instrumental analysis

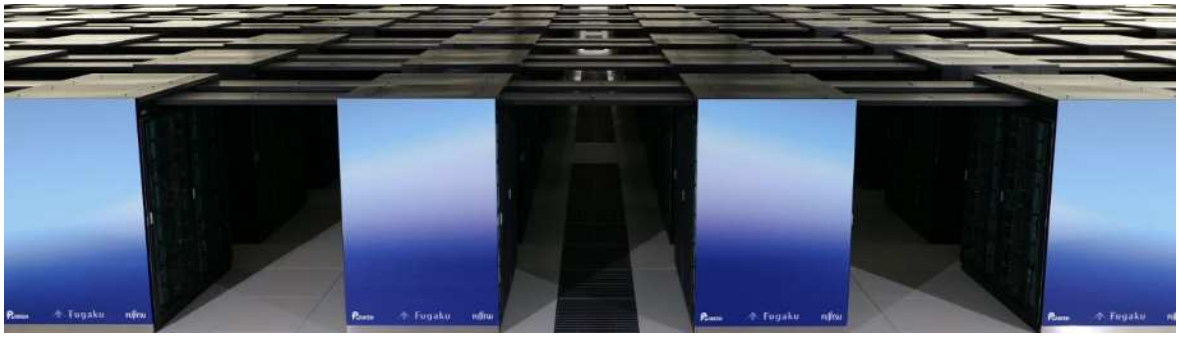
3. Remarks and Websites

E-mail: h-tahara@nagasaki-u.ac.jp
researchmap : https://researchmap.jp/ht_
Laboratory: http://www.cms.nagasaki-u.ac.jp/lab/softmater/en/index.html

We possess expertise in designing ionic liquids, synthesizing them with high purity, and engineering materials that exploit the optical resonances of noble metals and semiconductors. These efforts are underpinned by advanced analytical instrumentation and data-analysis techniques. For external users interested in the university's spectroscopic equipment, we offer technical consultation on both measurement and data analysis. If our research or capabilities align with your needs, please feel free to contact us. Offprints of our journal articles are also available upon request.

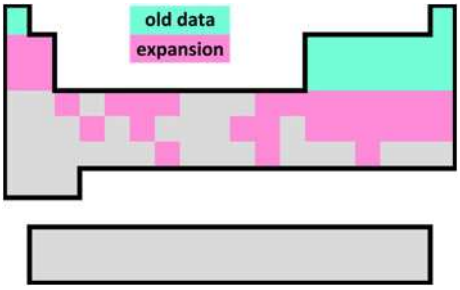
Name	Job Title	Area of Expertise
CHAN Bun	Associate Professor	Quantum Mechanics, Computational Chemistry, Chemical Data Science

1. Main Research Topic



Our research involves the use of high-performance computers for quantum chemistry. We develop new methods to accelerate the simulations, to model a wide range of chemical and materials systems. Such modellings are often conducted in collaboration with experimentalists, providing knowledge at the electronic level to develop new technologies. Below you will find a few examples of our work.

(1) High-precision quantum chemistry methods are traditionally applicable only to a limited range of chemicals, covering a small portion of the periodic table. We have developed a series of quantum chemistry methods to expand the scope of high-precision prediction, to provide reliable data for machine learning in chemistry.



- Chan, B. Accurate Thermochemistry for Main-Group Elements up to Xenon with the W*n*-P34 Series of Composite Methods. *J. Chem. Theory Comput.* **2021**, *17*, 5704.
- Chan, B. Compilation of Ionic Clusters with the Rock Salt Structure: Accurate Benchmark Thermochemical Data, Assessment of Quantum Chemistry Methods, and the Convergence Behavior of Lattice Energies. *J. Phys. Chem. A* **2023**, *127*, 5652.

(2) In a collaboration with several international research teams, we apply quantum chemistry to clarify structural features that leads to luminesce in a new type of glass materials.

- Hou, J.; Chen, P.; Shukla, A.; Krajnc, A.; Wang, T.; Li, X.; Doasa, R.; Tizei, L. H. G.; Chan, B.; Johnstone, D. N. et al. Liquid-Phase Sintering of Lead Halide Perovskites and Metal-Organic Framework Glasses. *Science* **2021**, *374*, 621.

2. Keywords

Quantum chemistry
Chemical physics
Molecular biology
Materials science
Chemical data science

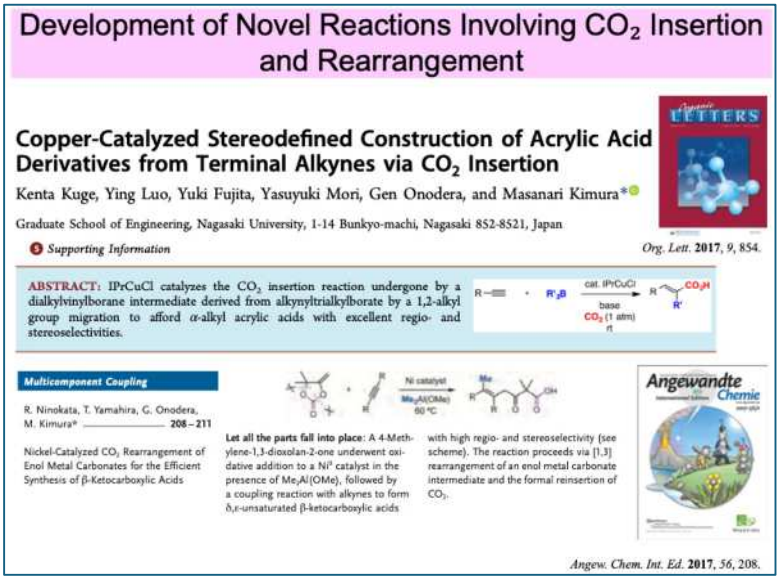
3. Remarks and Website

researchmap: https://researchmap.jp/el_buno
Laboratory: https://sites.google.com/view/bunchan
Google scholar: https://scholar.google.com/citations?user=URuEgEoAAAAJ&hl=en

Name	Job Title	Area of Expertise
KIMURA Masanari	Professor	Organic Chemistry, Synthetic Chemistry

1. Main Research Topics

We are pioneering new synthetic chemistry based on organic chemistry, and developing highly efficient synthetic methods for pharmaceuticals and bioactive compounds such as anticancer agents, antibiotics, and antiviral drugs. In addition, we aim to achieve technological innovation from a molecular chemistry perspective to address the urgent global issue of energy. Our research challenges include the development of reactions that utilize carbon dioxide as a carbon resource, the construction of carbon recycling systems for producing petroleum alternatives and fuels, and molecular transformation technologies related to hydrogen generation and utilization.



① Development of Novel Organic Synthetic Reactions

Our research focuses on the development of highly efficient synthetic methodologies utilizing metal catalysis. Key areas include cross-coupling reactions, novel transformations based on C–H activation of alkanes, multicomponent assembly reactions, and environmentally friendly reactions that proceed in water.

② Development of Pharmaceuticals and Bioactive Compounds

Functional and valuable compounds, including anti-dementia drugs**,** anticancer agents, non-steroidal anti-inflammatory drugs (NSAIDs), boron-containing compounds**,** agrochemicals, and functional luminescent materials, are synthesized using original reactions developed in our laboratory.

③ Design and Synthesis of Energy-Related Materials

Our research focuses on carbon fixation using carbon dioxide as a carbon resource, the synthesis of biomass-derived plastics, and catalytic reactions for hydrogen generation and utilization.

2. Keywords

Organic Synthesis, Catalytic Reactions, Carbon Dioxide, Organoboron Compounds, Pharmaceuticals and Drug, Hydrogen Generation & Storage

3. Remarks and Websites

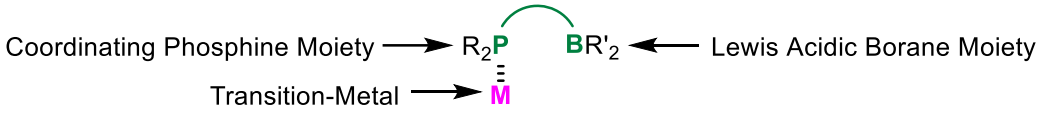
We are focusing on green chemistry related to carbon neutrality and carbon recycling technologies. For example, we are involved in the development of resources utilizing small molecules, such as carbon dioxide and carbon monoxide. We are also developing catalytic reactions for the generation of hydrogen molecules. In addition, we are advancing technologies in synthetic and catalytic chemistry to support the synthesis of pharmaceuticals, as well as the creation of bioactive compounds, including functional materials containing boron atoms and agrochemicals. We have a proven track record of collaborative research with chemical and materials manufacturers, pharmaceutical companies, and petroleum and energy-related industries.

researchmap： https://researchmap.jp/read0185029/
Laboratory: http://www.cms.nagasaki-u.ac.jp/lab/yuuki/

Name	Job Title	Area of Expertise
ONODERA Gen	Associate Professor	Organometallic Chemistry, Organic Synthesis

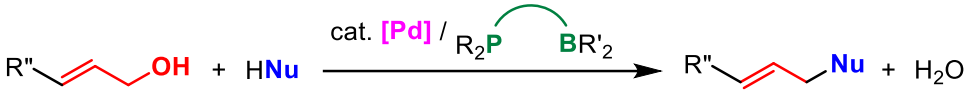
1. Main Research Topics

One of our research topics is the development of a novel organic synthesis method using a transition-metal catalyst bearing a Lewis acidic moiety. We designed and synthesized phosphine compounds bearing a Lewis acidic borane moiety. We have attempted to develop highly active transition-metal catalysts in which Lewis acid and transition-metal moieties can work in concert.



① Carbon–Oxygen Bond Activation of Allylic and Benzylic Alcohols

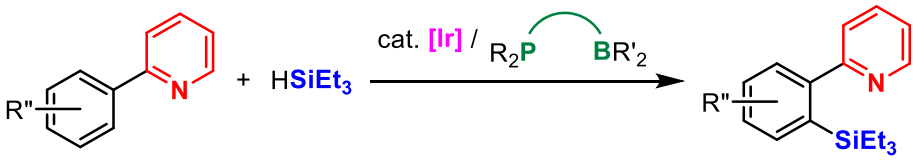
The substitution reactions of allylic and benzylic alcohols with nucleophiles (HNu) proceeded smoothly via carbon–oxygen bond cleavage using a palladium catalyst bearing a borane moiety.



References: *Org. Lett.* **2017**, *19*, 6148; *Adv. Synth. Catal.* **2018**, *360*, 1954; *Tetrahedron Lett.* **2020**, *61*, 152537.

② Aromatic Carbon–Hydrogen Bond Activation

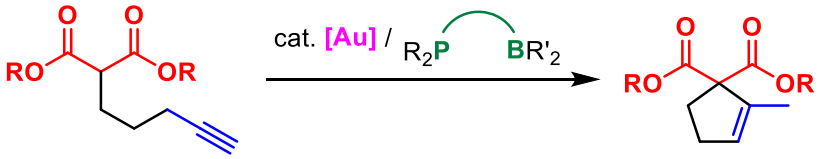
We reported that the aromatic carbon–hydrogen bond was cleaved, and hydrogen was substituted by a silyl group using an iridium catalyst bearing a borane moiety.



Reference: *Adv. Synth. Catal.* **2022**, *364*, 1223.

③ Dual Activation of Malonate Moiety and Alkyne Moiety

The novel cycloisomerization of a malonate derivative proceeded using a gold complex bearing a borane moiety.



Reference: *Adv. Synth. Catal.* doi.org/10.1002/adsc.70064.

2. Keywords

Transition-metal catalyst, Lewis acid, Organometallic chemistry, Organic synthesis

3. Remarks and Websites

Other research topics include the development of a novel molecular probe (in collaboration with the school of medicine) and novel organic synthesis using an external electric field.

researchmap: https://researchmap.jp/genonodera
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/yuuki/index.html

Name	Job Title	Area of Expertise
UNNO Hideaki	Associate professor	Structural Biology; Biochemistry

1. Main Research Topics

1) Structural analysis for proteins.

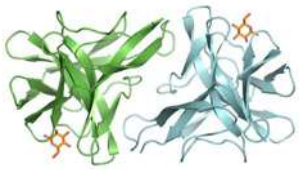
Our research targets enzyme proteins and carbohydrate-binding proteins (lectins). Using X-ray crystallography and cryo-electron microscopy, we elucidate their three-dimensional structures in detail. Through structural analysis, we further clarify the chemical reaction mechanisms catalyzed by proteins and the structural basis of protein function. Examples of proteins analyzed so far are shown below.。



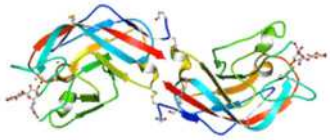
Membrane pore-forming complex structure of the hemolytic lectin CEL-III from Cucumaria echinata (a sea cucumber).
CEL-III is a protein that functions as a toxin against other organisms. Through crystallographic analysis, we revealed how CEL-III perforates cell membranes and destroys cells.

2) Discovery of novel lectins and their applications.

Focusing primarily on marine invertebrates, we search for new lectins from these organisms. For each lectin discovered, we carry out detailed characterization—including structural analysis—to uncover its unique properties. We also work toward practical applications such as drug discovery by identifying useful activities, e.g., antiviral activity, exhibited by lectins. Examples of novel lectins discovered so far are shown below.



Lectin CGL1 from a bivalve (Pacific oyster)



Lectin AJLec from a sea anemone.

2. Keywords

Structural biology; biochemistry; enzymes; lectins; antiviral activity.

3. Remarks and Websites

Ongoing projects: protein structural analysis; discovery of novel lectins and its functional analyses.

researchmap: https://researchmap.jp/read0127731
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/seitai/

Selected Publications

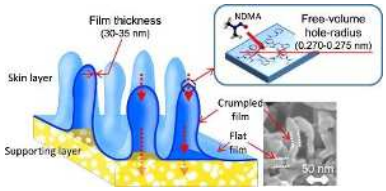
H. Unno, et al., *J. Biol. Chem.* **289**(18), 12805–12812 (2014).
S. Urata, et al., *Antiviral Res.*, **240**, 16189 (2025).

Name	Job Title	Area of Expertise
FUJIOKA Takahiro	Professor	Environmental Engineering

1. Main Research Topics

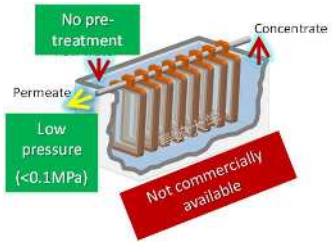
① **Development of high-rejection reverse osmosis membranes**

We are developing high-rejection reverse osmosis membranes that remove chemicals that are difficult to separate, which is an issue in the United States and other countries where sewage is purified and reused for drinking. Specifically, we remove *N-nitrosodimethylamine* (NDMA), a disinfection by-product.



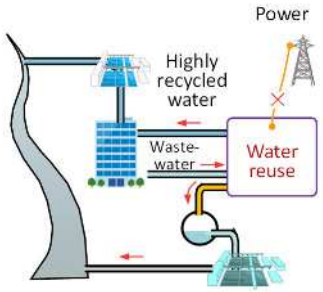
② **Development of advanced water purification technology directly from polluted river water**

In countries without well-developed sewage systems, such as Southeast Asia, the deterioration of water quality in tap water sources is a problem, and we are developing technology to perform advanced purification of these polluted water sources at low initial investment and operating costs. Specifically, we are developing nanofiltration membranes with pore sizes of a few nanometers and related technologies, and by omitting pretreatment, we aim to achieve an introduction cost that is 80% lower than conventional advanced water purification treatment.



③ **Development of net-zero energy advanced water reclamation technology**

We aim to significantly reduce water reclamation costs by introducing submerged nanofiltration membranes that do not require pretreatment when reclaiming sewage. In addition, energy is generated by subjecting the concentrated liquid generated during treatment to anaerobic treatment (methane fermentation treatment). By combining these energy-saving and energy-creating technologies, we aim to establish water reclamation technology that reduces overall power consumption to zero.



④ **Development of automatic algae measurement technology**

We are developing technology to automatically measure the concentration of algae (cyanobacteria and diatoms) present in surface water by species.



2. Keywords

Water treatment, Online water quality monitoring, Membrane separation

3. Remarks and Websites

researchmap: https://researchmap.jp/taka_fujioka
Laboratory: http://www.waterenviron.com/
SATREPS project: https://www.nusatreps.com

In this laboratory, we are conducting research to optimize the removal of trace organic compounds and pathogenic microorganisms using reverse osmosis and nanofiltration membranes as well as the other advanced water treatment technologies (ozone, activated carbon, ion exchange resins, ultraviolet-based advanced oxidation).

Name	Job Title	Area of Expertise
CHANG Ying Shi	Assistant Professor	Chemical Engineering

1. Main Research Topics

① Nutrient recovery and water purification from aquaculture wastewater

Recovering ammonia (NH_3) and phosphate (PO_4^{3-}) nutrients from aquaculture wastewater is a sustainable method for waste valorization. Conventional biological treatments are inefficient, often removing rather than recovering NH_3 while generating substantial PO_4^{3-}-rich sludge, consuming significant time, energy, and space. This research aims to intensify a sustainable vacuum membrane distillation (VMD) system to transform aquaculture wastewater into valuable resources and purified water (**Fig. 1**). Our goal is to achieve high-value nutrient recovery by concentrating PO_4^{3-} up to 10-folds and simultaneously recovering >90% of NH_3 in highly concentrated forms, suitable for agricultural N-P fertilizer production, and purified water production for reuse within the aquaculture system or for drinking or irrigation purposes. The effect of operating parameters such as feed temperature, pH, and phosphoric acid concentration as an NH_3-absorbing medium will be evaluated and optimized for NH_3 recovery. Further, feed temperature and crossflow velocity will be optimized to maximize PO_4^{3-} concentration and purified water yield. In addition, the fouling mechanism of VMD membrane towards complex aquaculture wastewater matrix, and the necessity of wastewater pretreatment will be elucidated. Overall, the research outcomes are expected to enhance circular aquaculture economy by transforming waste into valuable products, directly contributing to both environmental sustainability and improved water security.

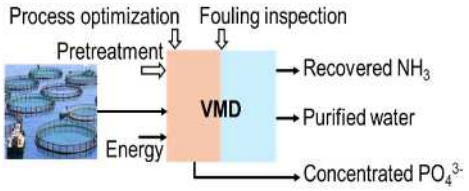


Fig 1. Overview of the research and targeted products

② Perfluoroalkyl substance remediation

Pre-concentrating perfluoroalkyl substances (PFAS) from contaminated water is a crucial step for their effective downstream destruction. Previous research by the applicant demonstrated that direct-contact membrane distillation (DCMD) using a commercial polyvinylidene fluoride (PVDF) membrane can pre-concentrate PFAS, however, surfactant-like PFAS fouled and diffused through the membrane, contaminated the permeate. This proposal aims to develop a novel amphiphobic PVDF surface-modified with silanized nanoparticles, designed to repel both surfactant and water (**Fig. 2**). Enhanced PFAS pre-concentration and water recovery will be achieved using optimal nanoparticle concentration and process conditions. The viability of the modified membrane performance will be assessed using real PFAS-contaminated groundwater. The research outcomes are expected to advance PFAS remediation, promote zero waste discharge, and enhance water security.

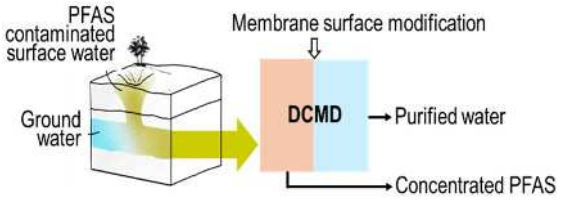


Fig. 2 PFAS-contaminated groundwater remediation through DCMD

2. Keywords

Membrane separation, water and wastewater treatment, resource recovery, desalination, process engineering, membrane development

3. Remarks and Websites

Future prospects and social implementation

My research aims to revolutionize wastewater management by transforming pollutant streams into valuable resources. We develop scalable membrane technologies for broad commercial deployment, directly applicable to diverse wastewater matrices. These solutions empower operations of all scales, from small to large industrial facilities, to minimize effluent discharge, optimize resource recovery, achieve regulatory compliance, and fully embrace circular economy principles.

On-going research funding:

(1) KAKENHI Research Start up Support Project (FY2024–2025)
(2) KAKENHI Young Scientist Research Project (FY2025–2027)

researchmap: https://researchmap.jp/ChangYingShi

Laboratory: Water Treatment Laboratory https://www.waterenviron.com/home

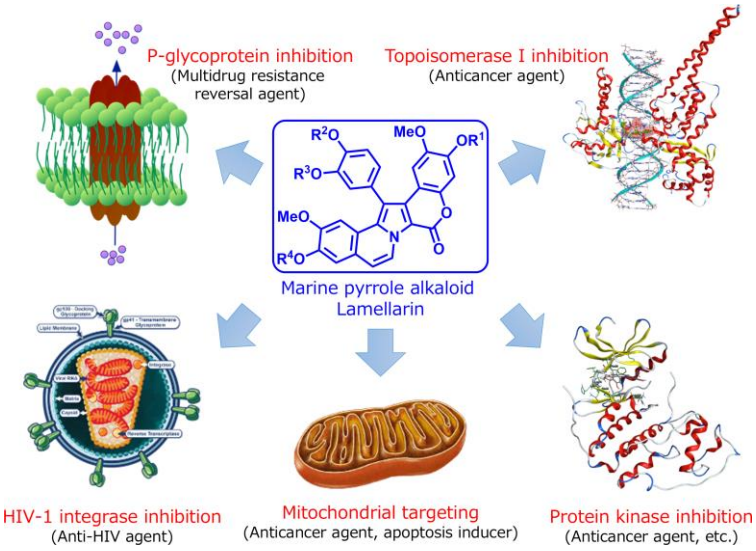
Name	Job Title	Area of Expertise
FUKUDA Tsutomu	Associate professor	Synthetic Organic Chemistry

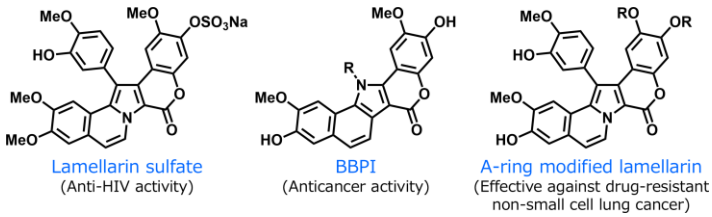
1. Main Research Topics

① Development of bioactive compounds based on marine natural products

Marine natural products contain a wide variety of bioactive compounds that are highly valuable for drug discovery. Our research focuses on the marine natural product "lamellarin," aiming to develop novel pharmacologically active compounds by leveraging its unique structure and biological activities.

Lamellarin was first isolated in 1985 by Faulkner and co-workers from a marine mollusk, *Lamellaria* sp. To date, over 70 related compounds have been reported. These compounds exhibit diverse biological activities, including topoisomerase I inhibition, protein kinase inhibition, and anti-HIV activity, making them promising candidates for pharmaceutical research.





We have developed several derivatives, including lamellarin sulfate with anti-HIV activity, BBPI with anticancer activity based on topoisomerase I inhibition, and A-ring modified lamellarin effective against drug-resistant EGFR C797S mutant non-small cell lung cancer.

Selected publications: *Biosci. Biotechnol. Biochem.*, **87**, 148 (2023); *Viruses*, **14**, 816 (2022); *Cancer Sci.*, **112**, 1963 (2021); *Bioorg. Med. Chem.*, **34**, 116039 (2021); *Biosci. Biotechnol. Biochem.*, **85**, 181 (2021); *Bioorg. Med. Chem.*, **27**, 265 (2019)

② Development of synthetic methods for drug discovery

To realize the above research, efficient synthetic methods are essential. Lamellarin features a polycyclic heterocyclic structure containing a pyrrole ring. We are developing a modular synthesis method that enables the introduction of functional modules into the pyrrole ring, serving as a foundational technology for drug discovery.

Selected publications: *Heterocycles*, **103**, 862 (2021); *Heterocycles*, **99**, 1032 (2019); *Heterocycles*, **98**, 916 (2018)

2. Keywords

Lamellarin, Heterocyclic compounds, Antitumor active compounds

3. Remarks and Websites

Lamellarin derivatives are expected to be applied as antitumor agents. We are currently conducting collaborative research with other institutions to explore their potential applications in cancer therapy. The synthetic methods we have developed are applicable to a wide range of heterocyclic compounds containing pyrrole rings and are expected to contribute to the development of pharmaceuticals and functional materials.

researchmap: https://researchmap.jp/t-fukuda
Laboratory: http://www.cms.nagasaki-u.ac.jp/lab/yuuki/

Division of Environmental Science

Name	Job Title	Area of Expertise
UMAKOSHI Kodo	Professor	Seismology, Volcanology

1. Main Research Topics

① Seismic activity at Unzen Volcano

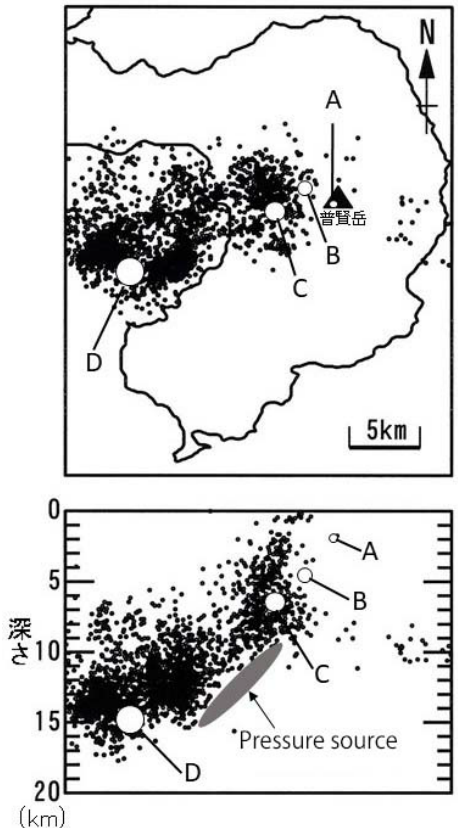
We are conducting a detailed study of seismic and tremor activity mainly related to the 1990-1995 eruption of Unzen volcano. Our results to date include the magmatic system of Unzen Volcano and high-frequency earthquakes near the crater associated with the emergence of the lava dome. We are currently studying low-frequency seismic activity associated with lava dome formation and tremor activity during the period from the beginning of the eruption to the emergence of the lava dome.

② Research on geothermal and hot spring utilization

Japan is the world's third largest geothermal resource producing country. In contrast, the amount of geothermal power generation installed in Japan as of 2018 ranked 10th in the world. In this study, we investigate the temperature and composition of each hot spring in the Unzen and Obama areas to clarify the characteristics of each source and the relationship between sources. We are also preparing background data to verify whether or not there are any changes in the hot springs as the use of geothermal resources expands in the future.



Continuous measurement of hot spring source temperature (Obama Onsen)



Pressure sources estimated from hypocenter distribution (1985-1999) and the pressure source inferred from focal mechanisms; A-D are locations of magma reservoirs obtained from leveling surveys.

2. Keywords

earthquake, volcano, Unzen, geothermal energy, hot spring

3. Remarks and Websites

We are trying to compile a database of characteristic seismic and tremor waveforms generated at Unzen Volcano for use in predicting volcanic activity.

In order to promote the use of geothermal and hot spring resources, we believe it is essential to establish a system that balances the protection and utilization of resources appropriate to the area. In the Unzen and Obama areas, we have been promoting this initiative in cooperation with the local community for more than 15 years.

researchmap: https://researchmap.jp/read0172439

Name	Job Title	Area of Expertise
KAWAMOTO Kazuaki	Professor	Atmospheric Science

1. Main Research Topics

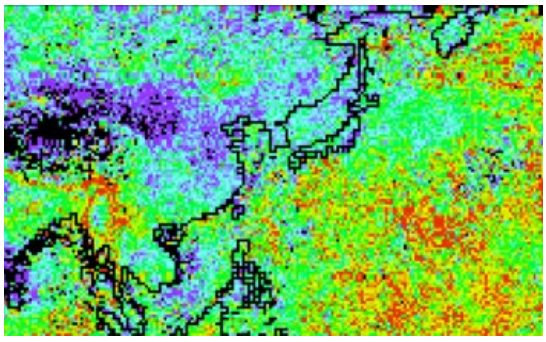
Clouds play two major roles in maintaining and changing the Earth's climate. One is their impact on the radiation process, reflecting solar radiation and absorbing and re-emitting terrestrial radiation. The other is their impact on the water cycle by causing precipitation. I am mainly using data analysis methods to study the following issues regarding clouds.

① Retrieval of cloud properties using satellite data and elucidation of their relationship with aerosols and precipitation

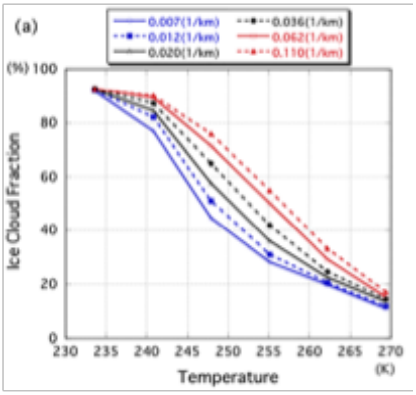
Some aerosols (fine particles suspended in the atmosphere) act as cloud condensation nuclei during cloud formation. In other words, if the aerosol properties (chemical composition and number density) differ, they affect microscopic physical quantities such as cloud particle size and number density, macroscopic physical quantities such as cloud top altitude, cloud base altitude, and cloud amount, and radiation-related physical quantities such as solar reflectivity and optical thickness, and ultimately affect the climate. I investigate the relationships between various particles in the atmosphere by comparing the cloud particle size and cloud optical thickness estimated from passive sensors with aerosol properties and radar reflectivity. The left figure below shows the cloud particle size near East Asia obtained from satellite data, with cool colors indicating small cloud particles and warm colors indicating large cloud particles. In general, we can see that cloud particles are smaller over the land, where there are more aerosols, than over the ocean, where there are fewer aerosols, because the amount of water vapor available per cloud particle is less over the land.

② Quantification of the relationship between aerosol properties and ice-cloud fraction (ICF)

Among aerosols, dust particles such as desert sand are known to act as ice nuclei and play an important role in the formation of ice crystals in clouds. The reflectivity of clouds and their precipitation processes vary depending on whether the cloud particles consist of water droplets or ice crystals. Previous research has shown that the proportion of clouds containing ice crystals (Ice-Cloud Fraction: ICF) depends not only on temperature but also on dust amount, and increases with dust amount. In addition to dust amount, the relationship between other physical quantities such as cloud particle size and ICF is also of interest. In the right figure below, the horizontal axis is temperature, and the vertical axis is ICF. When plotted with different dust amounts (extinction coefficient), a higher ICF is shown for the same temperature with more dust.



Modified from Kawamoto et al. 2001 (*J. Climate*)



Kawamoto et al. 2020 (*Geophys. Res. Lett.*)

2. Keywords

Climate, Clouds, Aerosols, Cloud-Aerosol-Climate Interactions

3. Remarks and Websites

My recent focus is on how aerosol property differences affect cloud microphysics—particularly ice processes—and influence precipitation in terms of amount, efficiency and phase (rain vs. snow).

researchmap: https://researchmap.jp/kazukawamoto

Laboratory:

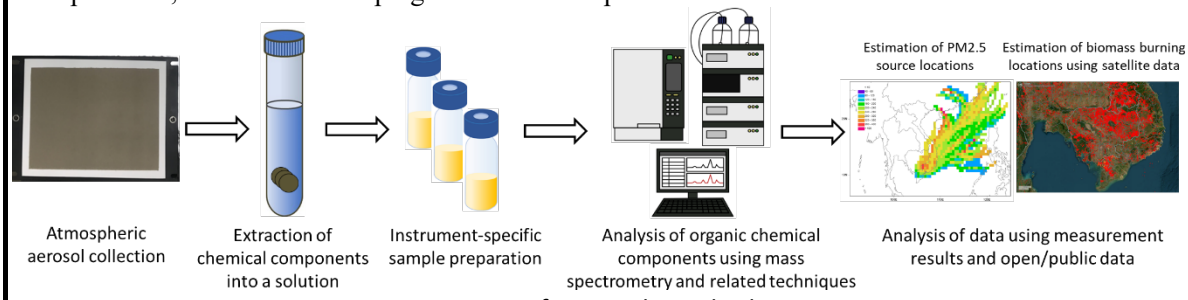
Name	Job Title	Area of Expertise
IKEMORI Fumikazu	Associate Professor	Atmospheric Environmental Science

1. Main Research Topics

We analyze the organic chemical components in atmospheric aerosol particles to clarify "*where*" they are emitted from and "*how*" they are formed. Depending on their size, these particles are sometimes referred to as "$PM_{2.5}$." Our goal is to scientifically elucidate their characteristics and provide insights that contribute to air pollution control through the following research topics.

① Source Identification and Formation Mechanisms of Air Pollutants in Japan and Abroad

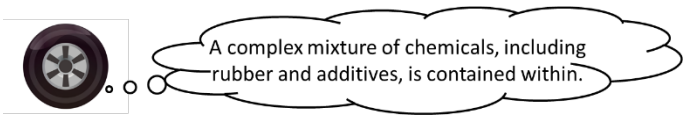
A key feature of our laboratory is source analysis of organic aerosols using specific compounds known as "*organic tracers*," which helps to identify their origins despite typically complex sources and formation processes. These tracers are extracted from aerosol particles collected on filters and analyzed using gas chromatography–mass spectrometry (GC–MS) and liquid chromatography–mass spectrometry (LC–MS) to determine their origin. We are also engaged in advancing both analytical techniques and data interpretation, as well as developing new tracer compounds.



Overview of Research Methods

② Research on Atmospheric Micro- and Nanoplastics

We are investigating microplastics suspended in the atmosphere, as well as even smaller nanoplastics. Among these, we focus particularly on tire wear particles and plastic combustion-derived particles. Our research involves chemical analysis of the organic compounds in these particles and the clarification of their behavior in the atmosphere.



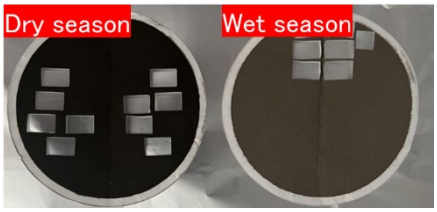
2. Keywords

Air pollution, $PM_{2.5}$, organic marker, environmental analysis, mass spectrometry, microplastics

3. Remarks and Websites

Our laboratory specializes in highly sensitive and selective analysis of organic chemical components in atmospheric aerosol particles, aiming to clarify their sources and formation processes. In particular, our mass spectrometry analysis of organic tracers and source apportionment has been well regarded both in Japan and internationally. Our research extends beyond Japanese cities; we have also clarified the impact of $PM_{2.5}$ emitted from Siberian wildfires and biomass burning in northeastern China on air quality in Japan. More recently, we have been conducting studies in Southeast Asia, mainly Cambodia, to identify the composition of organic components in $PM_{2.5}$ and to investigate the pollution characteristics of atmospheric aerosols scientifically.

Building on these findings, we aim to advance research that supports pollution control and exposure assessment for a sustainable society. The knowledge and skills gained in analytical methods and tracer development are expected to be applied in various areas such as environmental monitoring, product testing, and risk management. Moreover, we aim to contribute internationally by supporting efforts to reduce air pollution, particularly in developing countries.



Atmospheric aerosol particles in Phnom Penh, Cambodia
(The colored areas represent the particles; the white areas represent before collection.)

researchmap: https://researchmap.jp/read0150520
Laboratory: Website under construction (URL will be listed on researchmap)

Name	Job Title	Area of Expertise
NAKAYAMA Tomoki	Associate Professor	Atmospheric Environmental Science, Atmospheric Chemistry, Meteorology

1. Main Research Topics

We are studying on source/sink/transformation and properties of atmospheric gaseous compounds and aerosol particles including $PM_{2.5}$, based on observations in Nagasaki, as well as in various countries across Asia and Africa, and laboratory experiments, to understand their impacts on climate change, atmospheric environment, and human health.

① Observational Studies of Trace Gases and Aerosol Particles

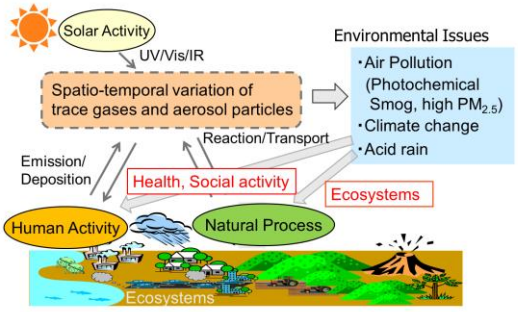
Observations of trace gases, such as NH_3, CO, CO_2, O_3, NO_x, and SO_2, and aerosol particles (*e.g.*, concentration, size distribution, chemical composition) have been conducted to examine their sources, chemical reactions, and transport processes in the atmosphere. For example, we detected the formation of $PM_{2.5}$ from SO_2 emitted by volcanoes in Japan.

② Multi-Point Observations of Air Pollutants using Low-Cost Sensors

Multi-point observations using originally developed low-cost sensor instruments have been conducted in Asian and African countries, as well as in and around Nagasaki, to investigate the sources and transport mechanisms of air pollutants, including $PM_{2.5}$. The data obtained from regions lacking prior literature are expected to significantly contribute to our understanding of air pollutant behavior and their health impacts.

③ Laboratory and Observational Studies on Climate Impacts of Aerosol Particles

Aerosol optical properties (light absorption and scattering) are being examined based on laboratory experiments and field observations to evaluate their impact on the atmospheric radiative balance. In particular, we focus on the optical properties of light-absorbing organic carbon, known as "brown carbon". Additionally, based on simultaneous observations of aerosol particles and cloud droplets at high altitudes (*e.g.*, on Mt. Unzen), the roles of aerosol particles in the formation of cloud droplets are being investigated.



Spatio-temporal variations of atmospheric trace gases and aerosol particles, and their environmental impacts



(Left) Air quality monitoring with low-cost sensors in Ghana
(Right) Observation of aerosol–cloud interactions at Mt. Unzen

2. Keywords

Field Observation; Laboratory Experiment; Trace Gas; Aerosol Particle; Cloud Droplet; $PM_{2.5}$; Air Pollution; Climate Change; Nitrogen Pollution; Meteorology; Climate Change; Asia; Africa

3. Remarks and Websites

We welcome applications to our master's and doctoral programs, as well as interest in the JSPS postdoctoral fellowship. We also welcome collaborations on developing, evaluating, or applying instruments for measuring trace gases and aerosol particles.

researchmap: https://researchmap.jp/read0139557
Laboratory: https://t-nakayama09.wixsite.com/t-nakayama

Name	Job Title	Area of Expertise
YAMAGUCHI Noriyuki	Professor	Ornithology, Movement Ecology

1. Main Research Topics

① **Remote Tracking of Birds**

We conduct remote tracking studies of various bird species, including migratory raptors, using GPS loggers and other tracking devices. Our research aims to understand why birds follow particular migratory routes, focusing on the influence of meteorological and environmental conditions.

Press Releases:

- *First confirmed evidence that the Eurasian subspecies of the Common Buzzard overwinters in Japan. Revealed that the migratory routes of the Eurasian and Japanese subspecies diverge along the Sea of Japan.*
  https://www.nagasaki-u.ac.jp/ja/science/science276.html
- *Unraveled the global migration routes of one of the world's fastest-flying bird species that spends most of its life in the air.*
  https://www.nagasaki-u.ac.jp/ja/science/science236.html
- *Study on the effects of climate change on raptor migration published in an international journal.*
  https://www.nagasaki-u.ac.jp/ja/science/science130.html

② **Conservation of Rare Bird Species**

We focus on the conservation of rare seabirds by locating breeding sites, monitoring population trends, and advancing research on their protection and propagation.

Press Release:

- *New breeding site of the nationally designated Natural Monument, the Japanese Murrelet, discovered in Nagasaki Prefecture.*
  https://www.nagasaki-u.ac.jp/ja/science/science337.html

2. Keywords

Ornithology, Movement Ecology, Conservation Ecology

3. Remarks and Websites

researchmap: https://researchmap.jp/read0090161

Name	Job Title	Area of Expertise
TAKASU Hiroyuki	Associate Professor	Biogeochemistry, Environmental Oceanography

1. Main Research Topics

① **Influence of drainage from a reservoir of reclaimed land on red tide and hypoxic water mass in Isahaya Bay**

In 1997, the inner part of Isahaya Bay, on the west coast of the Ariake Sea, was separated from the sea by dikes, forming a freshwater reservoir. After reclamation, red tides became more frequent in the bay because eutrophic, high-turbidity water containing large amounts of labile organic nitrogen is frequently discharged from the reservoir to the bay. We have reported that NH_4^+-N regenerated from organic nitrogen in high-turbidity waters may be an important source of nitrogen for red tides. In addition, we found that organic nitrogen accumulation in surface sediments has continued throughout Isahaya Bay over the past few decades. Labile organic nitrogen, which mainly originates from phytoplankton products, accumulates near the dike, and its distribution may be influenced by drainage from the reservoir. The regenerated NH_4^+-N from organic nitrogen may be released from the sediment into the water column and may be an important nitrogen source for red tides near the dike in Isahaya Bay. Our goal is to assess how much reducing the organic matter in water discharged from the reservoir and sediments in Isahaya Bay can decrease the occurrence of red tides and hypoxic water conditions.

Recent publications: Takasu et al. (2024) Limnologica 106:126174; Takasu et al. (2023) Marine Environmental Research 184: 105852

② **Response of zooxanthellate scleractinian corals and free-living zooxanthellae to elevation of seawater temperature in temperate Japanese coastal seas**

Coral ecosystems, often referred to as the "tropical rainforests of the sea" boast the greatest biodiversity among marine ecosystems, making their preservation a significant global concern. This rich biodiversity is sustained by reef-building corals, yet recent global reports of coral decline have sparked fears about the potential collapse of these ecosystems. A key factor in coral decline is the frequent occurrence of "bleaching" where corals lose their color and their skeletons turn a translucent white. Corals rely on the photosynthetic products of symbiotic zooxanthellae, and bleaching happens when these zooxanthellae are expelled due to environmental stressors like rising water temperatures. Prolonged bleaching can lead to coral death from nutrient deficiency, but if corals can reacquire zooxanthellae from their surroundings before dying, they can recover. However, for recovery to be possible, a sufficient number of zooxanthellae cells must remain in the environment when stress conditions improve, yet there is limited knowledge about the dynamics of zooxanthellae populations in seawater, leaving many aspects unclear. By elucidating the relationship between zooxanthellae growth rates in the seawater and environmental factors, we aim to aid in predicting coral recovery from bleaching and developing strategies to enhance recovery.

Recent publication: Kato et al. (2024) Marine Ecology 45(4): e12824

2. Keywords

Marine Environment, Biogeochemical cycles, Red tide, Hypoxia, Phytoplankton, Zooxanthellae, Corals, Ariake Sea, Isahaya Bay

3. Remarks and Websites

researchmap: https://researchmap.jp/20190109?lang=en

Name	Job Title	Area of Expertise
MATSUSHIGE Kazuki	Assistant Professor	Riverine Fish Ecology, Fisheries Science

1. Main Research Topics

We have engaged in research aiming to improve biodiversity conservation in riverine and coastal areas.

① Natural Science Approach

Japanese Eel, *Anguilla japonica*, is an important edible fish, but is also an endangered species facing population decline. The eels spawn in the open ocean, but spend most of their life in the rivers and coasts of East Asia, where they grow in preparation for a long cruise to their spawning area. In the context of eel conservation, it is essential to preserve and create suitable habitats in rivers and coasts. In addition, Japanese Eel has the potential as a symbolic species for the conservation of aquatic ecosystems because of its unique ecology and charismatic popularity. Our laboratory is attempting to elucidate the ecology of Japanese Eel and human impacts on them, and to develop urgent methods for the creation of suitable eel habitats, with biodiversity conservation in riverine and coastal areas in mind.



Life history of Japanese Eel



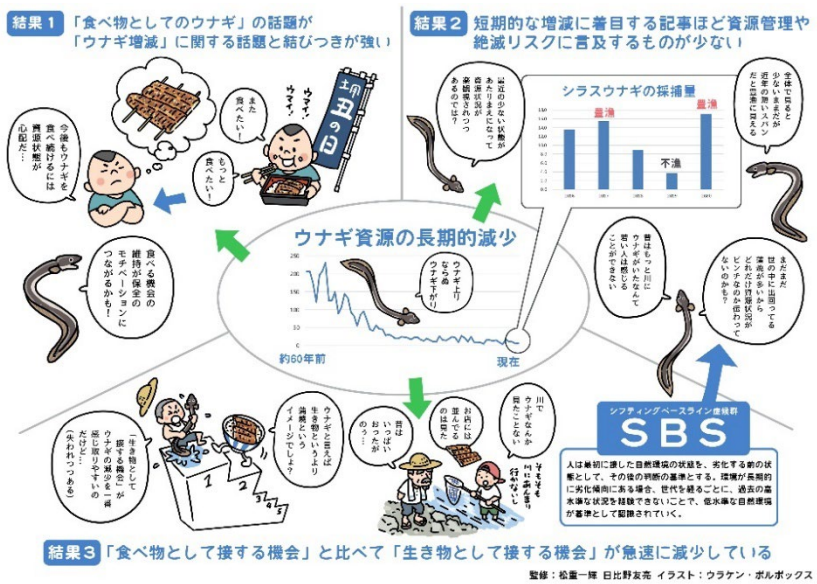
A wild Japanese Eel in a natural river



Field sampling using a refuge trap

② Social Science Approach

Conservation of living things can be attained when people demand it. We have been exploring ways to motivate people to conserve Japanese Eel by examining the public perception of eels, the factors that shape it, and its historical changes.



Outline of Matsushige & Hibino (2025; *Aqua. Conserv.*)

2. Keywords

River ecology, behavioral ecology, sustainable fisheries use, habitat use, upstream/downstream behavior, artificial light at night (ALAN), public perception, *Anguilla japonica*, *Anguilla marmorata*, freshwater eel, biodiversity conservation

3. Remarks and Websites

researchmap: https://researchmap.jp/kazuki_matsushige
Laboratory: https://sites.google.com/view/kmatsushige/

Name	Job Title	Area of Expertise
ENDO Yu	Assistant Professor	Population genetics Ecological genetics

1. Main Research Topics

My research question (Fig 1) is: **How has genetic diversity in wildlife been shaped, and what is the underlying population demographic history following environmental changes?** Crarifying this quesrtion contributes to both natural history and conservation management.

I investigate **genetic diversity and demographic history in wildlife using genome-wide sequencing**, molecular experiments, and fieldwork (Fig 2). Two past main research topics are introduced below.

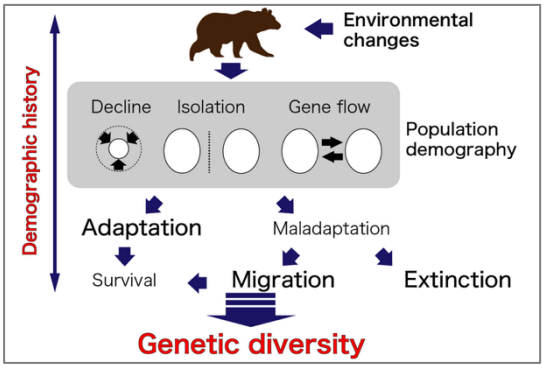


Fig 1. Research questions: Genetic diversity and demographic history

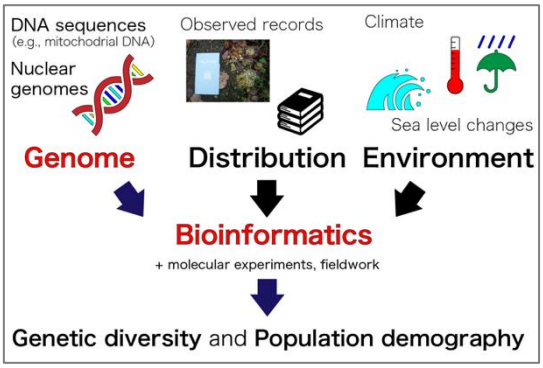


Fig 2. Research approach: multiple methods, particularly bioinformatics

① **Expansion routes of the mask palm civet in Japan**

The masked palm civet, which is distributed mainly in Honshu and Shikoku, Japan, requires management actions because it is an inversive species in Japan. However, its expansion routes in Japan remain unclear.

In this study, we conducted mitochondrial DNA and genome-wide SNP analysis and compared the results with observed recodes. We successfully inferred the expansion routes of the masked palm civet in Japan (Endo et al. 2020; Komatsu et al. 2026).

② **Genetic diversity and population demography of the brown bear in Asia, especially Japan**

Previous studies have suggested that brown bears in Hokkaido, Japan, differ from continental populations based on morphology and mitochondrial DNA. To infer the underlying and previously unknown demographic history, we performed whole-genome resequencing of brown bears across Asia. Compared with continental populations, the Hokkaido population shows relatively low genetic diversity, retains alleles from past hybridization with polar bears, and has lower copy numbers of amylase genes (*AMY*) which are related to starch digestion (Endo et al. 2021; Kotani et al. 2025).

In addition, I have experience in research and genomic analysis of the following animals: mammal (Asiatic black bear, Red fox, Japanese weasel, Siberian weasel, Invasive squirrel) and Three-spined stickleback (e.g., Tomita et al. 2026, Tshuchihashi et al. 2025).

2. Keywords

Genetic diversity, demographic history, population genomics, genome, mitochondrial DNA

3. Remarks and Websites

Our Lab was established in 2026, and research activities are currently being initiated. I have experience in **genetic and genomic analyses of wildlife**. In several projects, I have collaborated with research institutes and local administrative organizations.

Based on this experience, our lab **welcome collaborations with research institutes and local administrative organizations**. We can provide two following technical supports.

If you are interested in our lab's work, please contact us via email address provided on our website.

- Molecular experiments (DNA or RNA extraction, PCR, Libraries preparation of NGS)
- Data analysis (DNA sequences, whole-genome sequencing, genome assembly, ddRAD-seq, MIG-seq etc.)

researchmap: https://researchmap.jp/yuendo
Laboratory: https://sites.google.com/view/yuendo960822/conservation-bioinformatics-lab/english

Name	Job Title	Area of Expertise
OKADA Jiro	Professor	Animal Physiology, Ecotoxicology

1. Main Research Topics

Our laboratory investigates the relationship between environmental chemicals, behavior, and the nervous system in invertebrates, such as crustaceans and insects. By observing animal behavior in the laboratory or in the field, we aim to understand its biological significance and related neural mechanisms, and to clarify the effects of various environmental chemicals on behavior and physiological functions.

1) The Impact of Anthropogenic Chemicals on Crustacean Behavior

Tidal mudflats are often formed near estuaries and are easily exposed to human-derived chemicals through river water. Focusing on crabs densely inhabiting mudflats, we investigate the effects of relatively low concentrations of chemicals on various behaviors and physiological functions (especially cardiac activity).

2) Behavioral and Physiological Mechanisms of Crustaceans

Regarding the courtship behavior of mudflat crabs (commonly called "waving"), we conduct field observations, laboratory experiments using robots, and electromyograph recordings to explore both the behavioral and physiological mechanisms.

3) The Relationship between Social Behavior and Heart Activity in Crustaceans

Crabs living in dense groups on tidal mudflats frequently communicate with nearby conspecifics. We analyze the temporal patterns of heartbeat during such social behaviors to examine the coupling between physiological functions and behaviors (physiological and behavioral synchrony).

2. Keywords

Invertebrates, Environmental chemicals, Behavior, Physiological functions, Nervous system

3. Remarks and Websites

Even at extremely low concentrations, exposure to environmental chemicals can cause noticeable changes in animal behavior and heartbeat patterns. By using these changes as indicators, we are addressing environmental issues that have not received much attention. We also conduct basic biological studies on the mechanisms underlying various invertebrate behaviors.

researchmap: https://researchmap.jp/read0091805
Laboratory: https://www.env.nagasaki-u.ac.jp/professors/okada-jiro/

Name	Job Title	Area of Expertise
TAKAO Yuji	Professor	Environmental Analytical Chemistry

1. Main Research Topics

Analysis of trace chemicals originating from human activities in the environment, especially in the air and water

① Analysis of the concentration and seasonal/annual variation of polycyclic aromatic hydrocarbons in transboundary air

Nagasaki borders the Chinese mainland across the East China Sea, and westerly winds prevail except in summer, making it a suitable place to observe chemicals flying from the continent to Japan by collecting air in Nagasaki. On the other hand, it is known that trace amounts of polycyclic aromatic hydrocarbons (PAHs) are generated when fossil fuels burning or open field burning, and some of these are carcinogenic. We have been tracking the seasonal and annual variations in the concentration of these chemicals in transboundary air for over ten years. As a result, up to 70% of the concentrations of these chemicals in the air of northern Kyushu were from transboundary air, until a few years ago. However, in recent years, progress has been made in air pollution control, and the overall concentrations have decreased, but they are not zero and still show seasonal fluctuations similar to those in the past.

② Identifying the presence and origin of microswitches in the atmosphere

In recent years, the impact of microplastics in the environment on wildlife has raised concerns, and their presence has been confirmed in humans not only in feces but also in the lungs and blood. In particular, since extremely tiny microplastics can float in the air, there is concern that they may be ingested by humans through breath. If they are 10 μm or 2.5 μm in size, as in PM10 or PM2.5, they can float without falling and reach lungs. Research on millimeter-sized microplastics initially began with detection in the ocean surface and river water, but because they are so small in the atmosphere, their presence and origin have not been fully understood. For this reason, and due to the background mentioned in ① above, observations have just begun in Nagasaki, which faces the ocean.

③ Identifying the presence of antidepressants in river water and their impact on groundwater

In recent years, the amount of prescriptions for antidepressants has increased, especially in developed countries, and new drugs have been introduced to the market one after another. However, some of these are not toxic, but have been reported to affect the behavior of wildlife. In addition, these drugs, along with other pharmaceuticals, have been frequently detected in the environment. As a result of the investigation, that some of these antidepressants are relatively resistant to degradation in the environment, and that they can be used as molecular markers to predict the age of groundwater by utilizing the year of prescription. Wells remain in old residential areas, many of which are shallow type and are still in use, although most of them are not for drinking. With the aim of understanding the fluidity of groundwater, we have investigated the relationship between the detection patterns of pharmaceuticals in river water and those in well water, and found a very high correlation and regional differences.

2. Keywords

Analysis of transboundary air, Polycyclic aromatic hydrocarbons (PAHs), Atmospheric microplastics, Pharmaceuticals (PPCPs) in river water and groundwater, Analysis of trace amount of organic compounds

3. Remarks and Websites

Available to provide advice regarding the analysis of trace organic compounds present in the environment.

researchmap: https://researchmap.jp/read0172792

Name	Job Title	Area of Expertise
NAGAE Masaki	Professor	Environmental Toxicology

1. Main Research Topics

Our laboratory uses southern medaka (*Oryzias latipes*) and *Daphnia magna* as test organisms to evaluate the toxicity of environmental chemicals (pharmaceuticals, endocrine disrupting chemicals, air pollutants, etc.). We are also investigating the biological characteristics of two closely related Japanese killifish species, the southern medaka (*Oryzias latipes*) and the northern medaka (*Oryzias sakaizumii*), to understand which species is more suitable as a test organism for investigating chemical toxicity assessments.

① **Research on the effects of pharmaceuticals on the behavior and reproductive functions of fish/daphnia**

The effects of pharmaceuticals in the environment on wildlife are largely unknown. In the case of emission control and environmental concentration control, it is necessary to clarify the effects on various organisms and the extent of such effects. Our laboratory is investigating the effects on the behavior and reproduction of the Southern medaka (*Oryzias latipes*) and *Daphnia magna* of pharmaceuticals that are widely used in Japan, especially those that target the central nervous system, such as antidepressants and antipsychotics.

② **Research on evaluation of toxicity of transboundary air pollutants to Daphnia magna**

Transboundary air pollutants contain many toxic substances and there is concern about their impact on the Japanese ecosystem. In this study, we are conducting research on evaluating the biological effects of these substances using the *Daphnia magna* acute swimming inhibition test and the chronic toxicity (reproductive toxicity) test. Currently, we are investigating the reproductive toxicity of polycyclic aromatic hydrocarbons (PAHs), one of the transboundary air pollutants, to *Daphnia magna*.

③ **Comparison of biological characteristics of two closely related Japanese killifish species and application of test methods**

In 2012, Japanese medaka were subdivided into two species (southern medaka *Oryzias latipes* and northern medaka *Oryzias sakaizumii*). Although medaka are frequently used as test species in toxicological studies, genetic and physiological differences between these two closely related species (in this study, differences in response to sex hormones) remain unknown. We are investigating which killifish species is more suitable as a test species for chemical toxicity assessment.

2. Keywords

Environmental contaminants, toxicity testing, medaka, daphnia,
behavioral effects, reproductive effects

3. Remarks and Websites

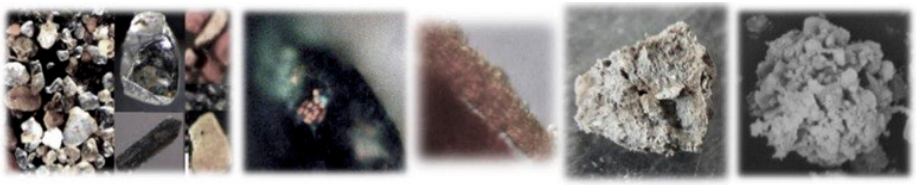
We can collaborate with researchers in field monitoring (environmental analysis) of environmental pollutants. In addition, we can evaluate the toxicity of various environmental pollutants to medaka/ *Daphnia magna*.

researchmap: https://researchmap.jp/Ma19684357
Laboratory: https://www.env.nagasaki-u.ac.jp/professors/nagae-masaki/

Name	Job Title	Area of Expertise
NISHIYAMA Masaya	Professor	Soil Science, Soil Microbiology

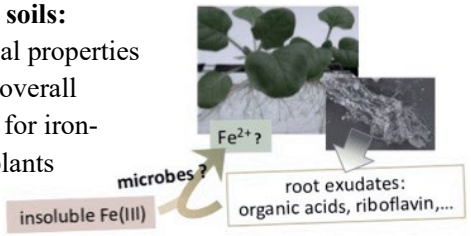
1. Main Research Topics

① **Interactions between minerals and soil microbes and fate/humification of microbial biomass:**
Most microbes in soil are associated with soil particles. This association alters the lives of microorganisms. We study the activities and the fate of microbes as well as the fate of their biomolecules.



② **Microorganisms associated with soil aggregates:**
Soil aggregates contribute to good water retention and permeability, carbon/organic matter storage, and greenhouse gas production, and also function as a breeding ground for diverse microorganisms. By studying these microorganisms, we aim to clarify the microbial activities that characterize the formation and disintegration processes of soil aggregates.

③ **Microorganisms in plant rhizosphere in alkaline soils:**
Root exudates alter the chemical and microbiological properties of the rhizosphere, making them different from the overall properties of the soil. Currently, we are searching for iron-solubilizing microorganisms in the rhizosphere of plants growing under alkaline conditions.



A handful of soil contains a number of microorganisms equivalent to the population of the Earth, with estimates suggesting that there are over a million different species. The diverse activities of soil microorganisms promote the decomposition and conversion of substances and the elemental cycling in the soil, and support the healthy growth of plants, thereby contributing to the homeostasis, the maintenance of the stability of terrestrial environments. On the other hand, microorganisms operate under the environmental conditions of their immediate surroundings. In our laboratory, we investigate how the environment surrounding microorganisms influences the diversity and activity of soil microorganisms, as well as elemental cycling and soil properties. We aim to conduct research that contributes to the design of safe and sustainable environments by leveraging insights into the control and utilization of soil microorganisms, based on the principles of soil ecosystems.

2. Keywords
soil science, microbial ecology, elemental cycling, soil microhabitat

3. Remarks and Websites
researchmap: https://researchmap.jp/read0157268_MN
Laboratory: https://www.env.nagasaki-u.ac.jp/professors/nishiyama-masaya/

Name	Job Title	Area of Expertise
YAMAGUCHI Masahiro	Associate Professor	Plant Physiological Ecology

1. Main Research Topics

With the aim of protecting plants essential to our lives, we are experimentally studying the effects of atmospheric environmental changes caused by our socioeconomic activities on plants.

① Effects of air pollutants on plants and its mechanism

Among the many air pollutants, there is currently strong concern regarding the effects of photochemical oxidants (Ox) on plants. Ozone (O_3), the main component of Ox, has harmful effects on plant growth and physiological functions. For this reason, research is being conducted to evaluate the impact of O_3 on crop yields as well as its effects on greenhouse gas (CO_2) absorption capacity (photosynthesis) of trees. In addition, investigations are being carried out to determine whether O_3 is affecting plants in regions such as Nagasaki Prefecture, which are subject to transboundary air pollution. By clarifying the mechanisms of these O_3 effects, studies are also being conducted to identify the ecophysiological characters that confer O_3 resistance in plants. Furthermore, exposure chambers have been designed to evaluate the effects of $PM_{2.5}$, which remain unknown in outdoor environments.

② Effects of elevated CO_2 and its variation

Due to the massive consumption of fossil fuels, atmospheric CO_2 concentrations continue to rise. To acquire the knowledge necessary for evaluating and improving plant productivity in such elevated CO_2 environments, various plants are exposed to elevated CO_2, and we study its effects on their growth, yield, and quality. Additionally, the factors that influence the effects of elevated CO_2 on plants are being investigated to gain insights that will contribute to improving future crop productivity.

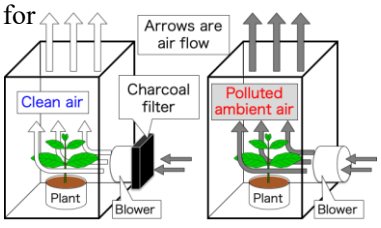
Photographs showing our study

①, ②: Cultivation of plants. ③: Treatment of plants with air pollutants or elevated CO_2 using chambers located outside. ④-⑥: Measurements of plant growth and physiological functions. ⑦: Harvest of the plants to evaluate the effects of the treatments.



Facility for the treatment: Plant cultivation chamber

To clarify the effects of atmospheric pollutants and elevated CO_2 on plants and their mechanisms, we are conducting exposure experiments in outdoor environments. The facility for these experiments is the plant cultivation chamber installed outdoors, as shown in ③ in the above photo. A schematic diagram for evaluating the effects of air pollutants is shown in the right figure. By comparing growth and physiological functions of the plants exposed to the clean air (left chamber) and polluted ambient air (right chamber), we can evaluate the effects of air pollutants on plants.



2. Keywords

Plant Physiological Ecology, Environmental Stress, Air Pollution, Photochemical Oxidants, Tropospheric Ozone, Aerosol, Elevated CO_2, Nitrogen Deposition to Soil, Agricultural Crops, Trees

3. Remarks and Websites

The results obtained from our research can be used to establish Air Quality Standards for protecting plants from air pollution, as well as to improve the productivity of crops and the accuracy of productivity forecasts in future cultivation environments. Currently, the Ministry of the Environment is reviewing the environmental standards for photochemical oxidants, and the findings from our field of research are being utilized in that process.

researchmap: https://researchmap.jp/read0204478?lang=en

Name	Job Title	Area of Expertise
KUBO Takashi	Assistant professor	Environmental Safety Science

1. Main Research Topics

① **Evaluation of the Genotoxicity (Carcinogenicity) of Airborne Particulate Matter and Its Sources**

Small particles are suspended in the atmosphere. PM2.5, which has attracted attention in recent years, is one of them. It has been found that these particles contain substances that can induce cancer. In general, carcinogenesis is thought to begin with damage to genes, so our laboratory uses a method called bioassay (toxicity testing using living organisms) to quantitatively evaluate the carcinogenicity of airborne particles by measuring the extent of their genotoxicity. In particular, we aim to clarify the effects of transboundary air pollution and nearby exhaust emissions.

② **Genotoxicity evaluation of wastewater and treated sewage water and analysis of toxicity changes due to various treatment methods**

Previous studies have revealed that many sewage samples also possess clear genotoxicity. Therefore, we are working to clarify the relationship between sewage treatment methods and the intensity of genotoxicity, as well as analyzing its correlation with substances such as ammoniacal nitrogen in treated sewage water. Additionally, by examining changes in toxicity through various treatments such as adsorption and redox processes, we aim to identify the substances that significantly contribute to genotoxicity and to consider strategies for reducing toxicity.

③ **Elucidation of the genotoxic potency of individual substances and structure-activity relationships**

We are quantitatively clarifying the genotoxic potency of polycyclic aromatic hydrocarbons and their derivatives, heterocyclic amines, and other compounds with known carcinogenic strength. By doing so, we are working to estimate the contribution rate of each substance to the genotoxicity of environmental samples. Furthermore, we aim to estimate cancer risk based on genotoxicity.

④ **Development and Application of Comprehensive Indicators and Simplified Measurement Methods**

In addition to toxicity testing, we are conducting research on the development of new pollution indicators that allow for comprehensive evaluation of environmental pollutants using general-purpose analytical instruments, as well as the practical application of existing simple measurement methods for university wastewater management. Furthermore, we are also working to shed light on the actual state of pollution caused by unregulated substances that are not covered by current chemical standards for wastewater and exhaust gases, and to assess the hazards associated with these substances.

2. Keywords

Bioassay, Genotoxicity, Comprehensive Indicator, Transboundary Air Pollution, Environmental Risk Assessment

3. Remarks and Websites

We hope to conduct joint research as described below in order to build a safer society.

- Development and practical application of new environmental assessment/management technologies
- Performance evaluation and improvement measures for new water purification/wastewater treatment technologies
- Performance evaluation and improvement measures for new air/exhaust gas purification Technologies

researchmap: https://researchmap.jp/env
related website: https://www.env.nagasaki-u.ac.jp/professors/kubo-takashi/

Name	Job Title	Area of Expertise
ASAKURA Hiroshi	Professor	Solid Waste Engineering

1. Main Research Topics

(1) Microplastic (MPs) Survey and Analysis

To confirm the status of MPs in the environment, long-term and wide-ranging surveys involving not only professional researchers but also citizens are necessary. Therefore, we evaluated the accuracy of simplified survey methods. Even without using heavy liquids, we were able to recover 90% of MPs using only seawater. Using simple experimental equipment such as buckets, sieves, seawater, hot plates, dryers, and electronic balances, the lower limit for quantifying MPs was achieved at 13 mg-MPs/m²-sand and 2 mg-MPs/kg-sand.

The long-term environmental contamination trend of MPs cannot be understood by simply investigating their presence in sandy beaches. We measured the accumulation rate of MPs to express contamination trends and weighted the measurement results to compare the MP content between multiple sandy beaches. The average accumulation rate was approximately 1.5 mg-MPs/(m²-sand·day). By calculating the weighted average of MPs concentrations in hotspots and non-hotspots based on their respective areas, we were able to determine the representative values and dispersion across the entire study area.

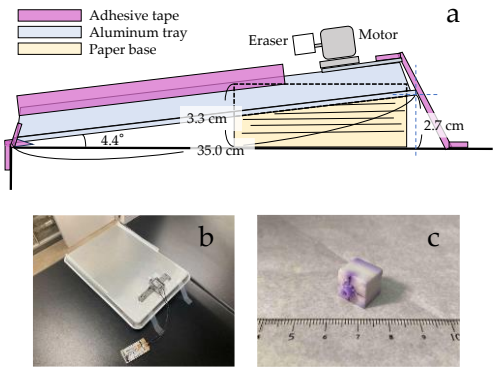


Figure. Vibrating sorter

Due to the large-scale pumice production caused by the 2021 underwater volcanic eruption in Japan, pumice became mixed during density sorting for analysis. Therefore, we evaluated the sorting efficiency of pumice using a vibrating sorter (Figure). The maximum Newton efficiency, which indicates separation efficiency, ranged from 0.68 to 1.00. Based on this separation efficiency, it was concluded that vibration separation cannot replace visual separation but is useful as a method for coastal cleanup.

(2) Proposal for standards and reduction methods for organic carbon content in soil for recycling

If soil containing wood debris generated by the earthquake is used as construction material without treatment, microorganisms may decompose the organic carbon in the wood debris, consume oxygen, and form an anaerobic zone, which could lead to the generation of methane gas. We investigated the relationship between the wood debris content in soil and the extent of the anaerobic zone. To avoid the formation of anaerobic zones, it is necessary to strictly limit the mixing of wood debris to 1% by weight or less, or to install a gravel layer for ventilation every few meters when laying separated soil containing 1% or more wood debris.

(3) Development of technology to suppress hydrogen sulfide generation from landfill sites

In Japan, it is recommended to separate and remove waste gypsum board to prevent hydrogen sulfide generation from landfill sites, but there are currently no quantitative guidelines such as content standards. We investigated the relationship between hydrogen sulfide precursors (sulfates, organic matter) and generation concentrations. To prevent hydrogen sulfide emissions exceeding 2,000 ppm, it was determined that the content standards for the soil should be 60 mg/kg for sulfate content and 0.011 w% or less for gypsum.

2. Keywords

Solid waste engineering, landfill engineering, microplastics, hydrogen sulfide, asbestos, construction and demolition waste, acceleration of stabilization, migration and reaction

3. Remarks and Websites

Features: While utilizing low-tech methods, we explore low-cost, high-efficiency treatment and disposal methods.
Research achievements: Microplastic survey and analysis, acceleration of stabilization of landfill waste, prevention of hydrogen sulfide generation, and improvement of sorting efficiency for construction waste.
Future prospects: We plan to progress from microplastic surveys to proposing beach cleaning methods. We will advance research aimed at accelerating the stabilization of landfill waste and its early end-up.

researchmap: https://researchmap.jp/read0073995/
Laboratory: https://asakurahiroshi.wixsite.com/----------solid-was

Name	Job Title	Area of Expertise
SHIRAKAWA Seiji	Professor	Green Chemistry

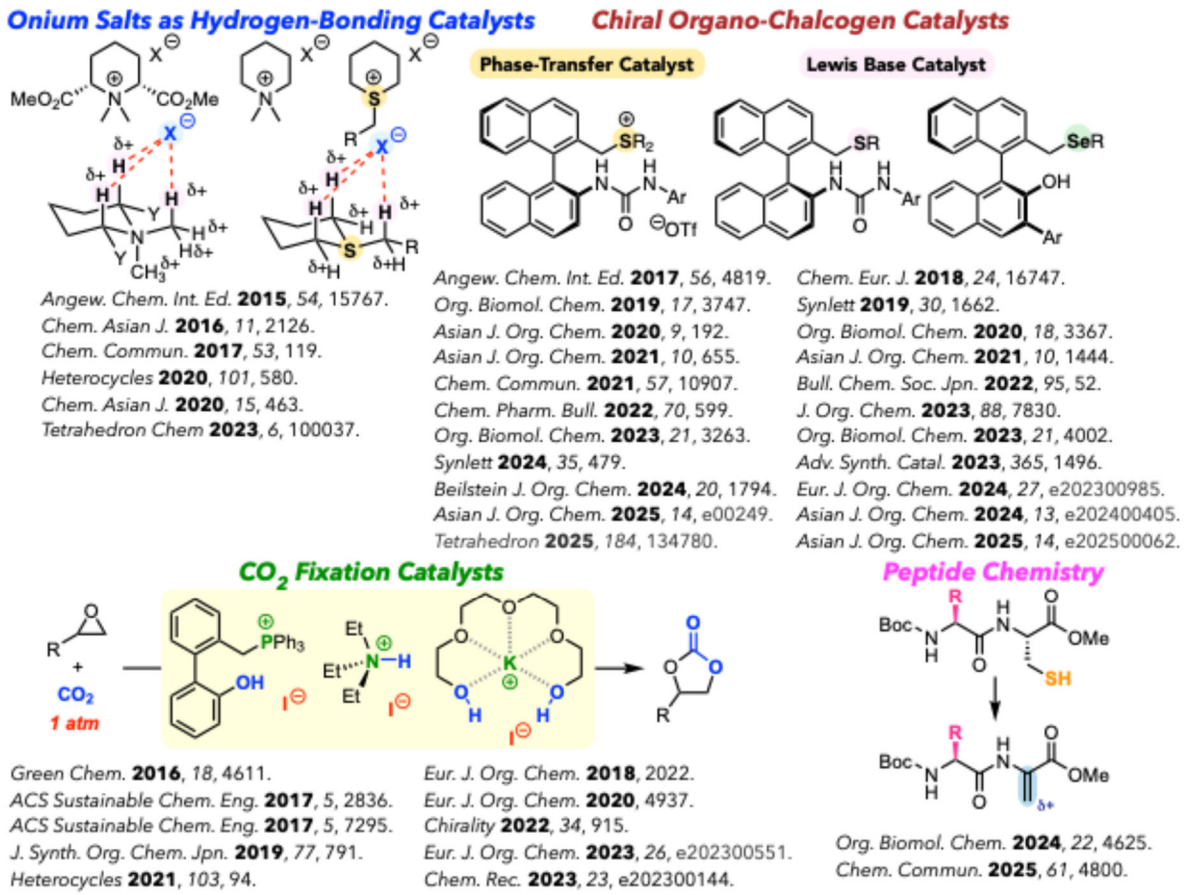
1. Main Research Topics

① **Design of Organocatalysts for Environmentally Benign and Precise Organic Synthesis**

② **CO_2 Utilization Reactions for Carbon-Neutral Organic Synthesis**

③ **Artificial Peptide Modification Chemistry**

④ **Molecular Design for Planetary Health**



Achievements @ Nagasaki Univ. (2014–2025)

2. Keywords

Green Chemistry, Organic Synthesis, CO_2 Fixation, Peptide Modification, Organocatalysis, Molecular Design, Planetary Health

3. Remarks and Websites

We are open to discussions on various types of collaborative research and technology development. Please do not hesitate to reach out to us.

researchmap: https://researchmap.jp/Seiji-Shirakawa
Laboratory: https://seijishirakawa.wixsite.com/greenchemistry

Name	Job Title	Area of Expertise
NAKAGAWA Kei	Professor	Environmental Groundwater Science

1. Main Research Topics

In the Environmental Groundwater Science Laboratory, we conduct the research on groundwater, water, soil and related processes in the aquatic environment. We investigate both natural and anthropogenic processes, aiming to create the knowledge that contributes to the scientific community and addresses needs of society. We work towards producing the results valuable for domestic as well as international audience.

① Use of Biochar in removal of Nitrate Nitrogen in the Aquatic Environments

In this study, we evaluate the water quality remediation method that uses biochar with adsorption capabilities to mitigate nitrate nitrogen pollution in lakes and groundwater. We investigated the removal efficacies in the batch (aquarium) experiments and are now developing the column experiments to simulate groundwater flow conditions.

② PFAS in sediment deposits and water

Recently, water pollution caused by Perfluoroalkyl and Polyfluoroalkyl substances (PFAS), which were commonly used in e.g., Teflon coatings and fire extinguishing agents, has become an emerging problem both domestically and internationally. In this subject, we conduct surveys, modeling, and consider mitigation measures for this class of environmental contaminants. We are currently investigating the presence of PFAS in the seabed sediments collected at Omura Bay. For over 50 years, this water body hosted the offshore Nagasaki Airport. The fire training site is suspected to be the source of PFAS. We have also begun examining the groundwater quality in the area close to the new semiconductor factories in the Kumamoto region. In addition to above, we are planning to develop the analytical methods for analysis of the Trifluoroacetic Acid (TFA) and ultrashort PFAS compounds.

③ Analysis of the Sterols levels as an Indicator Substances for Nitrate Nitrogen in groundwater

In our laboratory, we analyze coprostanol as an indicator substance for nitrate nitrogen contamination in groundwater. Our previous studies revealed that coprostanol exhibits strong adsorption characteristics and hydrophobicity towards sediments. We conduct field investigations e.g., groundwater sampling (Kumamoto area), analysis of the nitrate ions and sterols such as coprostanol, and laboratory experiments to evaluate the behavior of coprostanol in soil and water interfaces.

④ Sustainable Groundwater Use under Climate Change

We will forecast groundwater resources under climate change based on future economic scenarios and examine groundwater use in the sustainable agriculture sector. The field sites are in New Zealand and within the country.

⑤ Use of UV in water treatment and disinfection?

In our laboratory, we developed an experimental setup for evaluation of the UV effect on substance in water and solutes. We aim to study how UV can be used for water treatment and other mitigation needs.

In addition, there are research themes such as factor decomposition analysis using surveys and open data, and the impact of spring water environments on psychological aspects through VR. We are also currently planning a project to protect and conserve Maori rock art in New Zealand.

2. Keywords

Water environment, water resources, groundwater and soil contamination, nitrate nitrogen, PFAS, sterols, climate change

3. Remarks and Websites

We welcome future collaborations and joint research on water and groundwater quantity and quality, as well as the remediation methods for groundwater and soil contamination. Please feel free to contact us.
researchmap: https://researchmap.jp/nakagawa_kei
Laboratory: https://researchmap.jp/nakagawa_kei

Name	Job Title	Area of Expertise
KAGABU Makoto	Associate Professor	Water Environment Science

Main Research Topics

Research Summary

Our laboratory focuses on the invisible yet vital water resource known as *groundwater*, as well as *springs*, which serve as its natural outlets. We are engaged in elucidating the dynamics of regional hydrological cycles, including the movement of subsurface water. Since groundwater is stored beneath the Earth's surface and cannot be directly observed, understanding its flow paths, sources, and sustainability poses significant challenges.

To address these issues, we employ a suite of scientific approaches, including groundwater age dating, water quality assessments, and stable isotope analyses, to investigate how water travels underground and how long it resides within aquifers. Through this work, we aim to contribute to the sustainable management of water resources, assess groundwater contamination risks, and promote the broader conservation of aquatic environments. Ultimately, our goal is to make the “invisible” groundwater visible, thereby highlighting its value and returning that knowledge to society.

Furthermore, our research addresses pressing and complex groundwater issues, such as contamination by nitrate nitrogen and the increasingly recognized presence of PFAS. These pollutants are challenging to detect and monitor due to their invisible nature; yet, our scientific efforts provide critical insights into their sources and spread, making meaningful contributions to risk assessment and environmental protection.

Research Features, Achievements, and Future Outlook

Amid increasing fluctuations in surface water availability, attention is turning to groundwater as a quantitatively stable and resilient water source. However, due to its invisibility, conventional monitoring methods—such as water quality testing and groundwater level observation—have proven insufficient for capturing the full dynamics of groundwater flow. In response, our research introduces a novel approach: estimating groundwater age at multiple spatial and depth-specific points.

Groundwater generally exhibits a vertical age gradient, with shallower waters being younger and deeper waters older. By systematically analyzing the spatial distribution of groundwater ages, we can visualize flow pathways and residence times within the subsurface environment. These insights hold great potential for a wide range of applications, including the strategic development of recharge areas, land-use planning, and the identification and mitigation of contamination sources. We also envision the practical implementation of this initiative in collaboration with local governments and water management entities.

Looking ahead, we aim to establish adaptable and operational groundwater management technologies that are responsive to evolving societal demands, such as those posed by climate change and urbanization.

Prospects for Social Implementation

By making groundwater age and flow dynamics “visible,” our research paves the way for the strategic utilization of groundwater resources by both industry and government. For example, in the bottled mineral water industry, the "age" of water can serve as a unique branding element that enhances product value. At the municipal level, transitioning to groundwater as a reliable and high-quality source enables the development of resilient water management systems that can withstand droughts and natural disasters.

Moreover, our research provides a robust scientific foundation for the *sustainable use of groundwater*, serving as a transformative technology that encourages a shift away from surface water-dominated supply systems. In doing so, it holds significant societal value by promoting long-term water security and adaptive management strategies in response to environmental and socio-economic challenges.

2. Keywords

Groundwater Age Dating, Visualization of Water Cycle, Groundwater contamination (Nitrate・PFAS), Isotope and Water Quality Analysis, Sustainable Groundwater Management

3. Remarks and Websites

researchmap: https://researchmap.jp/kagabu

Laboratory: https://kagabumakoto.com/

Name	Job Title	Area of Expertise
NAKAYAMA Hideki	Professor	Environmental Bioengineering

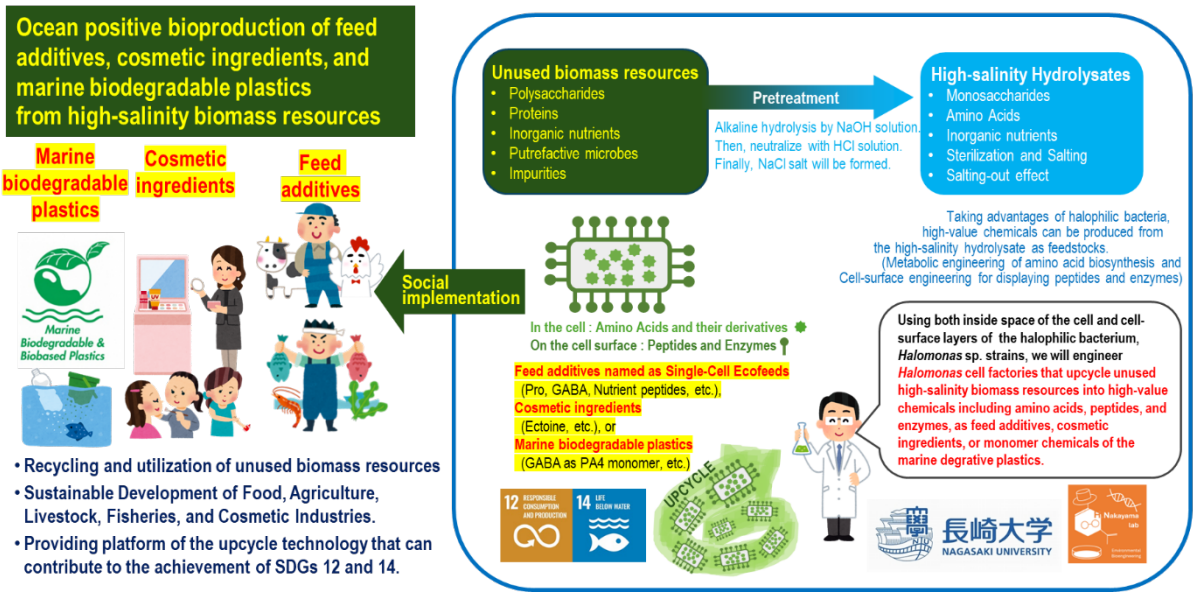
1. Main Research Topics

Development of biomanufacturing technology for unused biomass waste into valuable resources

Currently, methods for utilizing waste biomass, such as food waste and agricultural, livestock, and fishery waste, are being promoted through composting, energy production, and eco-feed production. However, waste glycerol from bioenergy production residues and nutrients such as nitrogen, phosphorus, and sulfur contained in waste biomass are primarily composted and used as agricultural fertilizer. However, while smart agriculture has optimized the amount of fertilizer used, there is an oversupply of compost. Therefore, we are conducting research to develop biomanufacturing technologies that can upcycle waste biomass that has undergone advanced decay or composting, making it difficult to turn into eco-feed, into valuable materials such as amino acids, peptides, and enzymes. In particular, the waste biomass upcycling technology developed by our research group, which utilizes the characteristics of the moderately halophilic bacterium *Halomonas elongata*, is a low-carbon technology that recycles unused waste biomass containing high concentrations of salt as a circulative resource. At the same time, it is a freshwater resource-saving technology that can directly use seawater, a source of minerals containing natural salts, concentrated seawater, a by-product of seawater desalination, as well as livestock and fishery wastewater, which contains inorganic nitrogen compounds such as ammonia nitrogen and nitrate nitrogen, which are factors contributing to eutrophication, as fermentation water. Going forward, we aim to implement low-environmental-impact biomanufacturing technologies that contribute to reducing carbon and water footprints, which are essential for building a sustainable, recycling-oriented society.

Ongoing Research Projects

1. Environmentally friendly feed additives for yellowtail (Nagasaki BLUE Economy Project)
2. Production of Cosmetic Ingredients from Soy Sauce Cake (Joint Project with a Soy Sauce Company)
3. Development of Vaccines for Farmed Shrimp (Joint Project with Mahidol University, Thailand)



2. Keywords

Halophilic microorganisms, Metal biotechnology, Biorefinery, Upcycling biotechnology, Biomanufacturing technology, Waste biomass, Metabolic engineering, Cell surface engineering, Microbial cell factories, Feed additives, Cosmetic ingredients, Marine degradable plastic materials

3. Remarks and Websites

- Produce single-cell ecofeed from waste biomass to increase the self-sufficiency rate of domestic feed.
- Reduce nutrients (N, P) that cause eutrophication of water environments.
- Reduce greenhouse gases (CO_2, CH_4, N_2O) that accelerate global warming.
- Provide seeds of upcycling biotechnology that contribute to the achievement of SDGs 12 and 14.

researchmap: https://researchmap.jp/nakayamah?lang=en
Laboratory: https://nakayamalab.com

Name	Job Title	Area of Expertise
KOYAMA Mitsuhiko	Associate Professor	Microbial Engineering, Molecular Biology

1. Main Research Topics

Laboratory of Resource Circulation Bioengineering studies environmental biotechnology, which utilizes the microorganisms to convert waste biomass, wastewater and environmental pollutants into valuable resources (Fig. 1). We use two approaches, microbial engineering and bioinformatics, to achieve the high efficiency and to elucidate the mechanisms. Our goal is to make environmental biotechnology faster, more economical, smaller, and easier to use, which would contribute to develop a biomass-recycling society.

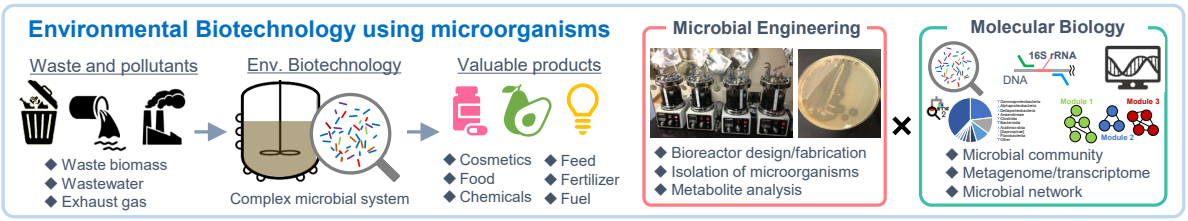


Fig. 1. Research Overview of the Laboratory of Resource Circulation Bioengineering.

① Development of a High-Concentration Nitrification Process for High-Efficiency Ammonia Recovery and Nitrate Accumulation (Japanese Patent Application 2024-137849)

We have developed a novel high-concentration nitrification process that captures ammonia gas from composting and livestock facilities with high efficiency, converts it to nitrate, and accumulates nitrate at concentrations exceeding 7,000 mg-N/L—far surpassing those achieved by conventional methods (Fig. 2). The concentrated nitrate solution serves as a portable, nitrogen‐rich fertilizer suitable for applications such as microalgal cultivation.

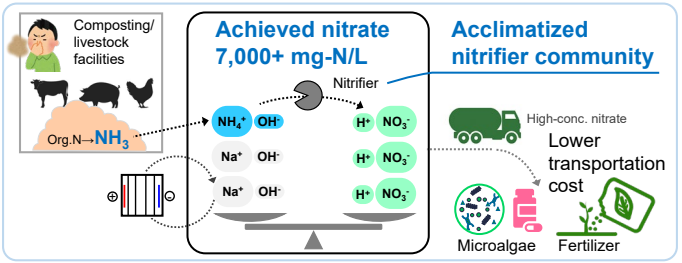


Fig. 2. High-Concentration Nitrification Process.

② Development of Waste Biomass Valorization Technologies Using Complex Microbial System

We harness diverse microbial consortia to advance environmental biotechnologies for waste biomass valorization (Fig. 3). Our work focuses on two main processes: thermophilic aerobic “ammonia fermentation,” a modified composting approach at elevated temperatures to accelerate organic matter degradation and control ammonia release; and anaerobic digestion, which enables low-cost methane production from water-rich waste streams.

2. Keywords

Resource Circulation Bioengineering, Microbial Engineering, Molecular Biology, Complex Microbial Consortia, Waste Biomass

3. Remarks and Websites

We are actively engaged in collaborative research with universities and companies both in Japan and abroad and are seeking further partnerships. If you are interested, please feel free to contact us.

researchmap: https://researchmap.jp/mkoyama
Laboratory: https://www.koyamalab.com/en

Name	Job Title	Area of Expertise
SUK Sunhee	Professor	Environmental Economics

1. Main Research Topics

Climate change has escalated from environmental concern to a global survival issue, now widely referred to as the climate crisis. In environmental economics, carbon pricing internalizes the external costs of greenhouse gas (GHG) emissions by assigning them to financial value. This creates carbon markets where emission reductions can be traded. Such mechanisms incentivize companies to prevent, reduce, or offset emissions, and encourage investment in low-carbon solutions. Article 6 of the Paris Agreement further promotes both new and existing carbon markets and encourages international cooperation to meet emission reduction targets. As a result, carbon pricing and market mechanisms are expanding rapidly worldwide, with growing interest in linking markets, especially in the Asia-Pacific region. Suk research focuses on climate change policy using market-based mechanisms, with three main themes: ① the economic impacts of carbon market linkage, ② corporate decarbonization responses, and ③ the valuation of natural resources' carbon absorption (green and blue carbon) through carbon pricing.

① Research on the economic ripple effects of carbon market linkages

Carbon pricing and carbon markets, which assign costs to carbon emissions, are essential tools for reducing GHG emissions. This research examines the economic impacts of cross-border carbon market linkages, as recommended by the Paris Agreement, with a particular focus on the Pan-Asian region—a region responsible for over one-third of global emissions and rapidly expanding its national carbon markets. The study develops a theoretical model of Pan-Asian carbon market collaboration and uses the E3ME macro-econometric model to quantitatively assess the medium- to long-term effects of market integration on both regional and global economies. This research aims to clarify the economic and industrial impacts of introducing carbon markets in the Pan-Asian region, approaching the subject from three key perspectives.

- Construction of a theoretical model for the cooperation of Pan-Asian carbon markets.
- Quantitative analysis of the medium- to long-term impact of Pan-Asian carbon markets linkage on the macroeconomy.

② Research on companies' decarbonization efforts in response to carbon pricing

We are now in an era where companies are expected to proactively adopt decarbonization strategies and enhance corporate value through forward-looking carbon management. This study aims to assess the policy effectiveness of emission trading scheme (ETS) by examining its impact on the development and evolution of corporate carbon management. This study has undertaken two key initiatives, building on previous research and leveraging an established research network in Korea:

- Evaluation of the effects of emissions trading on improving corporate energy efficiency and reducing greenhouse gas emissions
- Interviews and a questionaries survey targeting Korean companies under the ETS, gaining qualitative and quantitative insights into Korean companies' decarbonization strategies, key drivers and responses to carbon pricing and market.

③ Research on the valuation of the carbon offset credit from natural resources

The natural carbon dioxide removal (CDR) function of ecosystems is increasingly being monetized in the voluntary carbon market (VCM) through carbon offset credits (COCs), such as green carbon (GC) from forests and blue carbon (BC) from marine ecosystems. The global VCM has grown rapidly - expanding fivefold since 2020 - and is projected to increase more than sixfold between 2024 and 2032. However, concerns have been raised regarding the reliability of credit calculation methods, the evaluation of CDR capacity, and the risk of greenwashing. This study aims to address these gaps by identifying challenges in the CDR offset credit systems derived from seaweed beds and forests. It also seeks to quantitatively assess the potential and social value of these credits for local communities through empirical analysis, focusing on economic incentives on both the supply (credit creation) and demand (credit purchase) sides.

2. Keywords

Carbon market linkage, Companies' decarbonization management, ESG, Market based-instrument, Nature based-carbon offset credit

3. Remarks and Websites

researchmap: https://researchmap.jp/suksunhee

Laboratory: www.sshresearchgroup.com, https://sites.google.com/view/nucct/home

Name	Job Title	Area of Expertise
TAKESHITA Takayuki	Associate Professor	Energy System Engineering

1. Main Research Topics

① **<u>"Quantitative Analysis on the Impacts of the Russian Invasion of Ukraine on the Global Energy Supply Scenario Enabling Global Carbon Neutrality by 2050"</u>**

The numerical data on the optimal global primary energy supply by 2050 under the scenario enabling global carbon neutrality by 2050 derived from WEO2021, which were made before this invasion, were compared with those derived from WEO2023, which were made after this invasion. The results show that because the whole world has regarded the dependence on Russian energy as significant risks and hence began to decrease it, the share of natural gas in global total primary energy supply under the scenario enabling global carbon neutrality by 2050 decreases remarkably and the competitiveness of CCUS among all technologies decarbonizing primary energy supply structure also decreases considerably. It is also shown that at the expense of natural gas and coal with CCUS, the share of solar, nuclear, and other renewables such as geothermal and ocean in global total primary energy under the scenario enabling global carbon neutrality by 2050 increases after the Russian invasion of Ukraine.

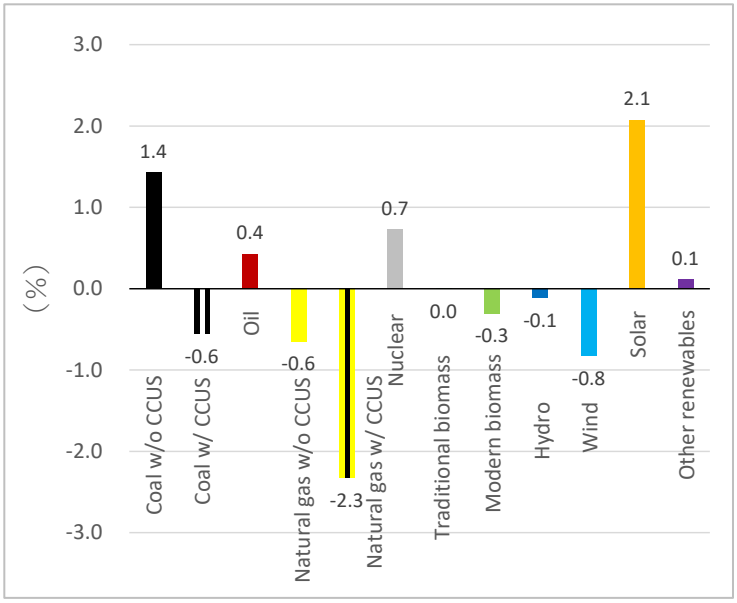


Figure. Difference of the share of each primary energy in the cumulative global total primary energy supply during the period 2020-2050 under the scenario enabling global carbon neutrality by 2050 among the data from WEO2021 and those from WEO2023.

② **<u>"Quantitative Analysis on the Impacts of the Russian Invasion of Ukraine on the Global Energy Supply Scenario Enabling Global Carbon Neutrality by 2050"</u>**

The impacts of the Russian invasion of Ukraine on energy exports from Russia were analyzed by comparing the numerical data on energy imports from Russia to the US, Europe, Japan, China, India, and the whole world in 2022, which were made after this invasion, with those in 2021, which were made before this invasion. The results show that among the impact of this invasion on energy exports from Russia, the negative impact of this invasion on the export of natural gas from Russia is largest, while the negative impact of this invasion on the export of oil from Russia is largest. It is also shown that Europe significantly decreases the import of natural gas from Russia due to this invasion, that the US and Europe significantly decrease the import of oil from Russia due to this invasion, and that Europe, Japan, and the Middle East and North Africa significantly decrease the import of coal from Russia. On the contrary, it is also shown that the increase in the import of natural gas from Russia to China due to this invasion is largest among all countries and that India and China significantly increase the import of oil and coal from Russia.

2. Keywords

Energy, Climate Change Mitigation, Low-Carbon Energy Technologies, Energy System Model, Energy Statistics

Name	Job Title	Area of Expertise
MA Teng	Associate Professor	Environmental Economics, Energy Economics

1. Main Research Topics

From the perspective of environmental economics, I conduct research focusing on the relationship between energy and the economy through empirical analysis. My research to date can be broadly divided into two topics:

① Analysis of the diffusion of renewable energy in Japan’s electricity market, and

② Analysis of air pollution policies in China.

① Research on Japan’s electricity market

I mainly focus on the electricity market and the emissions trading market, analyzing the performance of Japan’s electricity market, identifying its challenges, and proposing desirable institutional designs.

Specifically, I have conducted quantitative analyses of Japan’s electricity spot market, which had not been sufficiently discussed previously, in order to examine the price-reducing effects of renewable energy. Focusing on Japan’s wholesale electricity market, which is an imperfectly competitive market, I analyzed how the entry of renewable energy affects both the price level and price volatility in the spot market. For this analysis, I used hourly renewable energy generation data obtained from general electricity utilities, together with spot price data published by the Japan Electric Power Exchange (JEPX), applying a dynamic panel model.

In addition, I analyzed the indirect effects of renewable energy production in the Tohoku region on the Tokyo wholesale electricity market through interregional electricity procurement. I examined how spot market price levels and price volatility are influenced by renewable energy generation inside the region (Tokyo) and outside the region (Tohoku), with particular attention to how electricity demand alters the impact of renewable energy generation on the spot market.

② Research on China’s air pollution policies

I have conducted economic analyses of China’s air pollution policies from three perspectives: policy evaluation, technology choice, and energy efficiency.

Policy evaluation: Focusing on the period of the 11th Five-Year Plan (2006–2010), I investigated to what extent various air pollution policies implemented in China contributed to reducing SO_2 emissions from the thermal power sector, using econometric methodologies. Specifically, I examined the impacts of measures such as the installation of flue gas desulfurization (FGD) units, the closure of small thermal power plants, and the reduction of sulfur content in coal, treating them as explanatory variables.

Technology choice: Using a multinomial logit model, I analyzed how policy factors, environmental regulations, boiler characteristics, and macroeconomic factors influenced power producers’ choices to adopt post-combustion denitrification technologies at thermal power plants.

Energy efficiency: Regarding air pollution countermeasures in thermal power plants, I evaluated the effects of regional cooperation policies introduced in connection with the Beijing Olympics from two perspectives: the share of desulfurization/denitrification facilities and energy intensity. Applying a difference-in-differences approach, I estimated the changes in the share of desulfurization/denitrification equipment and energy intensity between regions covered by the regional cooperation policy and other regions.

2. Keywords

Electricity Markets, Renewable Energy, Power Producer and Supplier, Air Pollution Policy

3. Remarks and Websites

I conduct research on renewable energy deployment policies and the revitalization of electricity markets. Recently, I have been evaluating the merit-order effect of renewable energy sources in Japan and investigating the factors that enable new power suppliers to contribute to regional economic circulation.

researchmap: https://researchmap.jp/mateng
Laboratory: https://mat-ac.github.io

Name	Job Title	Area of Expertise
SEKI Yoko	Professor	Environmental Philosophy and Ethics

1. Main Research Topics

I have researched about the Japanese concept of *kyosei* (co-existence), including a field survey. The Japanese characters can be also read as *tomo-iki* (living together). This is a unique Japanese concept that expresses the ideal relationship between man and nature. However, *kyosei* is used in various fields, from biology, environmental science, social science to religious ideologies and philosophy. In addition to the *kyosei* between man and nature, the term can also show the relationship between people, such as "commons," which is the social order of a group. Since *kyosei* does not have one fixed meaning, it must be updated in consideration of the values and problem situation of the time. In order to establish a sustainable society as a goal of SDGs, questions such as "should we use technology to manipulate genes and the climate, and alter nature for human sustainability?" and "what should be the alternatives to capitalism?" can also be considered as themes of *kyosei.*

1) **"Nature as the other party," and its relationship with man**

Understanding the nature as "the other party," not as a "resource," and considering "co-existence" as a guideline to overcome the environmental crises.

2) **Co-existence of wild animals and man**

In Japan, the human population is rapidly decreasing, and damage caused by wildlife, such as bears, deer, wild boars, and monkeys has become more serious. The concept of *kyosei* has been considered philosophically and scientifically, in order to contribute to solutions to such real problems.

2. Keywords

Environmental philosophy in Japan

Animal ethics for Wildlife

3. Remarks and Websites

researchmap: https://researchmap.jp/39-27

Name	Job Title	Area of Expertise
OTA Masahiko	Associate Professor	Natural Resource Management, Area Studies

1. Main Research Topics

My area of expertise is forest policy and economics, with a primary focus on forest governance in tropical Asia—particularly in Indonesia and India—as well as in Japan. My research aims to provide insights into how the just and sustainable use and distribution of natural resources can be promoted. I employ an interdisciplinary approach that combines analysis of laws and administrative documents with interviews and household surveys conducted in rural and forested communities.

① **Forest governance in tropical Asia**

[The reality of community-based forest management]

In tropical developing countries, community-based forest management has been increasingly adopted since the 1990s. I have conducted research in multiple countries, including India and Indonesia, to examine how this approach functions in practice. Overall, my findings indicate that community-based management is not a panacea. In many cases, strong involvement of traditional forest bureaucracies in decision-making, or intra-village social dynamics, can lead to unfair practices such as elite capture.

[Frontline foresters as policy implementers]

To better understand frontline foresters' motivations and actual behavior, I conducted fieldwork on Java Island, Indonesia. My research revealed that the actions of these officers are shaped significantly by their relationships within rural communities. This includes discretionary practices such as intentionally overlooking minor "violations," which reflect their embeddedness in local social contexts.

[Politics over forests]

In India, various political developments have significantly influenced forest conservation and management. I have published studies examining the political processes behind the enactment and implementation of the 2006 Forest Rights Act. I am undertaking broader analyses on contemporary political discourse surrounding the definition of forests in India.

[Transformations of the supply chains for forest-risk commodities in the era of sustainable procurement]

Agricultural and forestry-related commodities closely linked to tropical deforestation—such as palm oil and natural rubber—are known as "forest-risk commodities." These have long been recognized as problematic. Since 2023, the European Union has implemented the EU Deforestation Regulation (EUDR), which mandates that companies provide evidence that such commodities are not associated with deforestation or forest degradation. This regulation imposes strict traceability requirements along the supply chain. Against this backdrop, I am investigating how supply chains for forest-risk commodities in Indonesia are being reorganized or are expected to be restructured in response.

② **Natural resource use and rural revitalization in Japan**

[The current state of communal forest use in Japan]

I have conducted research on contemporary forms of managing *iriai* forests—traditionally shared commons used by local communities for collecting firewood, thatch, and grass. The study revealed the persistence of management activities despite challenges such as the decline of forestry and the burden of corporate taxation. It also identified a trend toward polarization, particularly based on the presence or absence of non-forestry income sources such as land rents.

[Other topics]

I have engaged with a wide range of topics for student supervision. These include typologies of educational tourism in geoparks, the implementation of anime tourism in established tourist destinations, the revitalization of rural, mountainous, and fishing villages through educational farm-stay programs, the use of forest areas and local economic impact through trail running events, and the motivations and changes in environmental awareness among forest volunteers.

2. Keywords

Forest policy, Tropical forests, Policy process, Political ecology, Rural livelihoods

3. Remarks and Websites

researchmap：https://researchmap.jp/masahikoota/?lang=en

Laboratory: https://sites.google.com/view/masahikoota/

Name	Job Title	Area of Expertise
KURODA Satoru	Associate Professor	Environmental Sociology/ Regional Sociology/ Regional Resource Management

1. Main Research Topics: Elucidating the Social Processes Involved in the Internalization of Uncertainty in a Disaster-Prone Society

People and communities have sustained their livelihoods through diverse interactions with the natural environment close at hand—receiving many benefits from it and, at times, actively drawing out its "bounty" as a resource. However, on the other hand, we have simultaneously borne the immense "pain" stemming from environmental issues and natural disasters—situations where the balance of our interactions becomes uncontrollable. In recent years especially, society has been continuously exposed to "environmental risks" that profoundly shake the very foundations of our established way of life—from massive earthquakes to the novel coronavirus disease. This study examines how people confront risk in contemporary society, where everyone faces unforeseen dangers and inevitably finds themselves caught between one calamity and another. This study adopts the perspective of resilience, which involves recognizing the occurrence and threats of environmental risks and pursuing resilient recovery and adaptation through approaches at both the individual and system levels.It demonstrates perspectives and policy possibilities for building lives and sustaining livelihoods in disaster-prone societies.

①The Process of Building Resilience from Disaster

In communities devastated by disasters and calamities, we explore how severed connections—to homes, livelihoods, and social networks—can be reconnected and restored in the midst of daily life, proposing concrete social practices to achieve this recovery. Subtheme 1 will examine sociologically how we should confront the invisible and increasingly widespread environmental risks and their uncertainties in contemporary society.

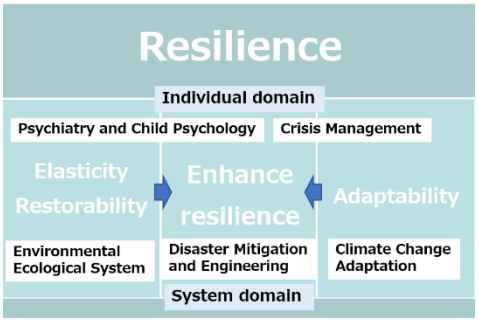


Figure: The Concept of Resilience and Its Approaches

②Resource Management Grounded in the Interrelationship Between Local Communities and the Natural Environment

As perceptions of the "desirable way to interact with nature" and its forms change with the times and circumstances, how should we engage with the natural environment? Subtheme 2 focuses specifically on "nature close to home"—from forests, rivers, and oceans to animals and plants—examining the mutual process whereby the state of nature shapes society, and society in turn profoundly influences the state of nature. Through this, we will interpret the future relationship between humans and nature and the appropriate distance between them, aiming to reconstruct regional resource management.

③Strategies for Sustainable Regional Management Under Island Environmental Risks

Islands possess diverse natural and social environments unique to their regions. However, these island environments simultaneously face existential threats. For example, regional challenges such as wildlife damage (harmful birds and animals) and population decline/shrinking societies are recognized locally as uncertainties (risks) within the natural environment. At the same time, these issues are closely intertwined with the realities of regional well-being and quality of life (QOL). By combining quantitative and qualitative research methods, we will elucidate the significance and actual state of these interrelationships and explore methods for sustainable regional management.

2. Keywords

Community Resilience / Everydayness and Extraordinary Events / Environment-Society Interrelationships / Risk (Disaster)/ Regional Recovery / Internalization of Risk / Interdisciplinary Research

3. Remarks and Websites

This research views environmental issues as challenges that cannot be resolved or improved through a single discipline or approach alone. Only by combining diverse fields and methodologies and working collaboratively can the full picture emerge. Based on this perspective, we focus on participatory environmental practices while actively promoting collaborative interdisciplinary research.

researchmap: https://researchmap.jp/7000000771

Name	Job Title	Area of Expertise
TOMOZAWA Yuuki	Associate Professor	Environmental Sociology, History of Environmental Problems in Japan

1. Main Research Topics

- Environmental sociology with historical interest

"What kind of epistemology has been formed through experiences of pollution incidents in Japan?"
The main period of research is the Meiji period and beyond.

- We research on the Japanese experiences of severe environmental damage and grass-roots anti-pollution movements from a historical viewpoint. Generally, "environmental philosophy" means Western thinker's products, but we think it is important that also many untitled citizens have produced their own grass-roots environmentalism and eco-philosophy.
- Japan has achieved rapid industrialization and economic growth through 1950s to 70s with enormous cost in human life. Not only the famous cases such as Minamata disease, but widespread environmental disaster had also occurred in other local areas too, and those cases are still less well understood. Against this situation, some general citizens metamorphosed into thinkers. They had struggled to avoid local environmental crisis, seeking alternative ways of changing our society to be eco-friendly and people friendly. Those efforts give us valuable hints for a sustainable society even now.

Research Themes

- **Re-interpretation and Re-evaluation of IIJIMA Nobuko (1938-2001, Pioneer of Environmental Sociology)'s academic works and UI Jun (1932-2006, Outstanding critic on pollution problems)'s theory on pollution**

We conduct archival research and interviews with Nobuko Iijima and Jun Ui, who developed themselves as researchers amid the intensification of pollution, as well as with the social movements and exchanges between researchers that influenced their work. This research overlaps with discussions on science and technology studies and agnotology.

- **Re-evaluation of anti-pollution and anti-development plan movement in Japan**

We conduct a comprehensive investigation involving literature and document analysis, as well as field interviews, to examine farmer-led movements that emerged in response to the environmental degradation caused by the Ashio Copper Mine Pollution Incident. Additionally, we explored resident movements that sought to reassess development plans due to pollution concerns in regions such as Rikuzentakata, Iwate Prefecture, Okinawa Prefecture, and Fukushima Prefecture, among others. A notable characteristic of these movements is the participants' transition in perspective from mere "opposition" to proactive "creation." Furthermore, we emphasize the interconnections among these movements.

2. Keywords

Pollution issue, Environmental movement, Grassroots Environmentalism, Environmental justice, Postwar Japan, Ashio copper mine incident, Minamata disease, Kanemi oil poisoning, Coal mine pollution

3. Remarks and Websites

TOMOZAWA Yuuki, 2023, Grassroots Environmental Thoughts in Japan: Created by the Victims' Perspective. The 9th International Symposium on Environmental Sociology in East Asia (ISESEA-9) , Yokohama, Japan.
TOMOZAWA Yuuki, 2019, Japanese Anti-pollution Movements During the Period of High Economic Growth: A Focus on the Role of Jun Ui (1932 - 2006). The 7th International Symposium on Environmental Sociology in East Asia (ISESEA-7), Seoul, Korea.

researchmap: https://researchmap.jp/24hiyokko

Name	Job Title	Area of Expertise
FUKAMI Satoshi	Associate Professor	Tourism Study, Environmental Education

1. Main Research Topics

① **"World Heritage Tourism" and Its Positive and Negative Impacts on Local Communities**
Focusing primarily on Yakushima—the first site in Japan registered as a UNESCO Natural World Heritage—and the "Sites of Japan's Meiji Industrial Revolution," as well as the "Hidden Christian Sites in the Nagasaki Region and Amakusa," inscribed in 2018, I conducted surveys of both tourists and residents to assess the "positive and negative" impacts that arise when local assets are developed as tourist attractions and access is restricted for conservation purposes. This research highlights the dilemma between the UNESCO World Heritage Convention's mandate for "conservation" and the real-world push for "tourism promotion."

② **Ecotourism and the Conservation of Local Environments**
In 2017, designated by the United Nations as the "International Year of Sustainable Tourism for Development," ecotourism—promoted in Japan by the 2007 Ecotourism Promotion Act—has gained attention under the concept of "Ecological & Economical Tourism." While ecotourism often emphasizes natural environmental resources, this research also focuses on human environmental resources (culture and history shaped by natural conditions), examining experiences of human–nature coexistence. The core interest is how diverse stakeholders can collaborate to build consensus on conserving and utilizing local environments.

③ **Geoparks, Geotourism, and Sustainable Regional Development**
A geopark is a field site where volcanic features, hot springs, distinctive natural landscapes (landforms and geology), and cultural and culinary heritage are recognized as "geo-heritage," serving as the basis for environmental education and geotourism. After UNESCO adopted geoparks as a formal program in 2015, global interest has been rising. I have investigated the efficacy and challenges of geoparks as a framework for sustainable regional development in locations including the Shimabara Peninsula; Sakurajima–Kinkō Bay; Mishima Village–Kikaijima Caldera in Japan; Huangshan in Anhui Province and Funiu Mountain in Henan Province, China; and the Stonehammer UNESCO Global Geopark in Canada.

④ **"New Forms of Tourism" Such as Dark Tourism**
Tourism has traditionally been defined as an activity undertaken for enjoyment involving travel to different places. However, the scope of tourism now increasingly encompasses journeys of learning or reflection—such as visits to "negative heritage" sites—education for sustainable development (ESD) initiatives supporting developing countries, and activities aimed at peacebuilding through intercultural understanding in contexts of diplomatic tension. These types of tourism are attracting attention for their potential to foster interpersonal interaction and mutual enlightenment. My research examines how such "new forms of tourism" might contribute to improving relations between Japan and its neighboring countries.

2. Keywords
Sustainable tourism, ecotourism, World Heritage, geoparks, island travel, overtourism (tourism pollution), environmental NPOs/NGOs, Education for Sustainable Development (ESD), tourism education and environmental education

3. Remarks and Websites

· Authorship of textbooks and supplementary materials in geography.
· Implementation of classroom practices focused on tourism education.

researchmap : https://researchmap.jp/satoshifukami

Name	Job Title	Area of Expertise
KATAYAMA Kensuke	Professor	Urban and Regional Planning

1. Main Research Topics

① **Regional planning and governance for sustainable city-regions in the face of population decline**

In many cities, people's living areas and urban areas have expanded beyond the boundaries of municipalities. However, this has led to increased environmental impacts. Furthermore, as Japan is under the era of population decline, urban problems such as a decline in suburban living services and the decline of urban centers have also arisen. To resolve (improve) these problems fundamentally, regional spatial plans are needed to guide cities and regions toward sustainable urban and regional structures. However, efforts by individual municipalities are insufficient.

I have been conducting research on the current situation and challenges of inter-municipal collaboration in urban and regional planning in Japan. Specifically, I have evaluated the wide-area association system, the "Heisei era municipal mergers" and one-to-one "flexible collaboration" between municipalities from the perspective of urban and regional planning. I have also shown that in. I also analyzed the current state of collaboration of urban functions under compact city policies.

Recently, I have also been conducting research on regional theory in national spatial strategy, such as the Regional Living Area Concept, and on deriving techniques for formulating regional plans in times of population decline.

② **Regional planning systems in other countries (especially Europe) and their applicability to Japan**

In Europe, the concept of "spatial planning" has been developed multilaterally since the 1990s, influencing EU common policies and national and regional planning systems in member states. I have conducted empirical research to examine how the concept of "spatial planning," which considers economic, social, and environmental aspects in a spatially integrated manner, has been incorporated into actual regional planning systems and methods.

Specifically, I analyzed the transformation process of spatial policies and spatial planning systems under regional integration in the EU, focusing on the United Kingdom, France, and Ireland, and found that regional-level governance and integrated spatial strategies are becoming increasingly important.

Recently, I have also conducted research on national and regional planning in the Netherlands and the duty to cooperate in urban planning in the United Kingdom (England).

③ **Collaboration among various actors in urban and regional development**

To form sustainable regions, the collaboration not only among government agencies but also among a variety of other actors, such as economic organizations, private companies, and citizen groups is required. I am conducting research on the significance and challenges of multi-stakeholder collaboration in urban and regional planning.

Specifically, I conducted joint research to make clear the urban development process in Tokyo's central commercial district, which has maintained its ability to attract visitors from a wide area, focusing on the involvement of the actors in urban development (government agencies, local communities, and participating companies). I also conducted researches focusing on collaborative efforts between government agencies, private companies, and shopping districts in revitalizing central city areas, the current state of collaboration between cities, towns, tourism organizations, and NPOs in developing tourist areas, and the role of residents' activities and government in managing suburban living areas.

2. Keywords

urban planning, regional planning, spatial planning, regional cooperation, Europe, population decline, *machidukuri*

3. Remarks and Websites

researchmap: https://researchmap.jp/kenkata
Laboratory:

Name	Job Title	Area of Expertise
GOTO Seiko	Professor	Landscpae Architecture

1. Research Topic

Landscape Architecture is a professional discipline that emerged in the United States in the late 19th century. It involves the planning and design of natural environments in urban and natural park settings while considering aesthetic, political, cultural, and environmental conservation roles. Landscape architects propose how green spaces should be planned as part of urban infrastructure, how they can improve people's lives, and how they can contribute to ecosystem preservation and environmental enhancement. My work focuses on how landscape design can help improve the environment in the 21st century, a time marked by global climate and social change. As a Japanese researcher, I also seek to understand the characteristics and effects of green space design nurtured by Japanese culture—namely, the *Japanese garden*. My research topics are divided into the following three themes:

① **Research on the Social Impact of Japanese Gardens**

Among the many garden styles found around the world, Japanese gardens are unique in their design, often representing miniaturized nature. Many Japanese gardens have been created not only in Japan but also in Western countries since the Meiji era. One of my key research themes is the study of Japanese gardens built abroad, especially those created in Japanese American incarceration camps during World War II. These camps were established in the deserts of the American West with the aim of isolating and eliminating Japanese Americans, and a total of 119,893 people of Japanese descent were interned there. Despite harsh conditions and the uncertainty of how long they would be confined, many internees used the limited materials available to create Japanese gardens. In particular, it has been found that over 100 Japanese gardens of various sizes, including a large strolling garden, were constructed at the Manzanar camp. I investigate why Japanese gardens were created in an environment where Japanese culture was being denied, and what their forms and meanings reveal.

② **Research on the Healing Effects of Japanese Garden**

Viewing Japanese gardens take various forms and serve different functions. For example, the small, meditative gardens viewed from the *hōjō* (abbot's quarters) in Zen temples, or *roji* tea gardens, were designed as spaces for silent contemplation and reflection—unique to Japanese culture. In addition to historical studies, I conduct applied research in modern contexts, focusing on the relaxation effects of viewing Japanese gardens. For this research, I built permanent experimental gardens in the U.S., Hong Kong, and Nagasaki. Clinical studies have been conducted with participants of different nationalities and ages. These studies have demonstrated that viewing Japanese gardens elicits notable relaxation and memory-recall effects, regardless of nationality, gender, or familiarity with the gardens. Particularly noteworthy is the significant effect observed in elderly patients with late-stage dementia, whose visual cognitive functions are often impaired. This suggests strong potential for Japanese gardens to serve as a non-pharmacological form of therapy.

③ **Research on Landscape Design Using GIS**

With the rapid progression of global warming, urban and green space planning must now account for global-scale impacts. In collaboration with Harvard University, I am conducting research using ArcGIS tools to assess and visualize the environmental impact of current conditions and proposed designs. At present, I am exploring a new design methodology called *GeoDesign*, which integrates geographic analysis into the landscape design process. By connecting information from various fields, GeoDesign aims to find solutions to critical global issues such as climate change, globalization, and nature conservation.

2. Keywords

landscape design, Japanese garden, viewing landscape, healing effects

3. Remarks and Websites

Characterictics: Engaged in collaborative research with universities in the United States, China, and Hong Kong.

Research Achievements: Research findings have been presented at numerous international conferences and papers.

Future Outlook: Promoting the beauty and effects of Japanese garden to the world.

researchmap: https://researchmap.jp/seiko-1

Laboratory: https://www.env.nagasaki-u.ac.jp/professors/goshima-seiko/

Name	Job Title	Area of Expertise
WATNABE Takashi	Professor	Landscape and Regional planning

1. Main Research Topics

Our research team has been conducting research on open spaces and landscapes in Japan and overseas. Our objective is to implement regional planning methodologies that leverage open spaces and landscapes in an efficient manner. Our research has been methodically structured around the following three core perspectives.

① **Identification of the structure of open spaces and landscapes**

Identifying the structure of open spaces and landscapes is necessary in order to determine the stock that should be utilized. Previous research has primarily concentrated the following three categories.

(i) O**pen spaces and landscapes in the suburban areas of major metropolitan centers**

Suburban landscapes in large metropolitan centers have been categorized into three classifications: planned single-family residential areas, new towns, and sprawl areas. Our research findings and those of previous studies have allowed us to identify the formation processes, characteristics, and evaluation and prospects of these landscapes. Consequently, we determined that these landscapes, developed according to contemporary urban planning principles, incorporate "agricultural" components such as farmland, forest land, and waterways, which are currently receiving significant focus.

(ii) **Open spaces and landscapes in residential areas of provincial core cities**

We identified the quantity and use of vacant lots in large residential areas in the suburbs of Nagasaki City, one of provincial core cities, as well as the changes in non-built-up areas in sloped urban areas. The results revealed that while there are many unused non-built-up areas in these areas, these areas are being utilized as spaces for crop cultivation through self-cultivation and the establishment of small farms.

(iii) **Cultural landscapes**

We identified the arrangement and form of potted greenery in high-density urban areas, the landscape formation processes and characteristics of hot spring areas in the Kyushu region, and the changes in land use related to nursery production in traditional nursery production regions.

② **Evaluation of the functions of open spaces and landscapes**

Evaluating the functions of open spaces and landscapes is essential for fostering an understanding of the importance of utilizing these areas effectively. Specifically, we assessed the suitability of farmland for multi-crop production based on soil data. Additionally, we considered the expansive nature of suburban farmland in major metropolitan centers as a potential contributor to creating a comfortable environment in high-densely built-up urban areas that lack openness. Through a series of psychological evaluation experiments using photographs and computer-generated imagery (CG), we identified farmland landscapes that effectively evoke a sense of openness. In addition, we assessed the aesthetic functions of street trees, the recreational and environmental education functions of forests, and the landscape functions of hot spring areas based on public preferences.

③ **Identification of the actual conditions of activities related to open spaces and landscapes conservation and restoration**

Identifying the actual conditions of activities related open spaces and landscapes conservation and restoration is essential for developing effective methodologies to support such efforts. Previous research has been focused on the following two key aspects.

(i) **Policies for the conservation and restoration of open spaces and landscapes**

We have examined the actual conditions of various policies, including The Productive Green Land Act, urban agriculture promotion initiatives involving city residents, hot spring-based geothermal power generation projects, legal frameworks for landscape formation in hot spring areas and settlements designated as Important Cultural Landscapes, and landscape formation initiatives associated with the UNESCO World Heritage Site “Hidden Christian Sites in the Nagasaki and Amakusa Regions”.

(ii) **Actions of stakeholders involved in conservation and restoration of open spaces and landscapes**

We have investigated the behaviors and activities of various stakeholders, including crop cultivation by urban residents on farmland in large metropolitan centers, operation of green tourism in rural areas and crop cultivation by urban residents in provincial core cities.

2. Keywords

open space, landscape, conservation, preservation, restoration, green infrastructure

3. Remarks and Websites

researchmap: https://researchmap.jp/read0208808

Name	Job Title	Area of Expertise
ARAI Yuki	Associate Professor	Agriculture and Rural Development

1. Main Research Topics

(1) Environmentally Sustainable / Regenerative Agriculture and Fisheries

While agriculture contributes to food production, there are concerns worldwide that it causes various negative environmental impacts, such as deforestation, loss of biodiversity, greenhouse gas emissions, and soil and water pollution. For this reason, various initiatives are being undertaken around the world to prevent the adverse environmental impacts of agriculture and achieve sustainable / regenerative food production. For example, initiatives include third-party certification systems for farmers and organizations practicing environmentally friendly farming methods, policies to promote environmental conservation and restoration on farmlands, information disclosure by food-related companies regarding their environmental impacts in production sites, and dissemination of environmentally sustainable agricultural techniques in developing countries. I am conducting research using social science and interdisciplinary approaches to examine the roles these initiatives play in local social and natural environments, as well as the challenges they face.



(2) Gender and Agriculture / Fisheries

Because jobs in agriculture and fisheries often involve physically demanding work, men typically play a central role in these industries. Globally, the reality is that most decision-making in agriculture and fisheries is done by men, and opportunities for women to participate are limited. However, in recent years, there has been a growing call for gender equality, and efforts to improve this situation are underway. In particular, as we promote environmentally sustainable / regenerative agriculture and fisheries, women's participation in decision-making processes is expected to play a crucial role. I am conducting research in Trang Province, southern Thailand—where initiatives to promote gender equality are actively underway—on the differences in gender roles in rural communities particularly in agriculture and fisheries, as well as the relationships between agriculture / fisheries and gender.



2. Keywords

Environmentally sustainable / regenerative agriculture and fisheries, certification system, international development, rural development, gender, Southeast Asia

3. Remarks and Websites

Through fieldwork in rural communities, international collaborative research with foreign universities (e.g. Thailand, Indonesia, etc.) and partnerships with NGOs, government agencies and business partners, we aim to apply our research findings to address social and international issues on agriculture and rural development.

researchmap：https://researchmap.jp/yukiarai

Name	Job Title	Area of Expertise
YOSHIDA Mamoru	Associate Professor	Disaster Risk Governance

1. Main Research Topics

① Modeling decision making process of preparing for and responding to disaster risk

To prepare for and respond appropriately to natural disaster risks such as earthquakes, heavy rains, and typhoons, it is necessary to deepen understanding of the decision-making process of residents and to consider policies based on that understanding. In this study, we use questionnaire survey data and other sources to model the decision-making process based on knowledge of psychology and economics, and work on policy design based on that model.

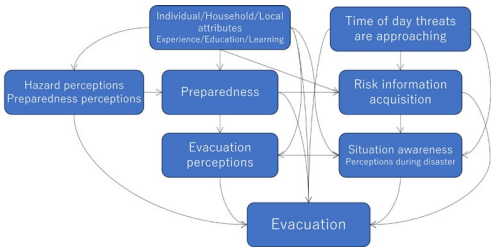


Fig.1. Causal diagram on the structure of relevant factors of evacuation process

② Developing a method to assess environments for evacuation with GIS

Local governments are required to provide appropriate support to enable residents to take evacuation actions in the event of a natural disaster. However, residents' evacuation actions are influenced not only by their individual and household attributes (such as age and number of people in a household), but also by the topography of the evacuation route and the capacity of nearby evacuation shelters. In this study, we develop a method to evaluate the evacuation environment in residents' residential areas and examine a framework for risk communication to promote appropriate evacuation actions.

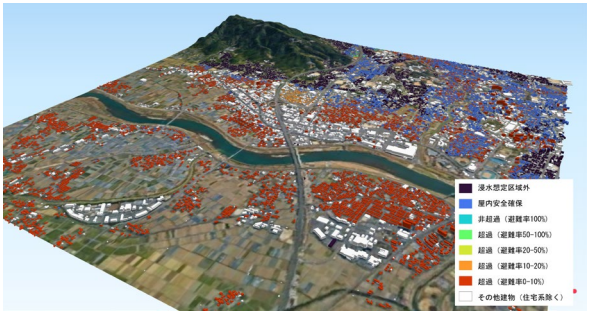


Fig.2. Bird-view of a possibility of overcrowding of the nearest shelters

③ Designing land use policy with the framework of ecosystem-based disaster risk reduction

In the context of flood risk reduction, farmland and forests are known to have the functions of water storage and infiltration and play a role in leveling the water level of rivers. In the context of tsunami risk reduction, Coastal forests also play a role in reducing the power of tsunamis to some extent. In these ways, the realization of appropriate land use contributes to reducing the threat of hazards. We are working to empirically clarify the role of farmland and forests in the framework of Ecosystem-based Disaster Risk Reduction using geographic information system data.

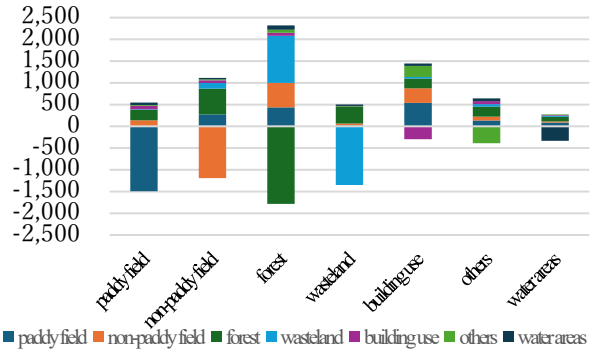


Fig.3. The increment and decrement of land use of whole Japan from 1976 to 2016

2. Keywords

Community-based Disaster Risk Reduction, Urban Planning, Infrastructure Planning, Disaster Risk Management, Disaster Risk Governance, Ecosystem-based Disaster Risk Reduction, Evacuation

3. Remarks and Websites

The laboratory tackles practical issues of disaster risk reduction and supports its implementation.
Please feel free to contract us.

researchmap: https://researchmap.jp/m_y?lang=en

Name	Job Title	Area of Expertise
ENDO Aiko	Professor	Agricultural Economics

1. Main Research Topics

① **Marin debris**

Studies on behavioral science statistics and interventions for removing stranded, drifting and benthic marine debris

② **Water-energy-food nexus**

Development research on interdisciplinary tools, methods and methodology for water-energy-food nexus

③ **Ocean and coastal policy**

Studies of fisheries policy towards integrated coastal zone management and marine spatial planning: the possibility of establishing boundary delineation of the coastal zone

④ **Aquatic food systems**

Studies on fisheries production, distribution and consumption

2. Keywords

Marine debris; water-energy-food nexus; coastal management, food systems

3. Remarks and Websites

researchmap: https://researchmap.jp/endoa
Laboratory:

Name	Job Title	Area of Expertise
KIKUCHI Hidehiro	Professor	Environmental Law and Policy

1. Main Research Topics

① **Japanese Policymaking Process of Acceptance and the Domestic Implementation of CITES**
This research chronologically analyses Japan's related policy making process during the period since the acceptance and domestic implementation of CITES in the 1970s up until the 1990s. It examines acknowledgments of the issues and the kind of initiative inside of Japanese government for the protection of species of wild fauna and flora from the point of view of environmental conservation.

② **Japanese Policymaking Process of Accession to the Ramsar Convention and its Domestic Implementation**
This research examines the characteristics of the Japanese global environmental policy by analyzing chronologically the process of Japanese accession to the Ramsar Convention and its implementation which Japanese government has activated since the late 1980s, such as hosting the conference of the parties in Japan, increasing the number of designated wetlands.

③ **Japanese Policymaking Process of Enactment of Ozone Layer Protection Law**
This research intends to analyze the policymaking process leading to the enactment of Law Concerning the Protection of the Ozone Layer. Additionally, because it is pointed out that Chemical Substances Control Law enacted in1973 has influenced on discussion on Law Concerning the Protection of the Ozone Layer, authors try to analyze the significance of Chemical Substances Control Law in Japanese environmental policy.

2. Keywords

Environmental Law and Policy, International Environmental Treaty

3. Remarks and Websites

researchmap：https://researchmap.jp/Kikuchi55
Laboratory: https://www.env.nagasaki-u.ac.jp/professors/kikuchi-hidehiro/

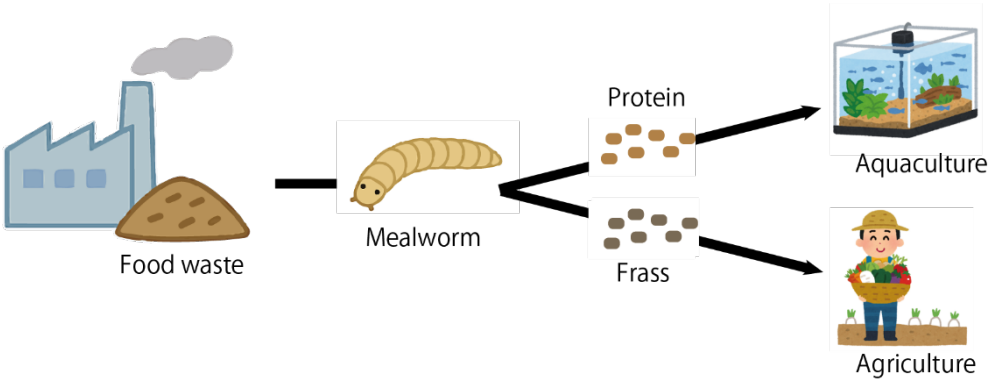
Name	Job Title	Area of Expertise
HATTORI Mitsuru	Associate Professor	Evolutionary Ecology

1. Main Research Topics

My research field is Evolutionary Ecology, which aims to understand how the lifestyles and traits of organisms have evolved. Utilizing my expertise, I conduct research to contribute to a sustainable society where everyone can live happily, through approaches that promote utilization of insects, human health, and biodiversity conservation.

① Protein production from food waste using yellow mealworms

Conventional protein production imposes significant environmental burdens, such as carbon dioxide emissions. To address this issue, I focus on mealworms (larvae of *Tenebrio molitor*) as a sustainable protein source. I am exploring those types of food waste that are useful for mealworm farming. In addition, their frass shows promise as an organic fertilizer, and I am investigating its potential as an alternative to chemical fertilizers.



② Creation of Tick-Borne Disease Risk Maps

Tick-borne diseases, including Japanese Spotted Fever and Severe Fever with Thrombocytopenia Syndrome (SFTS), are reported more frequently in Nagasaki Prefecture than in other prefectures. Contrary to the common belief that ticks are confined to mountain forests, they are also found in urban parks. Therefore, I am conducting field surveys in parks, campgrounds, and tourist spots to estimate tick density for the creation of risk maps to inform public health strategies.

③ Conservation ecology of *Rhododendron kiusianum* as a symbolic flower of Nagasaki

Rhododendron kiusianum is a symbolic flowering plant in the Shimabara Peninsula, highly valued for tourism. However, it hybridizes with the closely related species *R. kaempferi*, producing hybrids that are difficult to classify as either species. Our studies reveal that hybrid individuals account for a large proportion of their populations at major tourist sites in the Unzen region. To conserve this symbolic species, I am investigating its ecology and exploring conservation strategies.

2. Keywords

Yellow mealworm, *Tenebrio molitor*, insect farming, tick-borne disease, wildlife damage, hybridization, tourism resources

3. Remarks and Websites

Recent publications

Kimura, F., Yamawaki, R., Togawa, D., Sato, Y., Hattori, M., Hashizume, K., Kobayashi, T. (2025) A study on estimating mealworm growth curves for the automatic mealworm rearing system Worm Pod. SIG Technical Reports, 2025; 1–6.

Kidera, K., Kobasyashi, T., Hashizume, K., Hattori, M. (2024) Rearing potential of yellow mealworm (larvae of *Tenebrio molitor* L.) on food waste. ENRIC Conference, 5.

Miyauchi, H., Yorimoto, S., Shigenobu, S., Hattori, M. (2024) Colony size affects the induction of sterile soldier production in the eusocial aphid *Ceratovacuna japonica* (Hemiptera: Aphididae). Insectes Sociaux, 71: 323–330.

researchmap: https://researchmap.jp/Mitrusu_HATTORI

Name	Job Title	Area of Expertise
HASEGAWA Hayato	Assistant Professor	Landscape Ecology, Environmental Sociology

1. Main Research Topics

To achieve a Nature Positive society, it is essential to revitalize the connections between people and local natural environments and conserving local biodiversity. To explore how such community-based approaches can be realized, we conducted action research from three perspectives: (1) local environmental policy, (2) community-led conservation activities, and (3) the development of ecosystem assessment technologies. The main filed of research is Satoyama landscape.

(1) Comparison of Governance Processes in Environmental Conservation Linked to Regional Planning

This study, focusing on Fukutsu City in Fukuoka Prefecture, examined how two conservation activities—each based on different administrative plans—emerged and developed, and evaluated these processes from a governance perspective. In cases based on a comprehensive plan, local governance was established through the integration of government policies with resident-led autonomous activities. In contrast, in cases based on a basic environmental plan, administrative involvement declined after plan established, and community governance developed autonomously through collaboration between the university and local residents. The comparison indicates that effective environmental conservation requires a complementary relationship between top-down governmental support and bottom-up community collaboration. It also highlights the importance of involving practitioners from the planning stage and embedding their activities within regional plans.

(2) Formation Process of Satoyama Revitalization and Changes in Ecosystem Services

This study engaged in Satoyama revitalization activities on Mt. Omine in Fukutsu City as part of an action research project, documenting the process of reestablishing relationships between the local community and the Satoyama landscape. In addition, interviews with local residents were conducted to assess changes in ecosystem services over time. The conservation activities developed through four phases: issue sharing, organizational formation, value recognition, and the enhancement of technical and organizational capacities. Through these processes, ecosystem services that had not existed prior to the activities were restored, and sustainable mechanisms for regular engagement with the Satoyama, along with effective management practices, were established.

(3) Development of Ecosystem Assessment Technologies Using Remote Sensing

The objective of this study is to apply remote sensing technologies to evaluate the relationships between ecosystem structural characteristics, biodiversity, and ecosystem services, thereby contributing to environmental conservation and ecological restoration planning. We have analyzed microtopographic data obtained through UAV-based LiDAR surveys to identify sediment and water flow pathways linking forested areas to tidal flats. In addition, field surveys have been conducted to examine movement routes and roadkill hotspots of semiterrestrial crabs. Based on these findings, we are developing “eco-road” plans designed to restore connectivity between mountain forests and tidal flats by facilitating both organism movement and material flows. Furthermore, forest structure has been analyzed using ground-based LiDAR to generate point cloud data, and its complexity has been quantified using fractal dimension metrics. Through this approach, we aim to clarify the relationship between forest structural complexity and biodiversity.

2. Keywords

Satoyama landscapes / Action research / Community development / Local governance / Community governance / Process / Multi-stakeholder collaboration / Ecosystem services / Remote sensing / Drones / Laser surveying

3. Remarks and Websites

Landscape ecology is a field that seeks to elucidate the relationships between landscape structure and function, as well as the interactions between changes in these elements and human society. Building on these insights, it aims to inform ecological land-use practices. With an emphasis on practical application, the discipline integrates natural and social science perspectives to assess, utilize, and manage regional landscapes and ecosystems.

researchmap: https://researchmap.jp/hayato_hasegawa/published_papers?lang=en

Name	Job Title	Area of Expertise
HAMASAKI Hironori	Associate Professor	Water Governance, Water Resources Management and Policy Study

1. Main Research Topics

① Theoretical research on IWRM (Integrated Water Resources Management) and water governance

IWRM has been adopted as a basic concept for water resource management since 2000, not only in various countries and regions but also in JICA's international cooperation activities. However, because it is still a new concept, research on its content is ongoing, and the challenge lies in how to link this theory with practical water management at the field level. In this study, we are working in collaboration with JICA to refine IWRM theory in a way that enhances practicality at the field level while making it more effective.

Similarly, regarding watershed governance, as it is a relatively new concept with an undefined definition, we are working to deepen and refine the theory. Specifically, we are conducting theoretical and conceptual research on consensus-building among multi-stakeholders and between upstream, midstream, and downstream areas within a basin (watershed collaboration), as well as the structure of multi-layered water management systems from the global to the local level, based on several case studies.

② Empirical Research on IWRM and water governance through case studies

We are conducting research on water resource management and watershed governance, focusing on the Mekong River basin as an example of a monsoon region with abundant water and the Euphrates River basin as an example of an arid region. In particular, we are focusing on Cambodia in the former case and Turkey in the latter, conducting empirical research on themes such as water-related legal systems and policies, water allocation among multi-sectoral stakeholders (agriculture, industry, and domestic use), multi-level and multi-stakeholder interest coordination, and the social implementation of scientific knowledge related to water in local contexts.

In Japan, we are exploring governance for sustainable water resource use in response to social changes such as population decline and depopulation, as well as global warming. Our research focuses on themes such as watershed collaboration, forest-river-village-sea connectivity, and river town development, emphasizing the organic connections between diverse stakeholders and geographical/spatial contexts.

③ Transdisciplinary research for social integration of water knowledge

In the field of the environment in particular, the challenge has been how to link research results and scientific knowledge to policy and practical activities. In this study, for example, in Turkey, we have held workshops with stakeholders involved in actual water management and use to establish trial rule changes and conducted pilot projects in collaboration with water user associations and communities as action research. Through co-thinking and co-creation with local stakeholders, we are exploring the interface between research results and scientific knowledge on one hand, and policy and practice on the other.

2. Keywords

water governance, Integrated Water Resources Management (IWRM), transdisciplinary approach (co-design/co-creation/co-production), Mekong River basin (Cambodia), Euphrates (Turkey)

3. Remarks and Websites

The distinctive feature of this research is that it focuses on how to bring about behavioral change in individuals and groups and innovation in society and policy through collaboration with various actors in society. We have been conducting research in collaboration with JICA and local communities, but we would like to collaborate with a wider range of entities, such as local governments, NPOs/NGOs, companies, civic groups, and educational institutions, to consider sustainable water management and utilization together.

researchmap: https://researchmap.jp/read0149595
Laboratory: Under construction

Name	Job Title	Area of Expertise
HONJO Moe	Associate Professor	Animal Law, Environmental Law, Comparative Law

1. Main Research Topics

① Comparative Studies in Legal Concepts of Animal Protection

This theme examines the legal concepts of animal protection law and policy in different jurisdictions. While animal welfare is the main concepts in the western countries, some country like Switzerland states animal dignity in its animal protection law. On the other hand, in Japan, the main concept of animal protection is *aigo* (愛護) or "love and protection." While animal welfare focuses on the states of animals, *aigo* focuses on humans' feelings towards animals (Honjo, Moe. 'Japan: The case of *Aigo*', in Peters, Anne, Saskia Stucki, and Kristen Stilt (eds.), *Oxford Handbook of Global Animal Law,* Oxford University Press, Oxford: 2026, forthcoming). My research explores how these differences create different legal framework and legal status of animals.

② Industrial Animal Agriculture and Environmental Impact

This study investigates the legal and policy dimensions of sustainable food. Intensive farming, including its relationship to climate change and global warming. Research on sustainable food system encompasses the examination of regulatory measures, animal welfare implications, and the broader environmental consequences of industrial-scale animal production, with an emphasis on potential reforms and sustainable alternatives.

③ Regulation of Animal Experimentation

This theme focuses on laws and policies governing the use of animals in scientific research, with a comparative emphasis on the EU and the U.S. I have analyzed legal standards, transparency requirements, and ethical frameworks, such as the Three Rs (Replacement, Reduction, and Refinement). This study discovers how different jurisdictions balance scientific advancement with animal welfare.

2. Keywords

Animal Law, Environmental Law, Comparative Law, EU Law, Law in the Unites States, Animal Welfare, Aigo, Animal Rights Law, SDGs

3. Remarks and Websites

My research focuses on a comparative study of animal law in the EU, the United States, and Japan. In 2024, I published *Animal Welfare and Law: Regulations on Animal Experimentation in Europe and the United States* (Seibundoh) [in Japanese] as an outcome of this comparative research. While my work primarily examines legal frameworks concerning laboratory animals and farm animals, I also maintain a broad interest in the legal status of all animals that interact with humans, as well as in the theoretical foundations of animal law in various legal regions.

researchmap：https://researchmap.jp/moe_honjo

Name	Job Title	Area of Expertise
WADACHI Yoko	Associate Professor	Environmental Politics

1. Main Research Topics

① **EU environmental policy and politics study from a perspective of the political science**

The European integration has been recognized to be a political experiment on the delegation of national sovereignty to the international institutions. As the European integration has been proceeded, some problems about governance have emerged: how the competence is shared or divided between the European Union and the member states? How should the democratic deficit be corrected? These are essential to the definition and significance of democratic states and institutions. The EU environmental policy is an area where the political troubles caused by the European integration have been noticed easily and examined actively to find the solutions. The EU also has been diffusing the environmental norms all over the world and searching for the strategy of environmental leadership which will contribute to their supremacy. The European integration includes the theoretical and policy lessons full of good suggestions on the environmental governance.

Translation（in Japanese）
Annu Bradford（Supervisor of translation, Katsuhiro Shoji）
The Brussels Effect – How the European Union Rules the World, Hakusuisha, 2022, pp.293-325.
（『ブリュッセル効果―EU の覇権戦略　いかに世界を支配しているのか』）

WADACHI, Yoko
"Transnational Governance and Climate Change", in Katsuhiro Shoji & Miguel P. Maduro (eds), *Transnational Governance- Beyond Geopolitical Thinking,* Iwanami Shoten, 2021, pp.52-74.

2. Keywords

European Integration, Subsidiarity principle, Environmental leadership, Brussels effects, Environmental norms

3. Remarks and Websites

researchmap: 3kihirokikaesu888880
Laboratory:

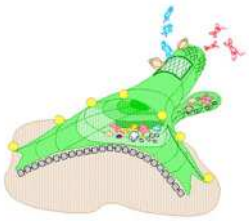
Division of Fisheries

Name	Job Title	Area of Expertise
MATSUSHITA Yoshiki	Professor	Fishing Technology

1. Main Research Topics

Development and research of low environmental impact fishing technology

① **Research on bycatch reduction technology, that avoid the capture of unwanted organisms**



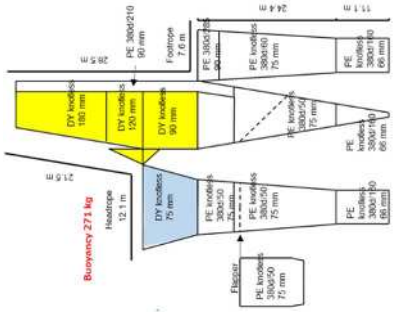
Expertise in designing and operating fishing gear based on the fish behavior and fishing gear characteristics, as well as catch data analysis techniques.

Trawl gear designed for bycatch reduction

② **Research on fishing techniques to reduce greenhouse gas emissions**



LED lights installed on squid fishing boats



Design of trawl fishing gear that maintains catch and reduces gear drag

③ **Research on mitigating marine debris, particularly ALDFG (Abandoned, Lost or otherwise Discarded Fishing gear)**

- The impact of marine debris bycatch on fishing operations
- The impact of benthic debris on sessile biological communities
- Fishing gear marking to mitigate ALDFG issues

and others.

2. Keywords

Fishing technology, fishing gear, fishing methods, fish attraction light, fishing gear design, bycatch, discards, marine debris, ALDFG, ghost fishing

3. Remarks and Websites

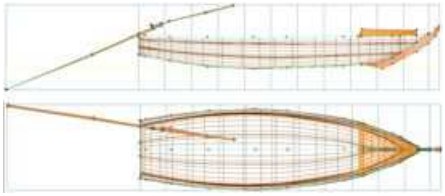
researchmap: https://researchmap.jp/read0086894?lang=en
Laboratory: https://sites.google.com/view/ggk-nagasaki-u/english?authuser=0

Name	Job Title	Area of Expertise
SHIMIZU Kenichi	Professor	Navigation, Nautical Instruments

1. Main Research Topics

① Study for Evaluation of Working a “Ro”-scull to Propel a “ Wasen”-Japanese Traditional Boat

I studied conducted experiments on actual vessels to compare the characteristics of rowing and propulsive efficiency of expert rowers on traditional Japanese boats with those of beginners. The results showed that expert rowers quickly grasped the characteristics of the oar and boat and did not row with excessive force.



Wasen Boat for experiments

② Study for Navigation

Research using training ships has included a study on the estimation error of visual observation distances at sea, a study on anchor holding performance in the local Nagasaki Port using model anchors, and a study on the effects of introducing the CFRP propeller newly installed on the Nagasaki Maru. Regarding the effects of introducing CFRP propeller, the researchers focused on the reduction in underwater noise, noise and vibration inside the ship, and fuel consumption, and compared the results when a conventional metal propeller was installed with a CFRP propeller. The results were also published in the April 7, 2025 edition of the Naiko Kaiun Newspaper.



CFRP propeller

③ Study for using Ship maneuvering simulator

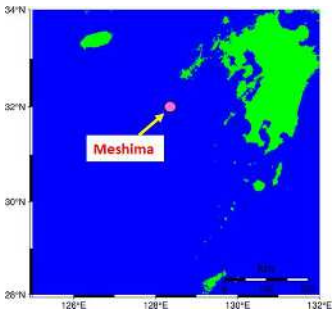
In October 2022, our Faculty of Fisheries installed a new ship-maneuvering simulator as part of the navigator training program for students hoping to advance to the Tokyo University of Marine Science and Technology's special corse. The system consists of mock bridge sections No. 1 and No. 2, as well as an ECDIS training area. Using this ship-maneuvering simulator, I am studying for training scenarios of beginners and comparing them with the maneuvering of navigators. I want to study about quantitatively clarify the navigators' ability to "look ahead" when watch keeping by showing them how to avoid several other vessels.



Ship maneuvering simulator room

④ Study for Marine litter around ocean going area

Using the Nagasaki Maru, a training ship attached to the Faculty of Fisheries, I study conducting surveys to understand the current state of drifting and seabed litter in ocean going areas. This study has been introduced on our university website (see QR Code ①). Furthermore, I recently held a marine litter survey class for elementary school students in the local Omura Bay, and footage of this event has also been introduced on our website (see QR Code ②). Also, I am conducting surveys of marine litter on the beach in front of Meshima Island in the Danjo Islands, an uninhabited remote island, and are working on beach cleanup activities in front of Meshima Island.



① ②



2. Keywords

Nautical instruments, navigation, ship maneuvering simulators, Ocean going marine litter

3. Remarks and Websites

researchmap: https://researchmap.jp/7000001984
Laboratory: None

Name	Job Title	Area of Expertise
TAKIKAWA Tetsutaro	Associate Professor	Physical Oceanography

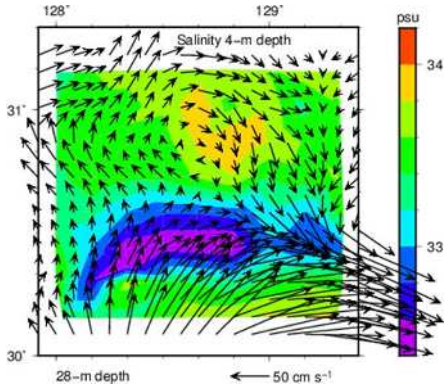
1. Main Research Topics

My research focuses on physical phenomena, such as ocean currents and variations in temperature. I also consider collaborative research, such as chemical and biological processes, and meteorology. We conduct observations, including CTD, mooring, and meteorological observations, using training/research ships.

① **Ocean observation research**



Bottom mooring ADCP

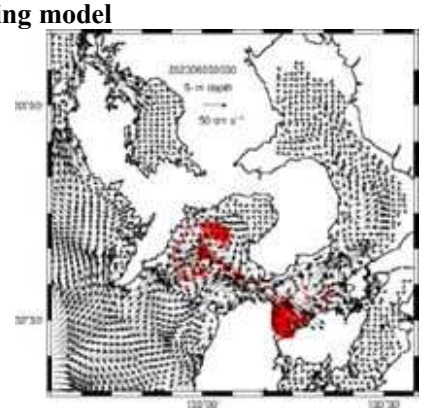


Rainfall-induced low-salinity pool observed at the Kuroshio front

② **Observation by fishermen in Smart Fisheries Network (SFiN)**



③ **Lagrangian particle tracking model**



Red tide tracer experiments. I also proceed with tracer experiments on eggs and larvae.

2. Keywords

Ocean observation, Tsushima Warm Current, Japan Sea, East China Sea

3. Remarks and Websites

I hope to reveal the changing environment, using observation data and numerical model outputs.
researchmap: https://researchmap.jp/tetu

Name	Job Title	Area of Expertise
HIROSE Miyuki	Associate Professor	Fisheries Acoustics (Marine Acoustics)

1. Main Research Topics

I am conducting the following research using ultrasonic measuring instruments to understand how changes in the marine environment affect the distribution and behavior of marine organisms:

① Effects of Decreased Dissolved Oxygen on Marine organisms

I use battery-powered quantitative echo sounders that can be installed at fixed locations, as well as acoustic camera capable of capturing images in dark and highly turbid conditions, to investigate changes in the distribution and behavior of fish and zooplankton inhabiting areas where hypoxic water masses occur.

② Investigation of the Prey Environment of Sperm Whales

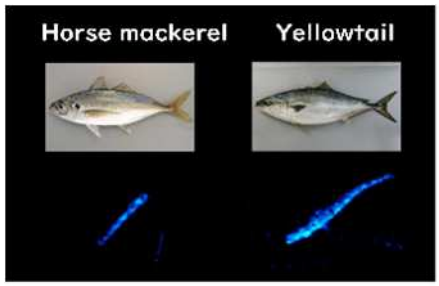
To clarify the factors behind the annual appearance of sperm whales in the Goto Submarine Canyon from around April to July, I monitor monthly changes in their prey environment using a scientific echosounder.

③ Development of a Survey Method for Marine Debris Distribution

I am developing a method to measure the distribution depth and amount of marine debris drifting in the mid-water column using ultrasonic measuring instruments.

④ Development of Fish Species Identification Methods

Ultrasonic devices such as scientific echosounder and acoustic cameras can detect the presence and quantity of organisms, but they have limitations in identifying species. To overcome this, I am working on developing species identification methods using optical cameras or machine learning techniques that take advantage of the specific features of each organism.



2. Keywords

Fisheries acoustics , Marine acoustics, Scientific echosounder, Acoustic camera

3. Remarks and Websites

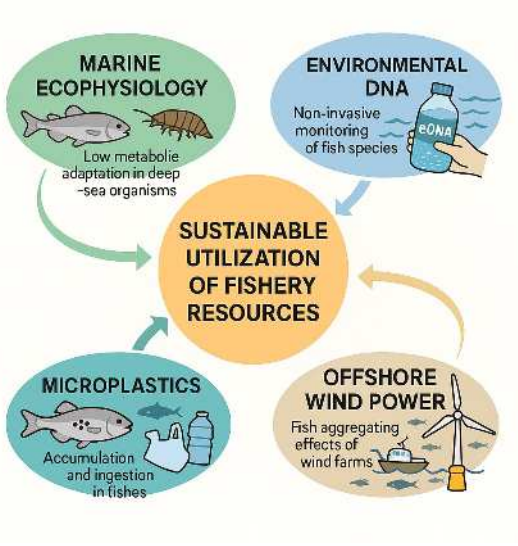
researchmap: https://researchmap.jp/hirose_Nagasaki-u
Laboratory: https://sites.google.com/view/ggk-nagasaki-u

Name	Job Title	Area of Expertise
YAGI Mitsuharu	Associate Professor	Fisheries Environmental Science

1. Main Research Topics

① Metabolic Adaptation and Growth Constraints in Deep-Sea Organisms

We investigated the low-energy metabolic strategies of deep-sea organisms such as the giant isopod (*Bathynomus doederleini*) by measuring oxygen consumption, growth rate, and feeding frequency. Our findings reveal how these animals adapt to extreme environments characterized by low temperature, low nutrient availability, and high pressure. We also applied metabolic scaling theory to explore size-metabolism relationships and their evolutionary implications.



② Organ-Specific Distribution of Microplastics in Fishes and Ecological Risk Assessment

We quantified and classified microplastics (MPs) in organs such as the digestive tract, gills, and muscles of commercially important fish species collected from the East China Sea and coastal waters. We evaluated the relationships between feeding behavior and MPs intake, and assessed potential impacts on growth and nutritional condition. Special attention was paid to MP accumulation in edible tissues, highlighting implications for food safety and ecosystem health.

③ Scientific Assessment of "Fish Aggregation Effect" around Offshore Wind Farms using eDNA

We conducted year-round environmental DNA (eDNA) surveys to analyze changes in fish distribution around floating offshore wind turbines. The results revealed that Japanese horse mackerel (*Trachurus japonicus*) tend to aggregate near the turbines, indicating a possible fish aggregation effect. This study provides a high-resolution, non-invasive monitoring approach for evaluating the coexistence of renewable energy development and fisheries resources.

④ eDNA-Based Estimation of Native and Rare Fish Distributions

We used eDNA analysis to investigate the distribution of species such as Japanese eel (*Anguilla japonica*) and giant mottled eel (*A. marmorata*) in river networks of western Kyushu. By comparing results with traditional capture surveys, we demonstrated the effectiveness of eDNA in detecting elusive species and contributed to the development of conservation-based distribution models.

⑤ Integration of Fisheries Education and Ship Performance Research

We evaluated the educational impact of practical training aboard the Nagasaki University training vessel *Nagasaki-maru*. Additionally, we conducted engineering analyses of vessel noise, turning performance, and propulsion efficiency to integrate fisheries education with marine engineering insights.

2. Keywords

Low metabolism, Growth constraints, Deep-sea organisms, Oxygen consumption, Metabolic scaling, Microplastics, Nanoplastics, Misfeeding, Food safety, Environmental DNA (eDNA), Offshore wind power, Fish aggregation effect, Fisheries resources, Fisheries education, Training vessel, Environmental impact, Anthropogenic disturbance, Aquatic environment, Ecophysiology, Conservation biology

3. Remarks and Websites

Our lab conducts diverse research in aquatic environmental science, focusing on deep-sea metabolic adaptation, microplastic accumulation in fish, and fish aggregation around offshore wind farms. We use eDNA technology for non-invasive monitoring, contributing to fisheries management and environmental impact assessment. Our work also addresses food safety and collaborates with industry and local governments to promote sustainable fisheries and marine conservation.

researchmap: https://researchmap.jp/7000001968
Laboratory: https://sites.google.com/view/yagi-lab/

Name	Job Title	Area of Expertise
TANAKA Takahiro	Associate Professor	Physical Oceanography

1. Main Research Topics

① Marine environment monitoring methods using underwater gliders

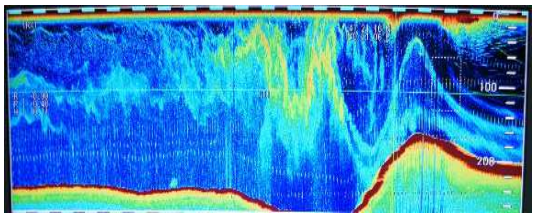
Underwater gliders are autonomous ocean observation platforms that observe the ocean by repeatedly diving and surfacing by adjusting the glider's density. The lift force acting on both wings of the aircraft allows it to move not only vertically but also horizontally, making it possible to set target sea areas, and the target point and diving depth can be changed by satellite communication during surfacing. In addition, observations can be made regardless of weather, and since the only driving force is buoyancy, it can be operated for long periods of time. In recent years, the construction of data collection systems using underwater gliders has been progressing for regular ocean monitoring by public institutions such as national fisheries research institutes. I am interested in developing ocean monitoring methods to efficiently capture changes in the ocean environment, such as water temperature, salinity, ocean currents, and the mixing process of seawater, using underwater gliders equipped with various sensors such as CTDs (electrical conductivity-temperature-depth meters) as well as current meters and turbulence meters.



Slocum G2 glider

② Vertical turbulent nutrient transport in the western North Pacific and marginal seas

The western North Pacific Ocean and its marginal seas are among the world's most productive marine areas for biological and fishery production. Vertical mixing in the ocean transports dissolved substances such as heat, oxygen, and nutrients across the density surface, contributing to ocean circulation and maintaining the photosynthetic production of phytoplankton in the surface layer. In order to predict the future marine environment with high accuracy, it is necessary to clarify the spatiotemporal variation of vertical mixing intensity and its causes and to appropriately incorporate them into future prediction models. However, because vertical mixing intensity varies greatly in time and space, its quantitative understanding is insufficient. I am conducting research, mainly using ship observations, to identify marine areas where vertical mixing is locally strengthened and to clarify the physical processes involved.



Internal waves detected by echogram

2. Keywords

Ocean observation, underwater glider observation, turbulent vertical mixing

3. Remarks and Websites

Publications:

- Kaneko, H., Tanaka, T., *et al.* (2025) Topographically driven vigorous vertical mixing supports mesoscale biological production in the Tsugaru Gyre. *Nature Communications*, 16, 3656, https://doi.org/10.1038/s41467-025-56917-4.
- Tanaka, T., *et al.,* (2022) In Situ Calibration of Underwater Glider Flight Model Using Acoustic Doppler Current Profilers, *Journal of Atmospheric and Oceanic Technology*, 39(9), 1331-1352, DOI:10.1175/JTECH-D-21-0074.1.

Future prospects: We would like to continue our research activities toward the construction of an automatic monitoring system for the marine environment. We welcome research collaboration with people in related fields.

researchmap: https://researchmap.jp/takahirot

Name	Job Title	Area of Expertise
FUJII Yosuke	Associate Professor	Industrial Engineering

1. Main Research Topics

① **Research on Improving Productivity in the Fishing Industry**

Although the fishing industry is often described as a world of experience and intuition, in reality, it is based on meticulous calculations—it's just that few fishermen quantify, track, and analyze these factors. In Fujii's research, we strive to quantify and understand the realities of the fishing industry as much as possible, with the goal of developing more efficient and safer fishing operations. Specifically, we analyze the sequence of movements involved in hauling fish from the sea and bringing them onboard, how many seconds each movement takes, and how many fish or how many kilograms are hauled in per movement. Based on this understanding, he aims to improve productivity by considering the layout of onboard equipment, workspace, and crew size. In other words, his research focuses on reducing the time required per action and increasing the amount of fish caught per action. He believes this research is crucial for ensuring a stable supply of seafood in the future, especially as the number of fishermen continues to decline.

② **Research on Safety in Fishing Operations**

Compared to land-based industries, the fishing industry has a higher incidence of workplace accidents and a higher accident rate. Improving workplace safety has consistently been a critical issue, and improvements are necessary to ensure a stable workforce for the fishing industry. In response to these challenges, Fujii has collected best practices from safety measures implemented across various regions and analyzed which measures are effective. As a result, he has presented evidence showing that voluntary improvement initiatives implemented by a fisheries cooperative in northern Iwate Prefecture have been effective, and analyzed the factors contributing to this success. We believe that such research contributes to the health and vitality of the fishing and aquaculture industries as professions and plays a vital role in Japan's food production.

③ **Research on Regional Fisheries**

Fisheries are characterized by the fact that their nature varies significantly depending on the characteristics of the region in which they are conducted. Consequently, there are few opportunities for improvements or efficiency gains that can be applied comprehensively across the entire fishing industry. Therefore, it is necessary to understand the characteristics of each region and implement measures tailored to each one. To date, we have analyzed the actual usage of the Production Area Electronic Information Network System operated at the Matsuura Fish Market in Matsuura City, Nagasaki Prefecture. In this study, we analyzed the actual conditions of the digitized wholesale market. Through this analysis, we were able to identify the specific types of fisheries-related information that are considered most important in Matsuura.

2. Keywords

Industrial Engineering, Fisheries Science, Fisheries Economics, Smart Aquaculture

3. Remarks and Websites

We are conducting research focused on community-based fisheries with the aim of improving efficiency. While the promotion of smart aquaculture is underway, the actual introduction of new equipment involves significant costs, making it crucial to determine whether the results will justify the investment. By analyzing these issues from a production engineering perspective, we can verify the effectiveness of such initiatives before implementation. Currently, in collaboration with faculty members from the Fisheries Research and Education Agency and the Faculty of Economics at Meiji University, we are engaged in joint research that examines the fishing industry from the perspectives of accounting and production engineering.

researchmap: researchmap.jp/60782349
Laboratory:

Name	Job Title	Area of Expertise
KAWABE Ryo	Professor (Director of ECSER)	Fish Migration

1. Main Research Topics

Observing animals by tracking them is very difficult. At the Kawabe (Biologging) Laboratory, we are conducting behavioral and ecological research using a method called “biologging,” which involves attaching small recording devices to animals to observe their behavior in their natural environment. The keywords are migration, spawning, feeding, and offshore wind power generation. By attaching depth and temperature sensors to fish, we can obtain information on swimming depth and ambient water temperature. Additionally, by using accelerometers to measure precise “body movements” in seconds, we can record spawning and feeding behaviors. Furthermore, by attaching video cameras to their bodies, we are attempting to observe their feeding environments and social behaviors. Our research areas span from the East China Sea to the Pacific Ocean, and from the waters near Taiwan to Hokkaido. We are tracking the movements of grater amberjack, yellowtail, and yellowfin amberjack, which inhabit subtropical to temperate waters, as well as fish species around offshore wind farms, to study the potential impacts of wind power generation on fish populations and fisheries.

① **Migratory ecology of the genus Seriola**

The genus Seriola (yellowtail, greater amberjack and yellowtail amberjack) is the most important fish species in Japanese fisheries. However, recent global warming may be a factor to genetic disruption among these three species, which have diverged, and natural hybrids between yellowtail and yellowtail amberjack, as well as between yellowtail and grater amberjack, have been discovered. We are conducting research to explore the future of Seriola species by combining bio-logging and genome analysis.

② **The impact of offshore wind power generation facilities on fisheries**

Marine renewable energy is considered promising as a measure against global warming because it can generate electricity without burning fossil fuels. Offshore wind power generation, in particular, is being introduced worldwide, and its introduction is accelerating in Japan as well. However, for local fisheries, the introduction of wind power can lead to a reduction in fishing grounds and restrictions on fishing methods. Therefore, we are tracking fish movements around wind power facilities to investigate the impacts of wind power introduction on fish populations and the fishing industry.

③ **Farmed fish + bio-logging = monitoring fish health and improving farming methods?**

Bio-logging is a powerful tool for studying animal behavior in natural environments, but it also appears to be useful for fish farming. We are conducting research to track farmed fish swimming in net cages in order to monitor their health and improve feeding methods.





2. Keywords

Fish migration, Biologging, global warming, offshore wind

3. Remarks and Websites

- Recent research achievements: Discovery of the spawning ground for greater amberjack in the East China Sea using bio-logging (https://www.nagasaki-u.ac.jp/ja/science/science243.html)
- Message to companies: Offshore wind power generation and fisheries coordination: Advice on fisheries impact surveys, etc.

researchmap: https://researchmap.jp/read0118952
Laboratory: http://sites.google.com/site/biologgingkawabehp/
FaceBook: http://www.facebook.com/BiologgingKawabe

Name	Job Title	Area of Expertise
NISHIHARA Gregory N.	Professor	Aquatic Plant Ecology

1. Main Research Topics

① The carbon flux of macroalgae and seagrass ecosystems and aquaculture systems

Oceans absorb approximately 23% of anthropogenic carbon dioxide emissions, with coastal vegetation playing a crucial role in this uptake. Macroalgae and seagrasses absorb dissolved CO_2 and, through photosynthesis, convert this inorganic carbon into organic carbon (i.e., sugars). Despite their importance, surprisingly little is known about the mechanisms that drive carbon transport into these ecosystems, the efficiency of its conversion, and its long-term fate. Our laboratory is actively investigating these processes in both natural seaweed and seagrass beds as well as in controlled seaweed aquaculture facilities to quantify their contribution to the marine carbon cycle.

② Elucidating the impact and mechanisms of plastic pollution on macroalgae and seagrass ecosystems

Alongside climate change, plastic pollution is a critical threat to planetary health. While attention is often given to microplastics or floating macroplastics that entangle marine animals, debris that sinks to the ocean floor poses a distinct and often-ignored danger. These submerged macroplastics can be highly disruptive to benthic habitats, smothering and damaging seaweed forests and seagrass meadows. Our laboratory investigates the impacts and mechanisms of this process, with a specific interest in how benthic macroplastics lead to a reduction in the size, density, and ecological function of these critical ecosystems.



Accumulating marine debris in the ecosystem can lead to the loss of habitat, biodiversity, and the ability to remove carbon dioxide from the environment.

③ Developing carbon neutral technology for large-scale macroalgae production

Macroalgae are a promising source for a new generation of foods, pharmaceuticals, fertilizers, and other commercial products. Their cultivation also offers a powerful tool for climate change mitigation, both by directly sequestering carbon dioxide and by serving as a sustainable alternative to resources with high carbon emissions. Working closely with industry leaders, our lab is developing innovative technologies for large-scale macroalgae production. Our research emphasizes creating carbon-neutral systems and developing novel products that can effectively displace those generated by carbon-intensive industries.

2. Keywords

Macroalgae, Seagrass, Photosynthesis, Blue Carbon, Plastic Pollution, Ecosystem Metabolism

3. Remarks and Websites

Current project: JST CREST (JPMJCR24J5 PI); F-REI (CoPI)

ORCiD: https://orcid.org/0000-0003-2543-1301

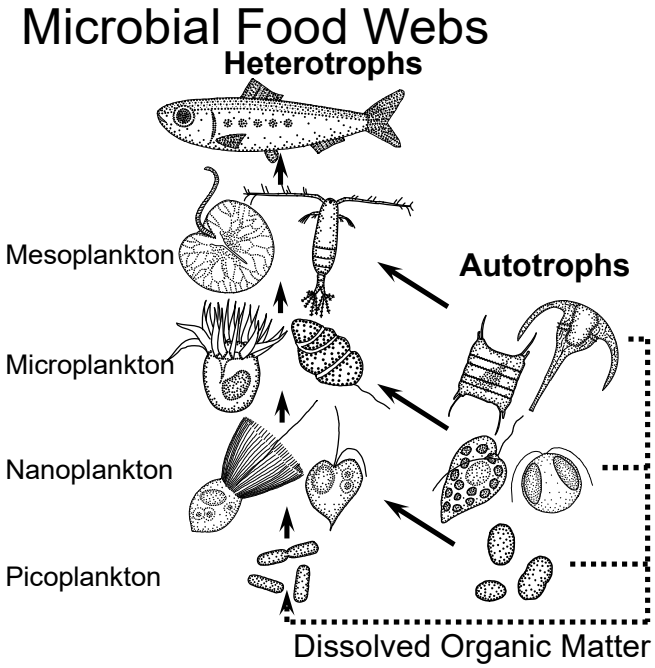
researchmap: https://researchmap.jp/nagaremo

Laboratory HP: https://nagaremo.jp

Name	Job Title	Area of Expertise
SUZUKI Toshikazu	Professor	Planktology

1. Main Research Topics

Marine plankton is an ecological group which includes huge numbers of individuals and species, and its constituents and structures are extremely complex. Various plankters have their delicate and ingenious survival strategies, and they hold their balance by relating to each other. Plankton is an indispensable key to the stability of marine ecosystem, and to understand its components and biological process is the main theme of my research.

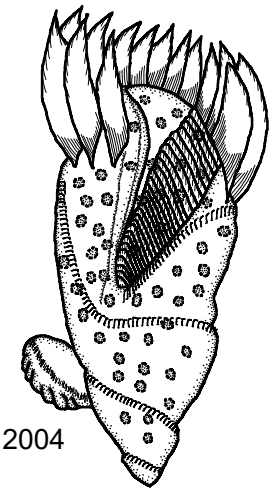


(1) **Carbon flux passing through plankton communities**

Based on the investigation of abundance, nutritional mode and individual size of marine plankton, I am trying to understand plankton food webs in the water column and carbon flux passing through plankton communities.

(2) **Species diversity of marine aloricate ciliate plankton**

Although aloricate ciliates are abundant in the water column, they have not yet been well investigated because of their difficulties in collection, fixation and microscopic observation. So, I am trying to clarify their species diversity and population dynamics.



Spirotontonia grandis (Suzuki & Han, 2000) Agatha, 2004

2. Keywords

plankton, marine microbial food webs, aloricate ciliates in the water column

3. Remarks and Websites

So far, we have conducted research to clarify the basic ecology of unicellular plankton in various sea areas. In the future, we would like to focus on various plankton groups in the East China Sea and off the west coast of Kyushu, and play a part in the progress of marine ecology through clarifying their way of life.

researchmap: https://researchmap.jp/17301-suzuki

Name	Job Title	Area of Expertise
AMANO Masao	Professor	Marine Mammalogy

1. Main Research Topics

① **Social structure of odontocetes**

Odontocetes encompass a wide range of species, varying from those with simple, temporaryh social structures to those that establish complex, enduring societies. By elucidating the social structure of each species and performing interspecies comparisons, we can enhance our understanding of social evolution not only in odontocetes but also in other mammals, including primates. Our laboratory is advancing research aimed at clarifying the social structures of male sperm whales, which have received limited attention, alongside bottlenose dolphins, which are extensively studied globally. The former focuses on how males develop long-term social bonds, while the latter examines the factors that contribute to variations in social structures within the same species.

② **Ecological research on the narrow-ridged finless porpoise**

The narrow-ridged finless porpoise is a small odontocete that inhabits the coasts and large rivers of East Asia. Due to its strong coastal nature, it is particularly vulnerable to human activities, leading to reported declines in population across several regions. This species is listed as endangered on the IUCN Red List. To conserve this species, comprehensive ecological information is essential. Our laboratory is collecting data on the life history, diet, and distribution of finless porpoises in Omura Bay, Ariake Sound/Tachibana Bay, and Seto Inland Sea to Genkai-Nada populations through studies of both stranded individuals and wild populations.

③ T**axonomy on odontocetes**

Odontocetes, despite inhabiting oceans with few geographical barriers, have undergone significant differentiation, resulting in a highly diverse taxonomic group. Among the taxonomic groups currently treated as single species, many contain multiple species that should be recognized as distinct. This is particularly evident in the case of the Pacific white-sided dolphins in the Sea of Japan. We primarily conduct research on the taxonomy of odontocetes from a morphological perspective.

2. Keywords

Cetacea, Odontoceti, Social structure, Ecology, Taxonomy

3. Remarks and Websites

researchmap: https://researchmap.jp/masaoamano
Laboratory: https://www7b.biglobe.ne.jp/~masaoamano/

Name	Job Title	Area of Expertise
SAKAKURA Yoshitaka	Professor	Aquaculture Biology

1. Main Research Topics

I am interested in the early life stages of marine fishes. I want to know how these tiny (ca. 2 mm to 40 mm), voiceless larvae and juvenile fishes thrive in the ocean. I believe that understanding the early life history of marine fishes will also be useful for rearing fishes (aquaculture), which is why I collaborate with people from various fields.

① **Early life history of Genus *Seriola* in the East China Sea**

Genus *Seriola* (yellowtail *S. quinqueradiata*, yellowtail kingfish *S. lalandi*, and greater amberjack *S. dumerili*) are important for both fisheries and aquaculture in Japan. We are about to identifying where the spawning grounds of these species are located in the East China Sea, which is the field site of Nagasaki University, through field surveys in these 10 years. We are also working on the recruitments and speciation of Seriola species in the Japanese waters. In addition, we have discovered that natural hybridization is occurring among these species in the East China Sea. We are investigating whether this phenomenon may be due to changes in the marine environment, such as climate change.

② **Physiological Functions of Tetrodotoxin in the Pufferfish Juveniles**

The starting point for this research topic was the stock enhancement program of tiger pufferfish (*Takifugu rubripes*). When juvenile tiger pufferfish are released in the wild, they are often preyed upon immediately after release. While seeking for ways to prevent predation after release, we turned to research on pufferfish toxin (tetrodotoxin). We revealed that tetrodotoxin serves not only as a defensive toxin to protect juvenile tiger puffers from predators, but also accumulated in the brain and functions to reduce overcrowding stress and other physiological effects.

③ **Improving the Efficiency of Larviculture (Seedling Production) of Marine Fishes**

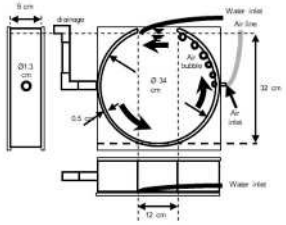
The fish baby (larvae) that newly hatched from eggs are only a few millimeters in size, very fragile, and will only feed on live and moving prey. Therefore, to achieve sustainable aquaculture with closing the life cycle of fishes, it is necessary to create an environment where fish larvae do not experience physical stress and to provide live zooplankton as feed.

With this in mind, I have been conducting research focusing on water flow in rearing tanks. By generating various types of flows and observing how larvae respond, as well as studying the correlation with their survival and growth, I have been working to determine the optimal conditions for larval rearing.

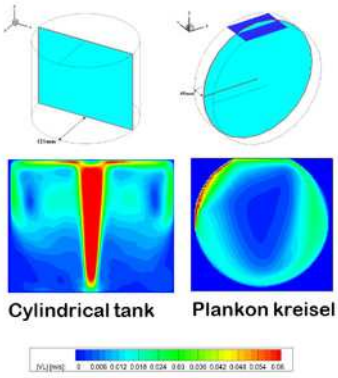
I am also investigating how larvae respond to zooplankton and how this affects their survival and growth, from behavioral and physiological perspectives.

I believe these findings will lead to greater efficiency and advancement in larviculture technology for marine fishes, and to serve as key technologies for promoting sustainable aquaculture.

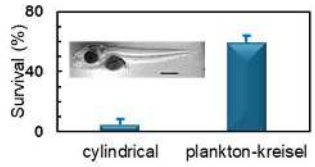
Plankton kreisel tank



Comparison the flow field between cylindrical and plankton-kreisel tanks



Survival of bluefin tuna larvae



2. Keywords

Marine fishes, Early Life, Larvae, Juvenile, *Seriola*, Pufferfish, Larviculture

3. Remarks and Websites

There is much to learn from both the field and the laboratory, and I believe that by driving both wheels, we can advance fisheries science as an applied science.

researchmap: https://researchmap.jp/sakakura?lang=en
Laboratory: https://www3.cncm.ne.jp/~sakakura/english/index_E.html
ORCID: https://orcid.org/0000-0003-0205-8364

Name	Job Title	Area of Expertise
YAMAGUCHI Atsuko	Professor	Ichthyology, Fisheries Biology

1. Main Research Topics

1) **Fish Taxonomy, Ecology, Behavior, Fisheries, and Conservation**

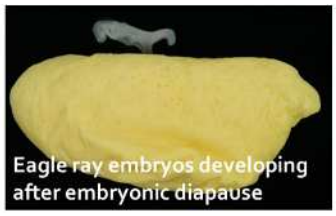


I conduct comprehensive research on the classification, distribution, ecology, migration, and behavior of diverse fish species in Japan and abroad. Despite challenges such as high mobility and difficulty in collecting some species, I focus on fieldwork. My studies have covered many species—including sharks, rays, croakers, pufferfish, soles, and butterfish—spanning their early life stages, reproduction, growth, diet, migration, and seasonal movements. I also assess fisheries impacts and work on conservation initiatives, serving as a committee member for Japan's Ministry of the Environment and the IUCN Red List.

2) **Impact of Oceanic Environmental Changes (e.g., Global Warming) on Fish and Ecosystems**

I investigate how rising sea temperatures and other environmental changes affect fish behavior and distribution, especially among herbivorous species such as rabbitfish and parrotfish. I've also studied the effects of warming and heavy rainfall on the movement and habitat of rays and sharks. For butterfish, I identified salinity as a key factor in their reproductive success—highlighting the importance of variables beyond just temperature.

3) **Reproductive Strategies and Embryonic Diapause in Sharks and Rays**



Embryonic diapause is a reproductive strategy that delays embryo development to optimize birth timing. I was the first to document a 9.5-month diapause in the eagle ray. Currently, I focus on how environmental and community-level factors regulate this process, aiming to understand how such flexibility contributes to biodiversity and vertebrate evolution.

4) **Ecosystem-Based Management Using Top-Down Control**

My work explores how top predators—mainly sharks and rays—affect marine ecosystems through food webs. By revealing the trophic structure, I aim to develop new ecosystem-based management strategies that promote both biodiversity conservation and sustainable productivity.

5) **Research on History and Food Culture**

I also study traditional fish-eating culture, the history of the sharks and rays skin trade, and the development of fisheries in Nagasaki. My research includes fieldwork on Asian culinary traditions, especially the history of Karasumi (dried mullet roe) in Nagasaki, Taiwan, and China. In the past 5 years, I've produced calendars based on Gluver Atlas (historical fish illustrations) and my own research findings.

2. Keywords

Elasmobranchs (Sharks and Rays), Ecology, Fisheries Resources, Global Warming, Reproduction, Feeding Ecology, Marine Ecosystems, Top-Down Control, Ariake Sea, Satoumi (Sustainable Coastal Seas), Biodiversity Conservation, Embryonic Diapause, East Asia, Thailand, Food Culture, Karasumi (Dried Mullet Roe)

3. Remarks and Websites

We conduct broad research across ichthyology, focusing on diverse taxa—from the eggs and larvae of small bony fishes to large sharks and rays—mainly through field studies in Japan and abroad. One unique and significant area of our work is the study of embryonic diapause in sharks and rays, which has important implications for understanding the evolution of all vertebrates.

Our research relies heavily on marine fieldwork, where success often depends on knowing exactly when, where, and how to collect the right specimens. Despite limited knowledge and methods for studying marine ecosystems, we have built extensive experience through over 30 years of research across various environments and fisheries. Balancing both basic and applied science, we aim to deepen scientific understanding while contributing to society.

researchmap: https://researchmap.jp/atsuko-yamaguchi
Research news: https://www.nagasaki-u.ac.jp/ja/science/science262.html
https://www.nagasaki-u.ac.jp/ja/news/news4551.html

Name	Job Title	Area of Expertise
WADA Minoru	Professor	Aquatic Microbiology

1. Main Research Topics

① Assessment of hypoxic water mass formation and its ecological consequences in enclosed coastal environments

We are conducting research in Omura Bay, Nagasaki Prefecture—one of Japan's most enclosed coastal bays—monitoring the development of hypoxic water masses in the bottom layer during summer and assessing their impacts on the ecosystem. In collaboration with local fishers and municipalities, our goal is to contribute to the conservation of biodiversity and fisheries resources within the bay. Given that hypoxia strongly affects benthic organisms, we focus primarily on monitoring changes in the abundance and community composition of bacteria and meiofauna within the sediments.

Selected Publications:

1. 森郁晃, & 和田実. (2024). 海底堆積物表層の微生物群集と貧酸素水塊の相互作用. *沿岸海洋研究*, *62*(1).
2. Mori, F., Umezawa, Y., Kondo, R., Nishihara, G. N., & Wada, M. (2021). Potential oxygen consumption and community composition of sediment bacteria in a seasonally hypoxic enclosed bay. *PeerJ*, *9*, e11836.
3. Nguyen, Q. T., Kim, D., Shimanaga, M., Uchida, J., Aoshima, T., & Wada, M. (2020). Horizontal distribution of nematode communities in a seasonally-hypoxic enclosed sea (Omura Bay, Japan). *Journal of Oceanography*, *76*(6), 479-489.

② Eco-Health Studies in the Mekong River Basin

The Mekong River, the longest river in Southeast Asia, supports a population roughly twice that of Japan through its rich biodiversity and abundant biological resources. However, in recent years, rapid development and the effects of climate change have led to a marked decline in both biodiversity and resource availability in the river basin. Our research adopts an Eco-Health approach—a socio-ecological perspective that integrates ecosystem and human well-being—to promote the sustainable use and management of biological resources in the Mekong River watershed. We have been involved in international collaborative studies in parts of the Mekong Basin, particularly in Vietnam and Cambodia. These projects have examined microbial communities in brackish aquaculture facilities, assessed local residents' well-being, and investigated the biological characteristics of underutilized fish species

Selected publications:

1. Zhu, H., Takeoka, J., Sokra, I., Horn, L., Ngy, L., Iguchi, K. I., Utsunomiya, Y., Wada, M., Yamada, A., Yagishita, N., Takatani, T., & Arakawa, O. (2025). Regional differences in intra-body distribution of saxitoxins in freshwater pufferfish Pao sp. A from Cambodia. *Toxicon*, *259*, 108363.
2. Iguchi, K. I., Tayama, J., Hamasaki, H., Ota, T., & Wada, M. (2022). Impact of livelihood and economic considerations on happiness in the Mekong River Basin, Cambodia. *Aquaculture Science*, 70(4), 381-384.
3. Wada, M., Mori, F., Yokouchi, K., Yagi, M., Takita, T., Ishimatsu, A., Iwataki, M., Takahashi, K., Mai, H. V., Vo, T. T., Ha, H. P., & Tran, D. D. (2016). Comparison of planktonic microbial abundance and dissolved oxygen consumption between the aquaculture ponds of mudskippers and shrimps in the Mekong Delta, southern Vietnam. *Fisheries science*, *82*(5), 787-797.

2. Keywords

Hypoxic water mass, Aquatic microorganisms, Benthic ecosystem, Eco-Health

3. Remarks and Websites

researchmap: https://researchmap.jp/read0052736

Name	Job Title	Area of Expertise
TAKEGAKI Takeshi	Associate Professor	Evolutionary Ecology, Behavioral Ecology

1. Main Research Topics

My laboratory is promoting evolutionary and behavioral ecological research focusing on reproductive strategies in aquatic organisms such as fish and cephalopods (squid and octopus).

① **Evolution of parental care behavior**

Parental care behavior aims to increase the survival and growth of offspring, but at the same time, care involves a significant burden (cost). Therefore, parents often abandon care or even kill and eat their own offspring. This phenomenon of filial cannibalism has been observed in many fish species that take care of their offspring. In our laboratory, we are investigating the evolution and mechanisms underlying filial cannibalism using a blennid fish *Rhabdoblennius nitidus*, a species in which male parents protect eggs, as our model organism.

② **Sperm competition and alternative reproductive tactics**

Sperm competition is a strong force driving the evolution of various traits, including behavior, morphology, and life history. Fish show particularly diverse alternative reproductive strategies among animals, which is likely due in large part to the diversity of spawning styles facilitated by external fertilization, as well as the close relationship between sperm competition and these tactics. The parasitic spawning behavior known as the “sneaking tactic,” where males try to achieve reproductive success by participating in the spawning of dominant males, is the most common alternative reproductive tactic in fish. In our laboratory, using a goby *Bathygobius fuscus* as a model organism, we are investigating the evolution of various reproductive traits related to fertilization success between nest-holding males and sneaker males, such as the unique fertilization patterns and sperm removal behaviors of nest-holding males, and the large testes, long-lived, and fast-swimming sperm of sneaker males.

2. Keywords

Behavior, Ecology, Evolution, Reproductive Strategy, Sperm Competition, Parental Care, Alternative Tactics, Infanticide, Fish, Cephalopods

3. Remarks and Websites

researchmap： https://researchmap.jp/read0118951
Laboratory: https://takegaki3.wixsite.com/takegakilab

Name	Job Title	Area of Expertise
KONDO Yoshiko	Associate Professor	Marine Biogeochemistry

1. Main Research Topics

In recent years, understanding the behavior of not only major nutrients such as nitrogen and phosphorus, but also trace metal elements such as iron, which act as the active centers of various enzymes that catalyze chemical reactions in living organisms, and related substances has become widely recognized as important for elucidating the mechanisms of marine biogeochemical circulation and their impact on marine ecosystems. Our laboratory focuses on the basin-scale distribution and circulation of these trace nutrients, which exist in extremely low concentrations in seawater, and their relationship with marine primary production. Elucidating these ocean circulation mechanisms will lead to a better understanding of the mechanisms of primary production responsible for the absorption of carbon dioxide into the ocean, making it an urgent issue for achieving a sustainable global environment.

① **Biogeochemical Cycle of Fe in the Ocean**

Among the trace metal elements, the behavior of iron in the ocean often exhibits distinct trends compared with other elements. One reason for this is that the inorganic solubility of iron in seawater is extremely low. The concentration of dissolved iron depends on the organic ligands that form iron complexes. Therefore, the distribution of natural organic ligands that form organic complexes with iron is an important factor that controls the marine iron cycle. In contrast, in reducing environments, such as hypoxic water masses, some parts of dissolved iron exist as ferrous iron, which is more soluble in seawater. To understand the mechanism of the iron cycle in seawater, we study the distribution of the chemical speciation of iron in the ocean.

② **Impact of Micronutrients on Phytoplankton Growth**

To understand the mechanisms of marine primary production, it is important to understand the limiting factors. For example, the major nutrient concentrations in the North Pacific vary latitudinally. Iron is known to be the major limiting factor for primary production in the high-nutrient, low-chlorophyll subarctic zone, whereas nitrogen is the major limiting factor in the oligotrophic subtropical zone. However, in recent years, it has been suggested that natural phytoplankton growth can be limited by a single nutrient or by two or more nutrient deficiencies simultaneously, resulting in “co-limitation.” Furthermore, the bioavailability of iron varies depending on its chemical form. Based on this background, we are investigating the limiting factors for the growth of natural phytoplankton communities and the effects of differences in the chemical form of iron on their growth.

2. Keywords

Ocean, Trace Metals, Iron (Fe), B Vitamins, Phytoplankton

3. Remarks and Websites

researchmap: https://researchmap.jp/kondoyoshiko
Laboratory: https://chemocean-kondo.wixsite.com/home

Name	Job Title	Area of Expertise
TAKEUCHI Seiji	Associate Professor	Marine Benthic Ecology

1. Main Research Topics

(i) Study on the Mechanisms of Community Dynamics in Marine Benthic Systems

We are conducting research on macrobenthos (especially bivalves; **Fig. 1**) that live on the sandy bottoms of the intertidal and subtidal zones of the coastal waters of Nagasaki. Thus far, our research has revealed that the intensity of tide-induced benthic disturbances affects the species diversity of bivalves, with the number of species being highest in environments with moderate disturbances. We will continue the research to elucidate the mechanism of long-term community dynamics.

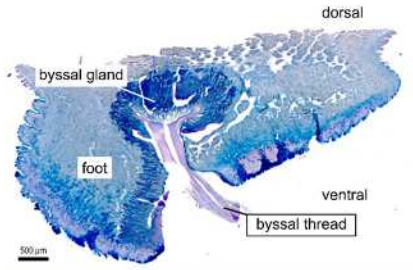


⬆Fig. 1. Some of the bivalve mollusks found in the study area.

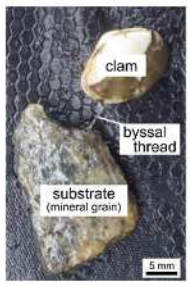
Publications: Takeuchi *et al.* (2016) *Journal of Shellfish Research* 35(4): 785–799; Takeuchi *et al.* (2017) *Journal of Shellfish Research* 36(3): 577–584; Takeuchi *et al.* (2019) *Journal of Sea Research* 153: 101794; Takeuchi *et al.* (2024) *Plankton and Benthos Research* 19: 125–140.

(ii) Study on the Mechanisms of Habitat Formation of Manila clams (*Ruditapes philippinarum*)

The annual catches of this species in Japan have decreased dramatically, and the cause of this decline has yet to be identified. One possible reason for this is that there is not yet a sufficient and fundamental understanding of favorable habitats for this clam species. We focus on their juvenile stage, in which mortality is comparatively high, and are working to clarify the environmental characteristics that can support their survival. Thus far, our research has revealed that *R. philippinarum* clams cannot burrow into the sediments rapidly, and are easily dislodged from the sediments. In particular, the loss of juvenile clams due to seabed disturbances associated with winter waves is considerable. On the other hand, *R. philippinarum* clams can secrete byssal threads from the byssal gland in the foot, and the thread adheres to a substrate on the bottom or in the sediments for firm anchorage (**Figs. 2 and 3**); however, the effectiveness of this attachment behavior and their substrate preferences remain unknown.



⬆**Fig. 2.** Histological section of the foot of *Ruditapes philippinarum* clams in the sagittal plane.



⬅**Fig. 3.** A clam adhering to a mineral grain with a byssal thread.

Publications: Takeuchi *et al.* (2015) *J. Exp. Mar. Biol. Ecol.* 466: 9–23; Takeuchi *et al.* (2018) *J. Sea Res.* 138: 8–18; Takeuchi *et al.* (2020) *Acta Zoologica* 101: 392–403.

2. Keywords

Population dynamics; Community dynamics; Benthos; Benthic invertebrate; Bivalve; Tidal flat; Sediment grain size; Benthic disturbance

3. Remarks and Websites

Collaboration for research on the resource dynamics of commercially valuable bivalves is possible.

researchmap: https://researchmap.jp/stakeuchi/

Name	Job Title	Area of Expertise
NAKAMURA Itsumi	Associate Professor	Behavioral Ecology and Physiology

1. Main Research Topics

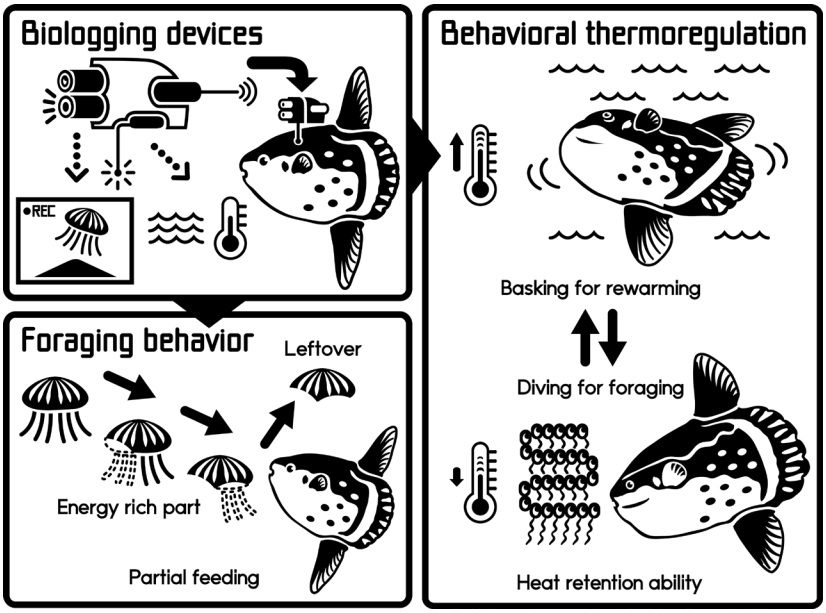
I study the behavioral ecology and physiology of fish in captivity and in the wild using bio-logging, which attaches recording devices to animals to monitor their natural behavior and physiological states. My main focus is on fish and temperature, aiming to clarify thermoregulation mechanisms and understand how changes in marine temperature affect fish behavior and distribution.

① **Research on the Behavioral Ecology of Fish**

I focus on feeding-related behaviors. Bio-logging allows studying feeding ecology beyond what gut content analysis reveals. By attaching behavior recorders and video cameras to fish released into the wild, I observe behaviors from prey searching to selective feeding. This helps predict how fish respond to prey distribution and temperature alongside behavioral thermoregulation.

② **Research on the Behavioral Physiology of Fish**

I focus on thermoregulatory behavior. Most fish are ectothermic, relying on water temperature, but they use the thermal environment to maintain suitable body temperatures. By attaching thermometers and measuring fish body and water temperatures simultaneously, I study behavioral thermoregulation and predict temperature-driven changes in fish behavior and distribution. Additionally, fish can physiologically regulate heat exchange to delay cooling or speed recovery. By recording electrocardiograms with body temperature, I investigate physiological mechanisms of temperature recovery and maintenance in cold water.



2. Keywords

Bio-logging, Foraging Ecology, Behavioral Thermoregulation

3. Remarks and Websites

Recent bio-logging research has challenged conventional views, but studies on ectothermic fish—whose body temperature was assumed to match water temperature—remain limited. With rapid ocean warming due to climate change, understanding how fish respond to temperature shifts is crucial. In collaboration with aquariums, we attach bio-logging devices to fish temporarily held in captivity before releasing them, helping reveal the ecology of rare species in the wild.

researchmap: https://researchmap.jp/itsumi
Laboratory: https://itsumola.wixsite.com/itsumi (in Japanese)

Name	Job Title	Area of Expertise
KAWABATA Yuuki	Associate Professor	Animal Behavior

1. Main Research Topics

① Escape and pursuit trajectories of prey and predators

We study the pursuit and escape behaviors of predators and prey in various animals, including fish, crustaceans, birds, and insects, using experiments, observations, and mathematical models. In particular, we geometrically analyze the escape trajectories of prey and the pursuit trajectories of predators to understand why animals move along particular paths. These findings are important not only for basic research in animal behavior, but also for considering the impacts of human activities on wildlife and possible mitigation measures, such as reducing collisions between wild animals and vehicles.

Recent research outcomes (press release):

・The great escape-An updated mathematical model reveals new insights into how prey optimize their escape routes to avoid being captured by predators (2023/03/31)

・Revolutionary Device Developed to Automatically Detect Predators to Enable Swift Escape of Prey (2024/05/14)

② Evolution of unique behaviors in animals

Some animals show highly unique behaviors. For example, many crabs move sideways, which is a very rare behavior in the animal kingdom as a whole. Why and how has this sideways movement evolved? To answer this question, our laboratory combines behavioral data from diverse crab species with phylogenetic information to examine the evolutionary history and adaptive significance of sideways movement. We also study other unique behaviors, such as juvenile Japanese eels escaping from a predator's gills after moving through the digestive tract following ingestion by the predator. Through these studies, we aim to clarify why and how unique behaviors have evolved.

Recent research outcomes (press releases):

・When Did Crabs Acquire Their "Sideways Walking"?— Study suggests crabs' iconic sideways walk evolved from common ancestor — (2026/04/22)

・Watch these Japanese eels escape from their predator's stomach (2024/09/09)

2. Keywords

Animal behavior, Behavioral ecology, Predator–prey interactions, Escape behavior, Pursuit behavior, Evolution, Video analysis, Mathematical models, Fish, Crustaceans, Birds

3. Remarks and Websites

We value highly original research that has not been explored by others and enjoy conducting such studies together with students. We study diverse animals, including fish, crustaceans, birds, and insects, by combining experiments, field observations, video analysis, mathematical models, morphological analysis, and phylogenetic analysis to understand fascinating biological phenomena. We will continue to collaborate with researchers from various fields and communicate the fascination of biological phenomena, especially animal behavior, to a wide audience.

researchmap: https://researchmap.jp/KawabataYuuki
Laboratory: https://sites.google.com/site/kawabatalaboratory/

Name	Job Title	Area of Expertise
YAMATE Yuta	Assistant professor	Cephalopod Ecology

1. Main Research Topics

① Ecology of Toxin Possession in Blue-lined Octopuses



The blue-ringed octopus is well known as a species that carries the potent neurotoxin tetrodotoxin (TTX), also infamous as the toxin found in pufferfish. TTX is mainly concentrated in a specialized organ called the posterior salivary gland, but it is also present in the muscles and skin throughout the body. The TTX stored in the posterior salivary gland functions as an offensive weapon: blue-lined octopuses bite prey organisms or predators to inject the toxin, thereby facilitating both predation and defense. In contrast, TTX present in the muscles and skin has been shown to be spontaneously released from the body surface, suggesting that it also acts as a deterrent against predators. More recently, studies have revealed that male blue-ringed octopuses bite females during copulation and inject them with venom. Ongoing research is now exploring the ecological significance of this behavior, particularly the potential benefits for males of using toxins during reproduction.

② Feeding Ecology of the Japanese Pygmy Octopus

The Japanese pygmy octopus (*Octopus parvus*) is a small species inhabiting intertidal zones. Compared with *Octopus sinensis* or *Amphioctopus fangsiao*, *O. parvus* is smaller in body size, forms dense populations, and can be easily collected. These traits make it a suitable species for ecological research, and our laboratory has conducted various studies on it. As octopuses are voracious carnivores that prey on a wide range of organisms, understanding their foraging behavior in the wild is essential for clarifying their ecology. Field observations revealed that *O. parvus* exhibits two distinct foraging patterns: (1) "outside-foraging," in which prey captured outside the den is consumed on the spot, and (2) "den-returning foraging," in which prey is carried back to the den for consumption. Interestingly, the prey types differ depending on the foraging pattern. We are now conducting more detailed investigations into these behaviors, including studies focusing on the reproductive ecology of this species.

③ Development of Seed Production Techniques for Octopuses

Octopuses are highly valued seafood in Japan, and their demand is increasing worldwide. However, in recent years, declining catches and rising demand have led to soaring market prices. In Japan, research on octopus aquaculture and seed production has been conducted for decades, and aquaculture techniques have been gradually established. Nevertheless, the production of farmed octopuses at prices low enough for large-scale commercial distribution has not yet been achieved. One of the major challenges is securing food for newly hatched paralarvae. Traditional live feeds are difficult to obtain and maintain, creating a bottleneck in octopus seed production. To address this, our laboratory is exploring the use of freshwater cladocerans (water fleas), which are easier to culture and more readily available, as an alternative first food for octopus hatchlings.



Juvenile *O. parvus* feeding on water fleas

2. Keywords

Cephalopods, behavioral ecology, toxin ecology, feeding ecology, reproductive ecology, octopus aquaculture, tetrodotoxin

3. Remarks and Websites

Our laboratory mainly focuses on studying various aspects of octopus ecology that have received relatively little attention so far. Our research spans a wide range of topics, from fundamental studies on survival and reproductive strategies of octopuses to applied research such as aquaculture and seed production. We plan to continue expanding our work across these diverse fields in the future.

researchmap: https://researchmap.jp/hyoumon
Laboratory: https://takegaki3.wixsite.com/takegakilab

Name	Job Title	Area of Expertise
KUWANO Kazuyoshi	Professor	Marine Plant Science

1. Main Research Topics

① **Research on sea desert**

There are various hypotheses about sea desert, but it is not well understood. We are focusing on the quality of seawater and studying its relationship to sea desert.

② **Development of the production of seaweed seedlings**

We are developing the technology for the production of seaweed seedlings.

2. Keywords

Sea desert, Seaweed seedlings

3. Remarks and Websites

researchmap: https://researchmap.jp/sotaatos

Name	Job Title	Area of Expertise
SATUITO Glenn	Professor	Ecology of Fouling Organisms, Bivalve Aquaculture

1. Main Research Topics

The settlement of attaching organisms, such as barnacles, tunicates and oysters on structures deployed in the sea affects various maritime activities. Attaching organisms undergo a planktonic larval phase before they finally settle on suitable substrates and grow into adults. We believe that clarifying the mechanisms of their settlement behavior will lead to the development of new technologies that can increase the production of economically important species and mitigate settlement of nuisance species in an eco-friendly manner.

① **Investigating the chemical basis of the gregarious settling in oyster larvae**

Oysters exhibit a strong gregarious behavior and larvae prefer settling on sites where adults are present. To elucidate the chemical basis of the gregarious settling in oyster larvae, we attempted to extract and identify the inducing substance in the shell of adult oysters. We found that several shell matrix proteins acting as settlement pheromone protein components (CGSPPC) were responsible for the gregarious settlement on conspecifics, and biochemical and molecular analyses revealed that Gigsin-6 isoform X1 and/or X2 is a major inducing cue for oyster larval settlement. This finding can lead to the development of more efficient oyster spat collectors that can improve larval settlement during seedling production.

② **Using sea anemone as an agent to control biofouling in oyster culture**

Oyster culture farms in Isahaya Bay, Nagasaki, Japan are usually heavily fouled by attaching organisms, such as barnacles and tunicates, leading to high oyster mortality and low production. We investigated the possible use of the sea anemone *Aiptasiomorpha minuta* as an agent to control biofouling in oyster farms by inoculating oyster collectors with sea anemones and comparing biofouling with control oyster collectors. We found that inoculating oyster collectors with sea anemones effectively mitigated biofouling. We also found higher growth and survival in oysters cultured with sea anemones. Using sea anemones as a biofouling control agent is currently being tested by oyster farmers in other localities.



Oyster collector heavily fouled with barnacles (control collector)



Oyster collector inoculated with sea anemones (note that there is minimum biofouling and larger oysters compared to the control)

③ **Development of suitable diets for larvae of various marine invertebrates**

The culture of various marine invertebrate larvae is heavily dependent on the mass cultured diatom *Chaetoceros gracilis* for food. Currently, we are investigating the dietary value of other phytoplanktons, including commercially available refrigerated algae on the growth of sea urchin larvae. Ultimately, we aim to develop a diet that will meet the nutritional requirement of sea urchin larvae.

2. Keywords

biofouling, antifouling, bivalve aquaculture

3. Remarks and Websites

researchmap: https://researchmap.jp/nufs-mgallo77
Laboratory: https://heejin0.wixsite.com/ecolab

Name	Job Title	Area of Expertise
SUGA Koushirou	Professor	Fish Pathology

1. Main Research Topics

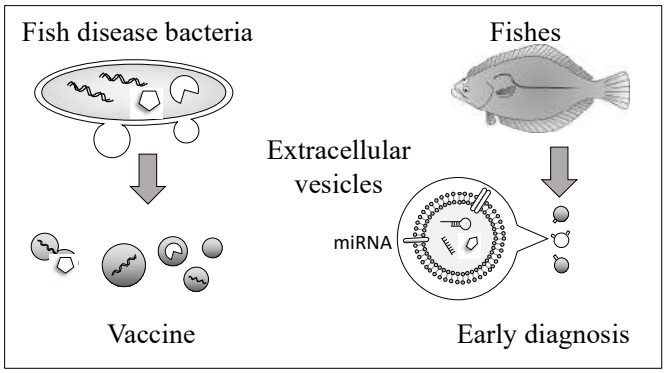
My research focuses on the pathogenesis of diseases that affect economically important fish species, such as those caused by bacterial infections, using molecular biological techniques. Through this work, I aim to develop preventive and therapeutic strategies for application in aquaculture. Currently, the number of approved aquatic animal drugs is limited, and complete recovery from these diseases remains challenging. Therefore, in addition to treating fish diseases, I am also conducting research on prevention, including methods to inhibit the spread of infections and techniques for early disease diagnosis.

1. **Development of a novel oral vaccine**

It is known that organisms use extracellular vesicles called exosomes, which are released extracellularly, to transmit functional molecules and other information between individuals and cells. By applying this biological phenomenon, I am working on the development of a novel oral vaccine using extracellular vesicles derived from fish pathogenic bacteria.

2. **Development of an early diagnostic method**

Extracellular vesicles released by cells have been implicated in various diseases in humans. Since similar mechanisms are expected to exist in fish, I am developing early diagnostic methods that utilize these extracellular vesicles.



3. **Development of a sterilization method using ultra-fine bubbles**

Ultrafine bubbles, approximately 100 nm in diameter, are being utilized to develop a novel sterilization method as an alternative to antibiotics.

4. **Analysis of antibody-like proteins in shrimp**

The Down syndrome cell adhesion molecule (Dscam) found in shrimp is synthesized from a single gene and has been shown to bind specifically to antigens similarly to mammalian antibodies. I am developing pharmaceuticals, such as diagnostic reagents, utilizing shrimp Dscam.

2. Keywords

vaccine, early diagnostic method, novel sterilization method, shrimp Dscam

3. Remarks and Websites

researchmap: https://researchmap.jp/NUF_FP-Lab_SG-KSR

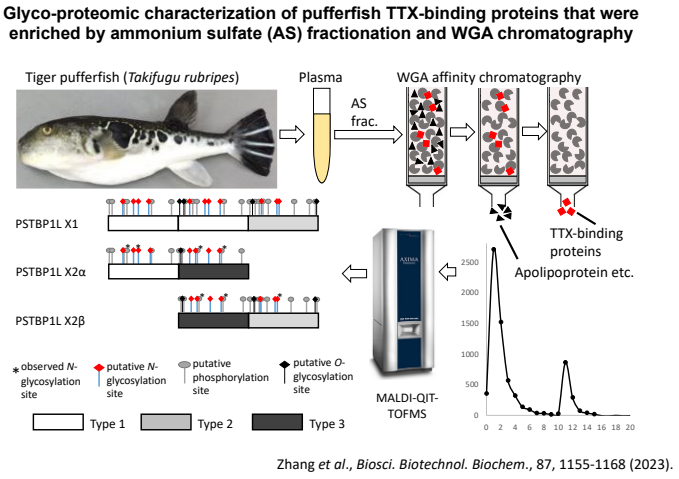
Name	Job Title	Area of Expertise
YAMAGUCHI Kenichi	Professor	Biochemistry (Protein Chemistry)

1. Main Research Topics

Our laboratory conducts research on the structure and function of enzymes and proteins that contribute to the palatability of seafood and seaweeds, under the theme **"Science of Sake Appetizers (Fish and Seaweeds)**

① Proteomics and Proteoform Analysis of PSTBP Homologs in Pufferfish

From the plasma of *Takifugu pardalis* (Higanfugu), a liver-derived glycoprotein named PSTBP (Pufferfish Saxitoxin and Tetrodotoxin Binding Protein) was isolated, and it has been suggested to play a role in the in vivo transport of toxins (Yotsu-Yamashita et al., 2001). PSTBP possesses a tandem repeat structure of two lipocalin domains; however, the molecular mechanisms underlying its specific binding to toxins, as well as the transport and accumulation of toxins in various tissues, remain unclear. In our laboratory, we have been investigating the structure and function of PSTBP homologs using *Takifugu rubripes* (torafugu) as a model species. Recently, by employing glycoproteomic approaches, we identified a novel PSTBP homolog in *T. rubripes* that possesses a three-lipocalin-domain repeat structure (Zhang et al., 2023). Western blot analyses confirmed that both the three-domain and two-domain types of PSTBP homologs are constitutively expressed in at least four *Takifugu* species (*T. rubripes*, *T. pardalis*, *T. niphobles*, and *T. poecilonotus*) (Zhang et al., 2025). Furthermore, PSTBP homologs were found to be expressed not only in the liver but also in other tissues such as skin, muscle, brain, gallbladder, and ovary. Interestingly, these tissue-derived PSTBP homologs exhibited different molecular masses from the liver-derived plasma PSTBP. We are currently performing proteoform analyses — including the characterization of post-translational modifications — to elucidate their chemical structures. In addition, through comparative biochemical analyses within the family Tetraodontidae, we aim to uncover the evolutionary origin of PSTBP and its association with toxin accumulation in pufferfish.



Zhang *et al.*, *Biosci. Biotechnol. Biochem.*, 87, 1155-1168 (2023).

② Structural and Functional Studies on Dry-Heat-Resistant Enzymes and Heat-Soluble Proteins Derived from *Pyropia* (Nori)

It is not widely known that the umami flavor of *nori* (dried *Pyropia*) arises during mastication through the action of an inosine monophosphate (IMP)-producing enzyme derived from the *Pyropia* thallus. This enzyme, adenosine monophosphate deaminase (APDase), converts adenylic acid into IMP, contributing to the characteristic savory taste of *nori* (Araki et al., 1996; Tentaku & Yamaguchi, 2020). Currently, we are isolating dry-heat-resistant APDase from toasted *nori* to analyze its chemical structure and to elucidate the molecular mechanisms underlying its resistance to dry heat. We also aim to examine whether dry-heat-resistant alginate lyase present in *yakinori* contributes to the texture and melt-in-the-mouth quality of *nori*. In addition, we are investigating the structure and function of heat-soluble (HES) proteins that may be involved in desiccation tolerance in *Pyropia*. Based on these studies, we are developing a proteotyping method for species identification of *Pyropia* using HES proteins as potential biomarkers.

2. Keywords

Pufferfish, *Nori* (dried laver) / *Pyropia* spp., Pufferfish Saxitoxin and Tetrodotoxin Binding Protein (PSTBP), Adenosine Monophosphate Deaminase (APDase), Alginate Lyase, Proteomics, Proteoform

3. Remarks and Websites

researchmap: https://researchmap.jp/nu_kenyama
Laboratory: https://seibukka.jimdofree.com

Name	Job Title	Area of Expertise
YOSHIDA Asami	Professor	Marine Biochemistry

1. Main Research Topics

Until now, I have conducted research focusing on muscle proteins, which make up the majority of the edible portion of seafood, and the enzymes (proteases) responsible for their breakdown. Various proteases are inherent in the muscles of fish and shellfish, and these are considered to be one of the key factors that determine the quality of seafood products. Therefore, I have devoted myself to research in the belief that clarifying the structure of endogenous proteases in fish and shellfish, as well as their functions and properties both within the living organism and in food after death, will contribute to the advancement of the seafood processing field. Below, I will introduce the new research themes I am currently working on, utilizing the findings from my previous studies.

① Quality Deterioration of Fish Muscle and Protein: Proteases and Molecular Chaperones

It is known that the muscle of fish consumed as sashimi softens more quickly (meat tenderization) than beef or pork, and for this reason, the decline in quality of fish meat is a particularly rapid issue. In addition, as seawater temperatures rise, a phenomenon called "burnt meat" (muscle whitening) occurs in fish such as yellowtail and tuna, which cannot be judged by the fish's appearance, causing significant losses for those involved in the industry. However, the mechanisms behind such fish muscle quality deterioration phenomena, as well as the mechanisms to prevent them, have not yet been scientifically clarified. Therefore, we are conducting research focusing on the "protein-degrading enzymes (proteases)" that cause meat quality deterioration and the "heat stress response proteins" involved in the mechanism to prevent quality loss.

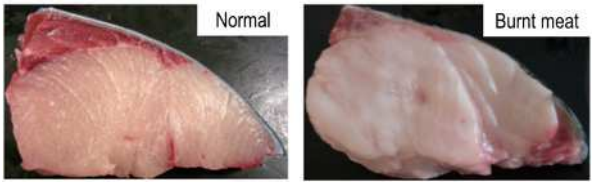


Fig. 1 Fish Muscle Deterioration "Burnt Meat" of Yellowtail

In recent years, we have identified the muscle-specific molecular chaperone UNC-45B as a heat stress response protein that helps prevent protein denaturation and aggregation, which are factors contributing to the deterioration of meat quality in farmed fish due to global warming. The results of this research are expected to aid in the development of aquaculture techniques, such as producing farmed fish less prone to meat quality deterioration.

② Development of Cell-based Fish Meat as a New Seafood Product

To address the global food crisis, "cell-based meat" has been attracting attention. However, when it comes to cell-based fish meat in particular, it remains difficult to fully replicate the taste and texture through 3D cultivation, and practical applications have not yet been achieved. In our laboratory, we are conducting basic research aimed at developing artificially cell-based fish meat (sashimi) as a new seafood product, using pufferfish—of which Nagasaki Prefecture boasts the highest farmed production in Japan—as our material.

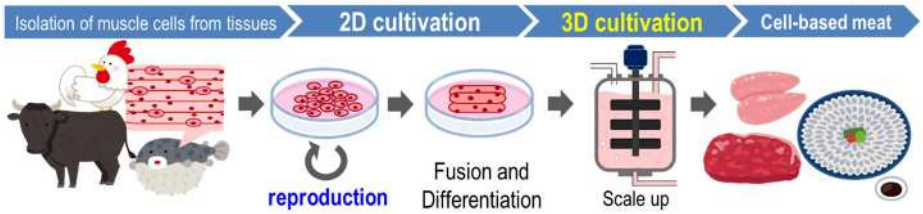


Fig. 2 Schematic Flow of Cell-based Meat

2. Keywords

Proteases, Molecular Chaperone, Heat Stress, Collagen, Cell-based Fish Meat

3. Remarks and Websites

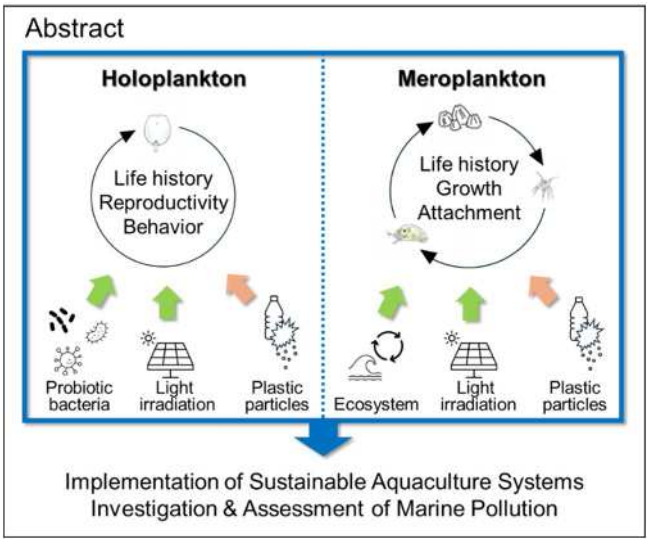
researchmap: https://researchmap.jp/ay-asami

Name	Job Title	Area of Expertise
KIM Hee-Jin	Associate Professor	Plankton Biology and Ecology

1. Main Research Topics

Microorganisms in the ocean are difficult to detect with the naked eye, whereas they play a crucial role in maintaining the functions of marine ecosystems. Among them, the activity of zooplankton is fundamental for driving energy flow and material circulation in the ocean. Plankton can be classified based on their life history into holoplankton, which only have a planktonic life, and meroplankton, which typically have a planktonic larval stage in their life cycle.

My research aims to deepen our biological and ecological understanding of both types of plankton to develop sustainable aquaculture techniques. Furthermore, I investigate the impact of pollutants on these organisms to support effective environmental management and remediation strategies.



① Effects of coexisting probiotic communities on the population growth of plankton

In the hydrosphere, a huge number of bacterial species coexist. Among them, certain species influence the metabolism of multicellular zooplankton. I have developed a symbiotic bacterial community that simultaneously enhances zooplankton population growth and improves the quality of culture water. Currently, I am exploring effective methods to apply this novel material in practical aquaculture settings.

② Patterns of behavior and population growth of zooplankton under different light conditions

Even tiny organisms like zooplankton possess an eyespot, a light-sensitive organ. Since the eyespot can detect differences in light wavelength and intensity, zooplankton exhibit various movement patterns and behaviors in response. I investigate the effects of light wavelength and intensity on zooplankton behavior to determine the mechanisms underlying their vertical distribution and attachment behavior.

③ Ecological characteristics of sea slug

Most marine benthic sea slugs have complex life histories, many of which have remained poorly understood so far. I focus on *Plocamopherus tilesii*, a bioluminescent species with potential as an ornamental organism, and investigate its ecological traits associated with its life cycle to develop a viable aquaculture system and contribute to the conservation of its population.

④ Impacts of nano- and microplastics on zooplankton

Plastic pollution has recently posed an urgent threat due to its adverse effects on marine organisms. In collaboration with the engineering faculty, I assess its impact on zooplankton to provide biological evidence that supports the development of model plastic particles for evaluating the effects of nano- and microplastics on the marine micro-ecosystem.

2. Keywords

Planktonic ecology・Attachment mechanism・Live food production・Marine pollution

3. Remarks and Websites

Antifouling and seedling collection technique using LED lights, Eco-friendly mass culture systems for live food organisms, Sustainable live food production using coexisting probiotics, Innovative aquaculture methods for ornamental marine species

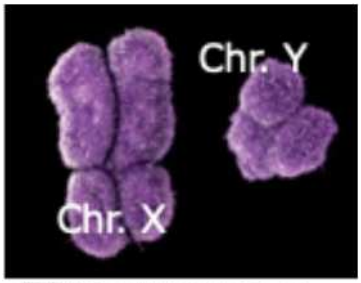
researchmap: https://researchmap.jp/KIM08
Laboratory: https://heejin0.wixsite.com/ecolab

Name	Job Title	Area of Expertise
KOYAMA Takashi	Associate Professor	Genetics, Molecular Biology

1. Main Research Topics

① **Unraveling the Early Evolution of Sex Chromosomes Using Seriola Fishes (Yellowtail)**

It is well known that the human Y chromosome is significantly smaller than the X chromosome, and this is thought to be closely linked to the suppression of recombination between sex chromosomes. But why does recombination become suppressed on sex chromosomes in the first place? Although this question has been the focus of research for decades, no unified explanation has been reached. One major reason is the lack of model organisms possessing sex chromosomes at the very initial stages of recombination suppression.



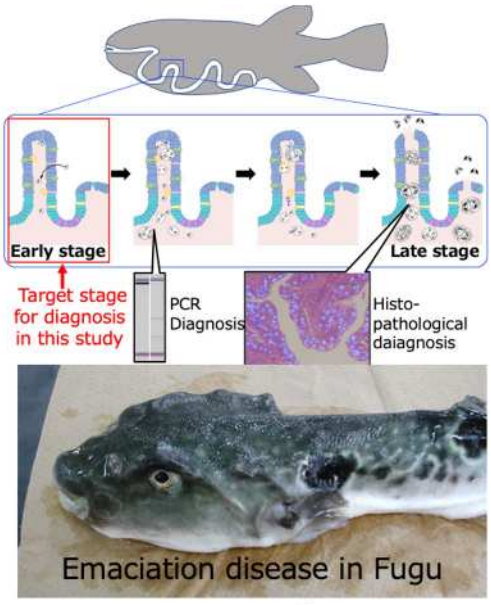
写真はThe New York Times, Apr. 24, 2014より転載

Our laboratory has discovered that the sex chromosomes of Seriola species (yellowtail) retain a state just after the onset of recombination suppression. Based on this finding, our research aims to use Seriola as a model to investigate the fundamental question: Why does recombination suppression occur on sex chromosomes?

② **Development of an Ultra-Early Diagnostic Method for Fish Diseases Using Integrated Transcriptomics and Liquid Biopsy**

In recent years, cell-free RNA (cfRNA)—RNA molecules released from cells into body fluids—has gained attention as a promising biomarker for the early detection of diseases such as cancer and infections. If this approach can be applied to fish disease diagnostics, it may allow us to detect and respond to outbreaks before they occur in aquaculture settings, thereby minimizing losses.

This study focuses on developing such a diagnostic technology, using emaciation disease—a major issue in farmed torafugu (tiger pufferfish) in Nagasaki Prefecture—as a model case.



2. Keywords

Seriola, Sex chromosome, Fugu, Emaciation disease, Next-Generation Sequence, Multi-sample mRNA-seq

3. Remarks and Websites

We have developed a cost-effective method for obtaining and analyzing gene expression data from multiple samples. This approach enables us to detect subtle biological changes that are not apparent from outward appearance.

researchmap: https://researchmap.jp/takashikoyama
Laboratory: Not Applicable

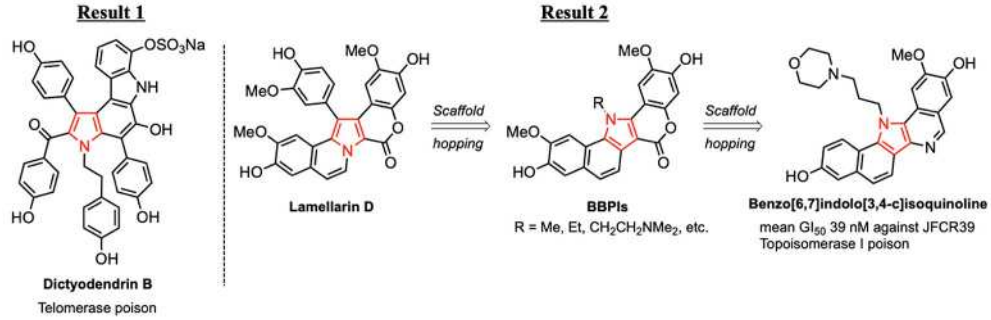
Name	Job Title	Area of Expertise
HIRAO Shotaro	Associate Professor	Natural Products Chemistry, Synthetic Organic Chemistry

1. Main Research Topics

① Research on the Synthesis and Biological Evaluation of Marine-Derived Pyrrole Alkaloids

Marine organisms are rich sources of structurally unique and biologically active natural products, offering valuable opportunities for drug discovery. Among them, pyrrole alkaloids stand out due to their distinctive molecular frameworks and diverse pharmacological activities. Our research focuses on the total synthesis and biological evaluation of marine-derived pyrrole alkaloids, particularly dictyodendrins and lamellarins. We have established efficient synthetic approaches to access these complex molecules and have designed novel lamellarin derivatives through scaffold modifications to improve their drug-like properties. These studies aim to identify promising lead compounds for therapeutic development, especially in anticancer research, and to expand the potential of marine natural products in medicinal chemistry.

References: *Biosci. Biotechnol. Biochem.*, **2009**, *73*, 1764; *Tetrahedron Lett.*, **2010**, *51*, 533; *Biosci. Biotechnol. Biochem.*, **2021**, *85*, 181; *Bioorg. Med. Chem. Lett.*, **2024**, *104*, 129710.



② Isolation and Structural Elucidation of Bioactive Natural Products from Marine Algae

Harmful algal blooms (red tides) caused by species such as the raphidophyte and the dinoflagellate have become a serious problem for fisheries in Japan. Conventional control methods, including chemical treatments and biological agents, are often limited by environmental concerns. Our research aims to isolate and characterize allelopathic natural products produced by marine algae that can selectively inhibit harmful algal species. By identifying the structures of these bioactive compounds, we seek to establish environmentally friendly strategies to mitigate red tide outbreaks and protect marine ecosystems.

References: *Biosci. Biotechnol. Biochem.*, **2005**, *69*, 2186; *J. Appl. Phycol.*, **2008**, *20*, 713; *Biosci. Biotechnol. Biochem.*, **2012**, *76*, 372; *Biosci. Biotechnol. Biochem.*, **2013**, *77*, 1120.

③ Development of Novel Functionalization Reactions Using Activated Carbonyl Compounds

Organic synthesis is essential for creating functional molecules in pharmaceuticals, agrochemicals, and materials science. A key challenge in this field lies in achieving the direct introduction of functional groups into aromatic compounds, a strategy that can enhance their physical and chemical properties while imparting novel activities and functions. Our research develops efficient and selective transformations based on activated carbonyl intermediates, aiming to expand synthetic methodologies and provide streamlined approaches for constructing diverse, highly functionalized organic molecules.

Reference: *ACS Omega*, **2022**, *7*, 48476.

2. Keywords

Marine natural products; Pyrrole alkaloids; Organic synthesis

3. Remarks and Websites

We study bioactive natural products from marine organisms, focusing on the isolation of valuable compounds and the total synthesis of promising lead structures for pharmaceuticals and agrochemicals. In parallel, we develop new synthetic methods to efficiently access diverse molecular frameworks.

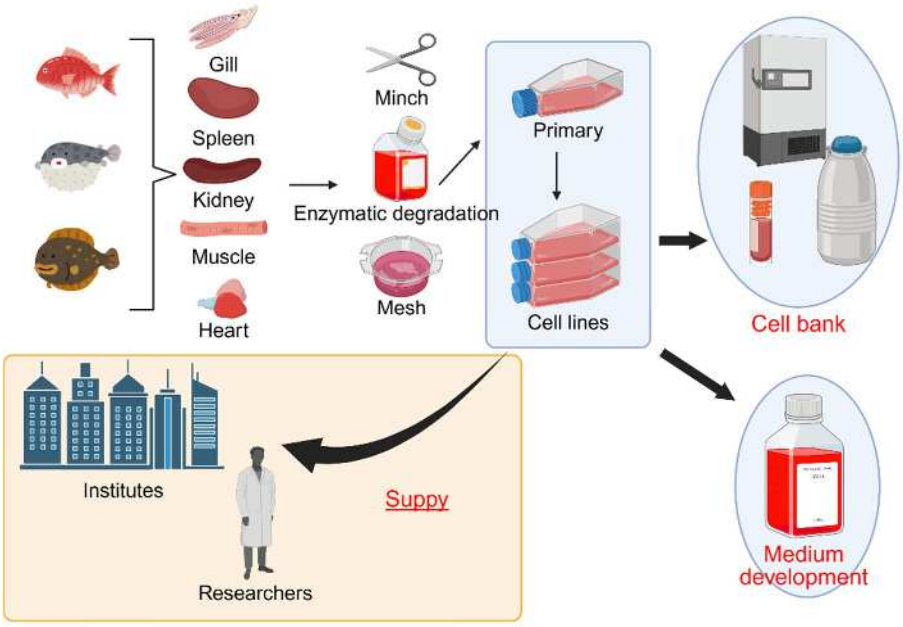
researchmap: https://researchmap.jp/07150405

Name	Job Title	Area of Expertise
UENO Mikinori	Assistant Professor	Cellular Biochemistry

1. Main Research Topics

① Establishment of fish cell line

Cell culture plays a crucial role in various fields of life science research such as cancer, immunology, and virology. Numerous cell lines have been established in mammals, while fish cell lines remain comparatively limited in number. I have been trying to establish fish cell lines from cultured fish. I would like to establish fish cell bank and supply them to researchers in the future in order to develop fish viral vaccine and take measures on red tide plankton occurred in aquaculture field.



② Biological activities of acidic polysaccharides isolated from marine algae

Acidic polysaccharides such as alginate, ascophyllan, fucoidan, and porphyran isolated from marine algae have attractive biological activities which are antioxidants, antitumor, and antiviral activities and so on. I have been trying to develop effective utilization for these polysaccharides described above. Especially, characterization of chemical structure of porphyran are ongoing. In addition, there has been a serious problem regarding the production of discolored nori, which is low quality and of no commercial value, due to red tide plankton and malnutrition in cultivated sea areas. Discolored nori has faded color and does not have a good flavor. I investigate biological activities of porphyran isolated from discolored nori to utilize them.

2. Keywords

Marine fish, Aquaculture, Cell culture, Fish cell line, Marine algae, Polysaccharide

3. Remarks and Websites

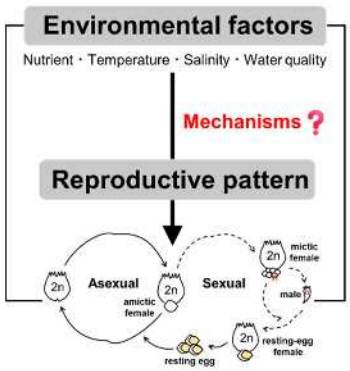
researchmap：https://researchmap.jp/ma-poly
Laboratory: https://seibukka.jimdofree.com/

Name	Job Title	Area of Expertise
HAN Chengyan	Assistant Professor	Aquaculture Biology

1. Main Research Topics

My research focuses on the biological functions of zooplankton, such as rotifers and copepods, and the molecular mechanisms underlying their responses to environmental variations. Through the integration of marine biology, ecotoxicology, and aquaculture biology, these works aim to provide practical insights for enhancing aquaculture productivity and promoting the sustainability of marine ecosystems.

Live feed is essential for the initial larval stages of marine fish due to their underdeveloped digestive systems. Rotifer *Brachionus plicatilis* was first identified as an effective live diet in Japan since 1960s, and it is now extensively used in aquaculture operations around the world. The stable supply of rotifers is not merely a matter of securing feed, but is directly linked to the overall production of cultured fish. Rotifer cultivation technology is thus a critical foundation supporting seed production in aquaculture. Rotifer reproduction involves both asexual reproduction, in which females produce offspring without mating, contributing to rapid population expansion, and sexual reproduction, which produces fertilized resting eggs with dormancy capability. Resting eggs can be preserved for a long time and serve as seeds that can be hatched upon needed. Using physiological and molecular approaches, I have investigated how the elements that are generally essential for the growth and reproduction of aquatic species, such as trace elements, dissolved oxygen, and ammonia, influence the reproductive strategies of rotifers when present in excessive or imbalanced concentrations.



Research on the biological functions of zooplankton and their application to aquaculture

① Trace elements effects on the reproduction of rotifers and associated molecular mechanisms

Trace elements, such as iron and zinc, are commonly added to the culture medium of microalgae, which is then directly supplied in the culture tanks of rotifer for mass production. We then found that the presence of these trace elements induced varied reproductive responses, particularly the induction of sexual reproduction, in different *Brachionus* species. The species-specific effects were determined to be closely associated with intracellular accumulation of neutral lipids, reactive oxygen species metabolisms, and sperm motility in rotifers.

② Ammonia tolerance in the survival and reproduction of rotifers and copepods

③ Effects of hypoxia on growth performance and glycolytic metabolism in rotifers

Ammonia, a metabolic waste accumulated in aquatic environments, is a major stressor that impairs the growth and behavior of aquatic species. Likewise, hypoxia is known to negatively affect feeding and growth of species. We demonstrated that tolerance to ammonia and hypoxia in terms of survival, reproduction, behavior, and energy metabolism differs among rotifer and copepod species. These findings provide important insights for the development of purpose-specific management strategies and for improving the productivity of aquatic organisms.

④ Effects of GABA supplementation on rotifer growth and vitality

Gamma-aminobutyric acid (GABA) has been shown to enhance stress tolerance in rotifers. During mass culture, as population expansion physiological changes in rotifers often lead to mass mortality. To stabilize the population, we investigated the effects of GABA supplementation for the purpose of improving population stability.

Research on the effects of environmental changes on the biological functions of zooplankton

⑤ Changes in reproductive strategies of rotifers in response to environmental stress

Rotifers and cladocerans (e.g., *Daphnia*) shift their reproductive strategies from asexual to sexual reproduction in response to environmental changes. This study focuses on how rotifers regulate their reproductive modes under marine environmental stress caused by global climate change, such as warming.

2. Keywords

Live feed, Rotifer, Reproductive regulation, Nutritional stressor, Environmental risk

3. Remarks and Websites

(Project in progress) Trace element manipulation on the reproduction of live feed rotifer: Elucidation of molecular mechanisms and biological significance

researchmap: https://researchmap.jp/chengyan-han

Name	Job Title	Area of Expertise
SOYANO Kiyoshi	Professor	Fish Reproductive Physiology and Endocrinology

1. Main Research Topics

The purpose of my research is to elucidate the reproductive mechanisms of fish using endocrinological and molecular biological methods. However, in order to correctly understand fish reproduction, it is also necessary to understand their ecology and behavior. Therefore, my laboratory is conducting eco-physiological research that also focuses on spawning migration and reproductive behavior

① **Elucidation of the maturation and spawning mechanisms of groupers**

Many groupers migrate from their habitat (usually feeding grounds) to spawning grounds for spawning. It is believed that communication between males and females using pheromones plays a role in spawning. Using the honeycomb grouper found in coral reef areas, we are conducting physiological studies on spawning migrations and reproductive events at spawning grounds.

② **Development of new technology for seed production**

We are conducting research on maturation induction and growth promotion using the blacktip grouper as a new target fish for aquaculture. In addition, we are working to advance seed production technology by reexamining the eco-physiological study of yellowtail.

③ **Elucidation of environmental factors affecting fish reproduction and their roles**

Fish reproduction is controlled by external environmental factors such as water temperature and photoperiod. However, the detailed control mechanisms are not yet understood. Currently, using dotted gizzard shad and yellowtail, we are investigating physiological responses to these environmental factors, focusing on the actions of gonadotropin and sex steroids.

④ **The impact of chemical substances on the next generation production of fish**

Various chemical substances are released into the natural environment through sewage treatment. These substances affect the behavior and reproduction of fish and hinder the production of the next generation. Therefore, we are focusing on endocrine disruptors, which are chemical substances that disrupt the endocrine system, and environmental pharmaceuticals, which have an impact on the nervous system, to investigate their effects on fish reproduction.

2. Keywords

Maturation induction, gonadal development, reproductive hormones, spawning behavior, artificial seed production, endocrine disruptors, environmental pharmaceuticals

3. Remarks and Websites

Project leader for the following projects

Nagasaki Blue Economy: A Co-creation Hub for the Industrialization of Aquaculture to sustain food production in the oceans (COI-NEXT program by JST)

researchmap: https://researchmap.jp/kiyosoyano_nagasaki

Laboratory: https://soyano.wixsite.com/fish-reproduction

Name	Job Title	Area of Expertise
NAGASAKA Reiko	Professor	Nutritional and Physiological Function

1. Main Research Topics

① **Research on Aquaculture via Metabolic Regulation in Fish**

We are conducting research to modify fish metabolism through dietary changes so that they grow larger faster while consuming less feed. So far, using components such as rice bran and plant-based ingredients, we have improved lipid and carbohydrate metabolism in fish, making it possible to increase feed efficiency.

Moreover, although many farmed fish are strongly carnivorous, due to rising fishmeal prices, fishmeal-alternative feeds are now being used. We are also studying the effects of these alternatives on fish metabolism, as well as evaluating their value as food products.

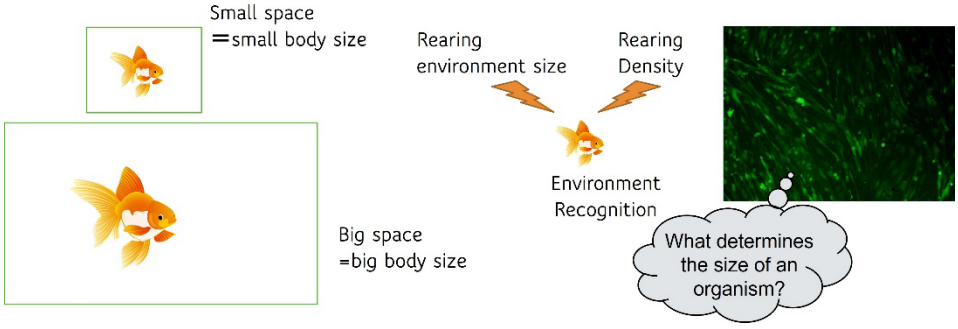
② **Research on Organismal Preferences**

We demonstrated that mice exhibit different taste preferences depending on their rearing temperature. Currently, we are focusing on gut microbiota—which changes with environmental temperature—and investigating their relationship with dietary taste preferences.

Not only in mice but also in fish, we are conducting research to elucidate the mechanisms by which rearing conditions influence feeding preferences.

③ **Elucidation of Factors Regulating Fish Body Size**

It is known that fish growth varies depending on the size of their rearing environment, but the mechanisms underlying this phenomenon are not yet understood. By elucidating these mechanisms, we aim to increase the edible portion of fish and contribute to safe and efficient production.



2. Keywords

metabolic regulation, functional components, preference, gut microbiota, body size control

3. Remarks and Websites

"From the Sea to the Dining Table: Scientific Investigation of Life's Signals."

Under this overarching theme, our research focuses on the following:

Taste preferences in fish and mammals

Functional components in seafood

Development of efficient aquaculture feeding strategies leveraging these elements

We aim to scientifically track the signals and pathways that connect marine life—starting from the ocean environment—all the way to the consumer's table, integrating insights on preference, functionality, and aquaculture application.

researchmap: https://researchmap.jp/reikonagasaka
Laboratory: http://tiny.cc/nagasaka

Name	Job Title	Area of Expertise
MURATA Ryosuke	Associate Professor	Reproductive Physiology

1. Main Research Topics

① Research on the reproductive physiology of squid

Squid is a familiar food for Japanese people, but surprisingly there is little research on its reproductive physiology, and it is shrouded in mystery. It is known that many squids hatch in early spring, grow over the course of a year, and spawn in the spring of the following year before ending their lives. However, basic information is lacking, such as the existence of hormones that control maturation and factors that determine the sex of young squid. Such basic information is essential for the proper management of squid resources, which have recently been the subject of discussion due to a decline in catches. First, I used the cuttlefish Kaminari squid (known as Mongo squid in the market), a type of cuttlefish that is relatively easy to raise, to investigate at what point in development the males and females are separated. As a result, I revealed that the sex of this species is already determined and the females are separated (sex differentiation begins) during the developmental stage inside the egg capsule (Murata et al. 2019). This fact means that the period spent inside the egg capsule before hatching is a very important period for squids to acquire reproductive ability. Next, we focused on gonadotropin-releasing hormone-like hormone (GnRH-like peptide), a type of brain peptide hormone related to reproduction, as a candidate for the endocrine factor that controls the sex differentiation of this species, and investigated the change in expression of GnRH-like during the early stages of development. As a result, we found that GnRH-like is already expressed in the brain from the early developmental stage before sex differentiation (Murata et al., in submission). However, the specific function of GnRH-like on sex differentiation has not yet been identified. In the future, we will use omics analysis technology, which has been rapidly developed in recent years, to search for new internal factors that control sex differentiation and sexual maturation of squids, and by identifying their functional roles, we will strive to collect knowledge on the reproductive physiology of squids. We would like to utilize the knowledge obtained for the sustainable use of squid resources.

② Research on the reproductive physiology of fish

Grouper fish are a target species for aquaculture in many countries around the world, but because they are hermaphrodites, it is thought that sex determination using general genetic methods is impossible. In this study, we will first use red grouper as material to identify factors that vary between males and females in non-invasively extractable areas such as the caudal fin and anal fin, and search for sex-discriminating markers. We will then examine the applicability of these sex-discriminating markers to other fish species. Sex-discriminating markers that can be used in hermaphroditic fish, which have no genetic differences between males and females, may also conserve their sexual expression differences in dioecious fish, which is expected to lead to the development of novel sex-discriminating methods that can be used in a variety of fish species.

2. Keywords

Reproduction, Squid, Cuttlefish, Teleost

3. Remarks and Websites

None

researchmap: https://researchmap.jp/ryosuke_murata

Laboratory: https://sites.google.com/site/muratalabhome/

Name	Job Title	Area of Expertise
TAKATANI Tomohiro	Professor	Food Hygiene, Fisheries Science

1. Main Research Topics

① **Toxicification mechanism of toxic xanthid crabs:**
We are searching for the prey organisms that are the source of toxicity in toxic crabs such as *Zosimus aeneus* and *Atergstis floridus*, which are known to possess high concentrations of paralytic shellfish toxins and tetrodotoxin (TTX), and aim to elucidate the toxicification mechanism.



Zosimus aeneus

② **Toxicity and origin of freshwater pufferfish:**
We are conducting research on the toxicity of freshwater pufferfish that inhabit rivers and lakes, including the selectivity of toxic components (TTX/PST) and the search for the origin of the toxin. We are conducting joint research with University of Kratie in Cambodia and Nifrel (aquarium) in Osaka.



Freshwater pufferfish

③ **Toxin-binding protein (PSTBP) involved in the accumulation mechanism of pufferfish toxin:**
We are investigating how the PSTBP involved in the accumulation mechanism of pufferfish toxin (TTX) interacts with TTX in the pufferfish.



Takifugu rubripes

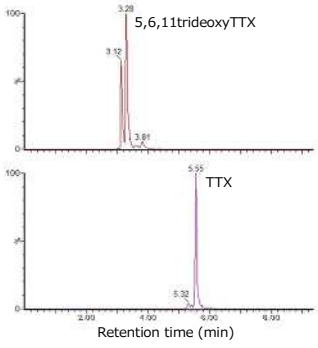
④ **TTX resistance in moray eels *Gymnothorax kidako*:** There have been reports of moray eels attacking pufferfish. Why are moray eels able to eat pufferfish, which contain TTX? We are conducting research on the mechanism of TTX resistance on moray eels.

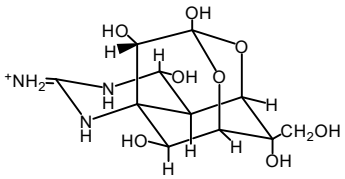
⑤ **Research on paralytic shellfish toxins (PST) toxicity in brown-lined puffer *Canthigaster rivulata*:** *C. rivulata* has been known to contain TTX, but in recent years, it has also been found to contain PST. We are investigating the source of PST and studying the selectivity of both toxins (TTX/PST).

In addition, we are conducting research on the biosynthesis pathway of doumoic acid in red alga *Chondria armata* “hanayanagi”, the identification of the toxins (palytoxin-like toxins) in parrotfish *Scarus ovifrons* and boxfish *Ostracion immaculatum*, and the origin of newt toxins.



LC-MS/MS





tetrodotoxin（TTX）

2. Keywords

Marine toxin, tetrodotoxin (TTX), paralytic shellfish toxins (PST), LC-MS/MS

3. Remarks and Websites

researchmap： https://researchmap.jp/read0192063
Laboratory: https://marine-toxin.wixsite.com/marine-toxin

Name	Job Title	Area of Expertise
INOUE Tetsushi	Professor	Microbiology

1. Main Research Topics

① Research on Symbiotic Microorganisms

A diverse array of microorganisms lives symbiotically in the intestines of animals. Our research has focused on the diversity and functions of microorganisms inhabiting the guts of herbivorous fish, sea cucumbers, abalone, and other marine animals. Elucidating the gut microbial communities that influence host development and physiology holds potential for enhancing the efficiency of seedling production and aquaculture practices. Moreover, the isolation of functionally beneficial microbes from the intestinal environment offers promising avenues for the development of biotechnologies aimed at the sustainable utilization of marine biomass resources, including macroalgae.

② Research on Microorganisms Involved in Fermented Seafood Products

During the maturation of traditional fermented seafood products, microbial succession—characterized by shifts in the dominant microbial species—and mutualistic interactions among microbial populations are commonly observed. Our research has focused on elucidating the diversity and functional roles of microorganisms involved in the fermentation and aging processes of traditional Japanese seafood products such as *narezushi* and *karasumi*.

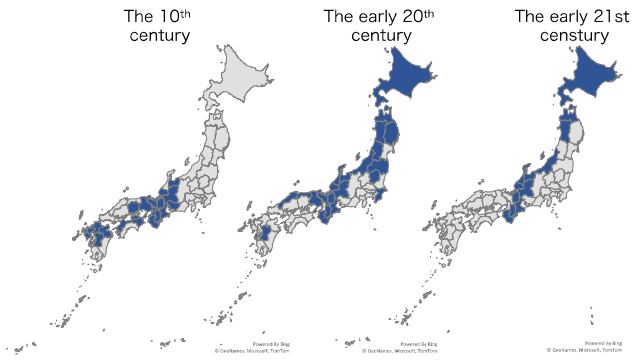
③ Cultural Studies on Fermented Foods

The prototype of sushi, now globally popular, originates from a traditional fermented food known as *narezushi*, which traces its roots to Southeast Asia. Originally, narezushi was a preserved food in which lactic acid fermentation of the rice starch imparted acidity and enhanced shelf-life. In Japan, sushi underwent a unique cultural evolution, transitioning from traditional fermented forms to non-fermented varieties, which have since become widespread.

Even today, Japan presents a complex regional landscape: areas where fermented sushi is still practiced and preserved, regions that have entirely shifted to non-fermented styles, and localities where both traditional and modern forms coexist. However, the historical and sociocultural dynamics underlying these regional variations and the coexistence of old and new sushi forms remain largely unexplored. By investigating the transformation and transmission of sushi culture—a form of intangible cultural heritage—this research aims to generate insights into broader mechanisms that support the sustainable inheritance of traditional foodways and cultural practices.



Top, *narezushi* in Thailand; Bottom, *karasumi*.



The changes in the distribution of fermented sushi.

2. Keywords

Symbiosis, fermented food, fermented sushi, food culture

3. Remarks and Websites

We are currently engaged in collaborative research on wild yeast.

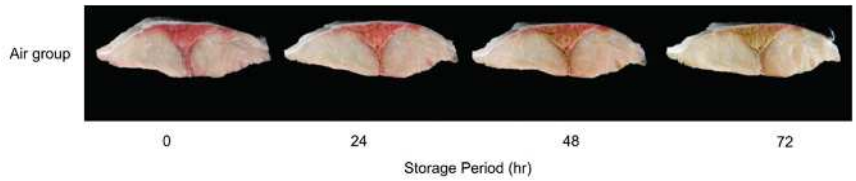
researchmap: https://researchmap.jp/7000001967
Laboratory:

Name	Job Title	Area of Expertise
TANIYAMA Shigeto	Professor	Food Nutritional Science

1. Main Research Topics

1. **Investigation of the factors behind the color changes in dark muscle of fish after death and possible countermeasures**

Fish dark muscle undergoes color changes more rapidly than meat from land animals, particularly in the case of yellowtail, where the formation of metmyoglobin progresses quickly during air exposure post-mortem. Therefore, using cultured yellowtail as a model, we are investigating the factors responsible for these color changes and exploring possible countermeasures.



Changes in color of the dark muscle observed by the naked eye during storage packed with air.
(*Journal of Aquatic Food Product Technology* 32(3); 1-9, 2023)

2. **Elucidation of the mechanisms of brunt meat in ordinary muscle of fish**

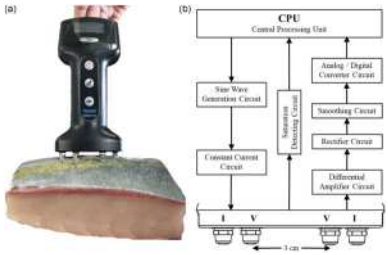
During the high-temperature summer months, a phenomenon known as burnt meet occurs in cultured yellowtail and other species, leading to whitening and softening of the muscle, which significantly degrades flesh quality. Therefore, we are investigating the mechanisms behind the development of this heat-induced meat discoloration.



Ordinary muscle of normal (left) and burnt meat (right) of cultured yellowtail.

3. **Quality evaluation of fish by bio-impedance analysis**

To scientifically evaluate the quality of fish, it is necessary to collect muscle samples from the fish, which can compromise the product's value. Therefore, we are exploring a non-destructive, simple, and rapid method for evaluating fish quality, particularly the freshness and lipid content of fish muscle, using bioelectrical impedance analysis.



(a): Measurement of impedance by Fish Analyzer.
(b): Block diagram of Fish Analyzer. I = current probe; V = voltage probe.
(*Bioelectromagnetics* 40; 488-497, 2019)

2. Keywords

Color, Brunt meat, Bio-impedance analysis, Freshness, Fat

3. Remarks and Websites

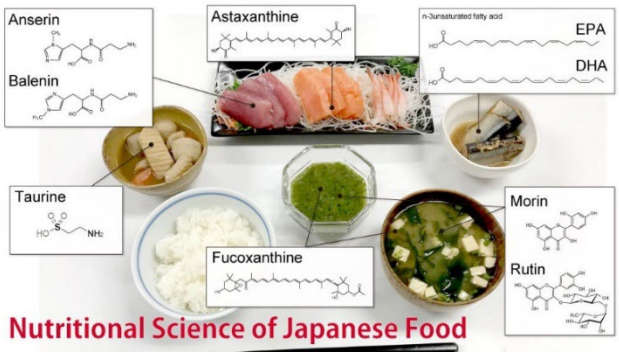
We are also participate in research through industry-academia-government collaboration.

researchmap: https://researchmap.jp/shigeto_taniyama
Laboratory: None.

Name	Job Title	Area of Expertise
HIRASAKA Katsuya	Professor	Molecular Nutrition, Nutritional Physiology

1. Main Research Topics

In the 1980s, Japanese food consisted of rice, vegetable, sea food, and seaweed and was well-balanced diet. Since *washoku* was listed by UNESCO in 2013, there has been intense renewed interest about its health benefits, and how it may be responsible for Japan having the world's highest life expectancy. In fact, Japanese food includes n-3 unsaturated fatty acid, flavonoids, carotenoids, and peptide, which are associated with hearth promotion



Active compounds containing *washoku*



Food Functionality Evaluation

"Food and health" has been one of the topics keywords in the worldwide. In our lab, we combine applied research in nutrition with molecular biology to conduct research on nutritional physiology and molecular nutrition with the aim of maintaining health and preventing diseases through seafood.
The representative research themes are as follows.

① **Identification of nanovesicles derived from fish and their functionality**
② **Effect of feeding timing of functional nutrients derived from marine products**
③ **Anti-obesity and anti-fatigue effects of nucleic acid-based components in fish broth (*dashi*)**
④ **Effect of seaweed-derived polysaccharides and carotenoids on muscle atrophy**
⑤ **Functional research on marine dipeptides**
⑥ **Development of fish oil ketogenic diet**
⑦ **Development of seaweed-derived food preservation material**
⑧ **Development of a method to detect *Anisakis* allergy**

2. Keywords

Functional nutrition; Nanovesicles; Muscle atrophy

3. Remarks and Websites

researchmap： https://researchmap.jp/_Hirasaka_Katsuya

Laboratory: https://ahs-mn.localinfo.jp/

Name	Job Title	Area of Expertise
HAMADA Yuki	Associate professor	Marine Food Chemistry

1. Main Research Topics

① Elucidation of the properties of seafood allergens

My lab is researching seafood allergy, a food allergy caused by consuming seafood. The sarcoplasmic protein parvalbumin has been identified as the major allergen in fish. In crustaceans and mollusks, the major allergen is the myofibrillar protein tropomyosin. However, many other proteins have been reported as allergens by patients. Furthermore, with the large number of types of seafood consumed, differences in the amino acid sequences of proteins are observed depending on the species, and it is expected that reactions to the same protein may differ between species. Therefore, we are investigating the identification, content, and chemical and immunological properties of allergenic proteins in many seafood species.

Theses basic informations will be useful for allergy prevention and treatment, as well as food development.

② Development of safe processed seafood products

As a "hypoallergen food", kamaboko can be made by thoroughly soaking it in water during the manufacturing process, which can remove parvalbumin, a major allergen in fish. It has also been suggested that the use of high-pressure heat sterilization for canned foods may reduce tropomyosin, an allergen in shellfish tumors. In this way, we are using processing technology to explore seafood processed foods that are delicious and safe for people with allergies.

My lab is also developing "food for people with dysphagia." Kamaboko is made from fish meat, so it is low in fat and rich in protein. The elasticity of kamaboko, known as the "ashi," is an important texture, but it can also be difficult for people with dysphagia to chew. Therefore, I would like to create kamaboko with various elasticities to suit the degree of dysphagia, and use it to prevent aspiration and treat swallowing.

③ Research into the freshnes and safety of seafood

It is well known that seafood loses its freshness more quickly than meat, but this varies greatly depending on factors such as the growing temperature, slaughtering method, and storage temperature and conditions. Therefore, I am investigating methods (conditions) to ensure that fresh fish from Nagasaki Prefecture is shipped in good condition not only domestically but also overseas.

I will clarify changes in muscle protein and the risk of food poisoning over time, and explore improvement measures to prevent quality deterioration and safety.

2. Keywords

Processed seafood, food safety, seafood allergens, food for people with swallowing difficulties, freshness, histamine

3. Remarks and Websites

I plan to renovate the facility into a training factory for seafood processing that conforms to HACCP standards. It will also be possible to use the training factory's equipment for the development of new seafood processing products.

researchmap: https://researchmap.jp/Hamada1219
Laboratory:

Name	Job Title	Area of Expertise
YAMADA Akinori	Associate Professor	Molecular Biology

1. Main Research Topics

My research broadly focuses on the analysis of genetic and genomic sequences to promote the sustainable use of fisheries resources, reduce food loss, improve aquatic species, and understand their ecology and evolutionary history.

① **Genetic Differentiation among Fishery Stocks**

Fishery resources in the waters around Japan are thought to be divided into several large populations called "stocks." For example, in pelagic fish species such as mackerel and horse mackerel, there are stocks like the Tsushima Warm Current stock (distributed from the East China Sea to the Sea of Japan) and the Pacific stock (distributed from the South China Sea to the Pacific Ocean). Since stocks are the basic unit for resource management, it is essential that they accurately reflect the biological reality. Therefore, I am analyzing genetic data to evaluate the relationships among different fish stocks.

② **Genetic Diversity of Fishery Resources**

Pelagic fish not only show large fluctuations in population size, but nearly half of the population may be harvested each year. This raises concerns about a decline in genetic diversity. Such a decline could lead to problems such as disease outbreaks and population crashes due to environmental change. To assess this, I am comparing different year-classes (groups born in the same year) to examine whether genetic diversity is actually decreasing (Figure 1).

③ **Research on Anisakis Parasites**

Food poisoning caused by Anisakis parasites is a significant concern in Japan, where raw seafood is commonly consumed. While many studies have been conducted on Anisakis, much about its biology remains unclear. I am investigating the infection patterns, frequency, and behavior of Anisakis within fish hosts such as mackerel and horse mackerel. In addition, I examine their genetic characteristics and explore the possibility of using them as markers to trace the migration routes of host fish.

④ **Evolutionary Studies of Pufferfish**

Pufferfish are known for their unique ecological traits and for accumulating toxins derived from microorganisms, which are thought to protect them from predators. Although the mechanism of toxin accumulation is gradually being uncovered, the evolutionary question of why pufferfish began storing toxins remains largely unanswered. To explore this, I conduct genome analyses across a wide range of pufferfish species to elucidate their evolutionary history.

⑤ **Research on Genome Size Variation**

All living organisms possess a genome containing their entire set of genes, but genome size varies significantly among species. For example, humans and pufferfish have roughly the same number of genes, yet the genome size of pufferfish is only about one-tenth that of humans. This raises the question of whether smaller genomes may be more efficient or more advanced in evolutionary terms. To address this, I am analyzing the genomes of various bony fish to investigate how small genomes evolved and what biological significance they hold.

⑥ **Research on "Living Fossils"**

Coelacanths are often referred to as "living fossils," thought to have undergone little evolutionary change for hundreds of millions of years. While there are other organisms given this label, it remains debated whether they have truly experienced little or no evolution. To investigate this, I focus on mitochondrial genomes and conduct simulations of different evolutionary scenarios to better understand what "living fossils" really are.

2. Keywords

Gene, Genome, Simulation, Diversity, Ecology, Evolution

3. Remarks and Websites

I have conducted collaborative research involving genetic analysis with various companies and organizations.

researchmap : https://researchmap.jp/akinori_yamada

Name	Job Title	Area of Expertise
WANG Yao	Associate Professor	Marine Food Science and Technology

1. Main Research Topics

Compared to livestock meat, seafood deteriorates more rapidly during storage, with a faster decline in texture and freshness, leading to a rapid reduction in quality as a food product. Therefore, research and technological development aimed at improving the quality of flesh have been sought for many years. Currently, research is being conducted on preservation methods and processing techniques to maintain the freshness and enhance the flesh quality of edible seafood. Below are some examples of the main research themes:

① **Inhibitory Effects and Mechanisms in the Discoloration of Fish Dark Muscle During Storage**

For sashimi and sushi ingredients, color is an important indicator used by consumers to evaluate the freshness of raw fish. The economic consequences of consumer discrimination against dark muscle color, such as price discounts and product discarding, can be significant. However, the surface of the dark muscle in fish flesh is susceptible to discoloration (browning) during storage due to the formation of ferric metmyoglobin. In a highly fresh state, the dark muscle contains deoxymyoglobin (dark purple color) and oxymyoglobin (bright red color); however, in the post-mortem muscle, these heme proteins react with oxygen, resulting in the formation and accumulation of metmyoglobin (brown color), which is the principal reason for the loss of redness. To suppress this discoloration, modified atmosphere packaging and antioxidants are being focused on, using three species of *Seriola* (*S. quinqueradiata*, *S. dumerili*, *S. aureovittata*) as model fish; the effectiveness and mechanisms of these methods are being investigated.

② **The Effects of Ice Crystal Formation During Freezing on Flesh Quality After Thawing**

Freezing is an effective method of preserving the freshness of seafood over extended periods. However, the three-dimensional structure of muscle cells and connective tissues is collapsed by ice crystals that form during freezing, leading to a decrease in flesh quality, especially in terms of texture and water-holding capacity after thawing. This diminishes their value for raw consumption. Conversely, even after long-term frozen storage, the decline in flesh quality of squid is less pronounced than that of fish, and the overall quality tends to be better preserved. The relationship between ice crystal formation during freezing and post-thaw flesh quality is being clarified by focusing on the morphological characteristics of muscle tissue in fish, squid, and other raw ingredients used for sashimi or sushi.

③ **Mechanisms of Flesh Quality Deterioration (such as the 'brunt meat') and Development of Quality Preservation Technology**

During the summer months, retailers complain of a quality deterioration phenomenon known as 'brunt meat', whereby the muscle of fish such as yellowtail, common dolphinfish, and tuna becomes whiter, softer, and waterier, rendering the fish unsuitable for raw consumption. This phenomenon of quality deterioration cannot be identified by appearance alone and is only discovered after the fish are processed at the shipment destination. This will not only lower consumer ratings but also hinder initiatives to raise fish prices and expand high-value export opportunities. Recent research suggests that implementing proper slaughter methods and bleeding processes from harvest to shipment can help control such quality deterioration. Consequently, quality preservation technologies are being developed by uncovering the mechanisms of flesh quality deterioration, such as 'brunt meat'.

2. Keywords

Freshness (K value); ATP-related compounds; Ultrastructure; Electron microscopy; Food properties; Morphology

3. Remarks and Websites

So far, highly practical research results have been obtained, such as discoloration inhibition using modified atmosphere packaging, structural changes in muscle cells during freezing and thawing, mechanisms and preservation techniques for quality deterioration. In the future, these results will be developed into subsidized projects and joint research, contributing to the improvement of seafood quality and the sophistication of distribution technology.

researchmap: https://researchmap.jp/yao_wang
Laboratory: none.

Other divisions

Faculty of Education / Graduate School of Education

Office for Research Initiative and Development

Institute of Integrated Science and Technology

Name	Job Title	Area of Expertise
MUTO Cosy	Professor	Analog Signal Processing and Electronic Circuits

1. Main Research Topics

① **Mismatch sensitivity analysis of complex analog filter**

Since digital communication systems such as QPSK and OFDM can be treated as complex signal processing, complex filter is applied for unwanted spectrum rejection and orthogonality compensation between I and Q channesl. Passive complex filters consists of inductors, capacitors nad imaginary resistors are low-sensitive in passband for tracking errors between I and Q channel. However, mismatch errors are only analyzed for inductors and capacitors. Sensitivity analysis for mismatch error in imaginary resistors is a major subject for complex filter implementation, especially for “Beyond 5G” applications.

② **Conjugate imaginary resistor**

“Conjugate imaginary resistor” is derived from mismatch error consideration of imaginary resistor. Its properties other than misimatch are not known. Analysis and application of conjugate imaginary resistor is the main topics in this theme.

③ **Sensor signal processing**

Soil moisture is major interest in agriculture and disaster prevention. There are commercially supplied soil moisture sensors, however, a large sensor networking using inexpensive ones is required in disaster prevention applications. By using complex signal processing, integrated, low frequency and lo-cost soil moisture sensors may be realized.

2. Keywords

Complex signal processing, Complex Filters, Sensitivity analysis, Sensor signal processing

3. Remarks and Websites

researchmap: https://researchmap.jp/read0056442
Laboratory: https://mutolabworks.blogspot.com/

Name	Job Title	Area of Expertise
FUKUYAMA Takao	Professor	Physics, Physics Education

1. Main Research Topics

Within the field of physics, I am conducting research in the areas of plasma physics and chaos theory. These fields are collectively referred to as complex systems science. To date, my research has focused on the "waves" observed in plasma. Additionally, I am engaged in research related to science education, with a particular emphasis on physics education, including the development of physics teaching materials and classroom research.

① **Research on nonlinear phenomena in vacuum plasma**

As plasma is often referred to as a "treasure trove of nonlinear phenomena," a wide variety of nonlinear phenomena, such as chaos, solitons, and self-organization, have been observed in plasma. We are studying the dynamic behavior of a coupled oscillator system in which chaotic oscillations induced by glow discharge in a vacuum discharge tube are coupling with spatially free chaotic waves. Additionally, we are investigating the dynamic behavior of plasma systems when external forces are applied to ionization waves exhibiting spatiotemporal chaos, or when time-delay feedback methods (Pyragas method) are applied.

② **Research on atmospheric pressure plasma**

We are conducting research on plasma generated in atmospheric pressure. We apply chaos analysis to the time series of discharge plasma in atmospheric pressure, focusing on the chaos and fractal nature of the discharge, and study how the system changes as it transitions from spark and corona discharge to arc discharge. Additionally, we are studying the dynamic behavior of flames, as well as changes in flame temperature and luminescence, by applying a strong alternating electric field to flames with plasma-like properties in atmospheric pressure. Furthermore, we are investigating the interaction between two plasma jets generated by dielectric barrier discharge.

③ **Research on physics and science education**

We are conducting research mainly focused on teaching materials. We have been researching the development of teaching materials that can be generated with simple equipment so that plasma can be carried around, as well as teaching materials related to chaos theory in higher education and upper secondary education. In addition, we are attempting to advance the content of physics experiments by incorporating spectroscopic measurements using a spectrometer and thermoelectric conversion using the Peltier effect and Seebeck effect. Furthermore, focusing on the study of electricity in the second year of junior high school science, we have introduced a pachinko ball model as a model of electric current, and are conducting teaching material reviews and practical lessons.

2. Keywords

Plasma, Chaos, Physics Education, Science Education

3. Remarks and Websites

We are conducting research on plasma science and science teaching materials.

researchmap: https://researchmap.jp/fukuyama-takao
Laboratory: https://www.edu.nagasaki-u.ac.jp/en/

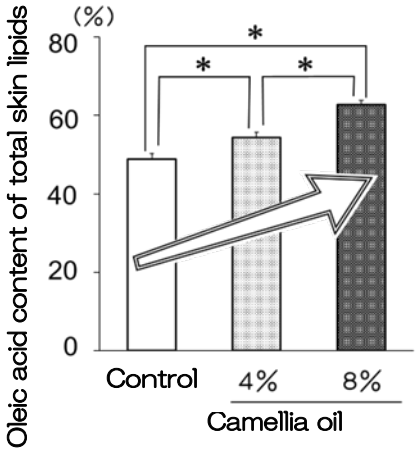
Name	Job Title	Area of Expertise
OIKAWA Daichi	Associate Professor	Dietetics, Food Science, Nutrition

1. Main Research Topics

We study the effects of oral lipid intake on the properties of the liver, skin and adipose tissue. Using mice as an experimental model, samples are ingested orally for a long or short period of time, and then the lipid content, fatty acid ratio, and lipid-related gene expression of tissues collected by dissection are analyzed. Animal testing is conducted at animal breeding facilities inside and outside the university other than the Faculty of Education, lipid analysis is conducted within the Faculty of Education, and gene expression is conducted with external collaborators.

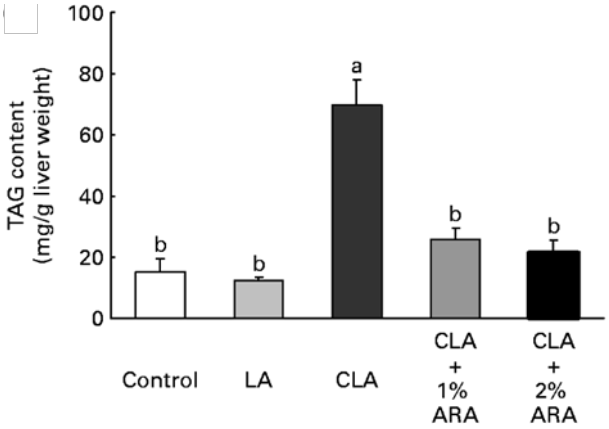
① **Theme:** "Does oral intake of camellia oil change lipid metabolism in biological tissues?"

"Camellia oil" is an oil produced in Japan, such as Nagasaki and Fukuoka prefectures. As a previous study, there have been multiple reports that the application of camellia oil reduces itching in atopic dermatitis and keeps the skin moisturized. Camellia oil contains more than 60% oleic acid, which is similar to the fatty acid composition of olive oil. In previous studies, it was reported that the consumption of camellia oil increased the oleic acid content of total skin lipids in mice [Journal of the Japan Society of Home Economics 2018]. On the other hand, it was also revealed that the amount of lipid components in the liver increased [Bulletin of the Faculty of Education, Nagasaki University 2019].



② **Theme:** "Does oral intake of conjugated linoleic acid cause in the skin and liver?"

Conjugated linoleic acid is a fatty acid with linoleic acid conjugated to it, which has been reported multiple times in previous studies. Many biological functions have already been discovered, such as anti-cancer and anti-obesity effects. In previous studies, oral intake of conjugated linoleic acid oil reported a noticeable transfer of conjugated linoleic acid to the skin [British Journal of Nutrition 2005]. It has also been reported that conjugated linoleic acid is prone to accumulating lipids in the liver. Therefore, we reported that consuming other fatty acid-rich fats and conjugated linoleic acid fats at the same time suppresses fat accumulation in the liver [British Journal of Nutrition 2009].



2. Keywords

Lipids, Fatty acid, Biological function, Camellia oil, Skin, Liver

3. Remarks and Websites

researchmap: researchmap：https://researchmap.jp/oikawadaichi

Laboratory:https://researchers.ir.nagasaki-u.ac.jp/researchdetail.php?id=dTg3YjI2TGpSdXpoNXJuUzV2L0orWisza0VoalhSYlEwU3AvNkE9PQ==

Name	Job Title	Area of Expertise
OHBA Shin-ya	Associate Professor	Insect Ecology, Behavioral Ecology, Conservation Ecology

1. Main Research Topics

We conduct research on the ecology and behavior of insects (mainly aquatic insects such as water bugs, diving beetles, fireflies, and sap-feeding insects) in the field. In addition, we are engaged in practical conservation of rare aquatic insects and research on the biodiversity of islands in Nagasaki.

1) Behavioral ecology in foraging and reproduction

We have clarified the feeding ecology of predatory aquatic insects and how mosquito larvae, which are preyed upon by aquatic insects, escape from predators. Research on the adaptations of these predators and prey leads to an understanding of basic interspecies interactions in ecosystems. We are also conducting research to clarify the egg protection and reproductive behaviors of male Belostomatid insects from the perspectives of natural selection and sexual selection. Such research on the interaction between male caring and female mate choice contributes to our understanding of the evolutionary basis of sociality in the animal kingdom.

2) Conservation ecology research on aquatic insects and the development of methods for eradicating invasive species

To conserve rare aquatic insects, which are rapidly declining nationwide, from extinction, we are conducting research combining field surveys and laboratory experiments to elucidate their ecology and life history. Additionally, since *Kirkaldyia deyrolli* and *Cybister chinensis* have been designated as domestically rare wild animal and plant species (class II nationally rare species) by the Ministry of the Environment in recent years, their conservation has become an urgent priority. Therefore, we are not only conducting basic research but also engaging in practical conservation activities (creating habitats, monitoring populations, and controlling invasive species) with the support of the Ministry of the Environment. Furthermore, we are not only conducting research on the eradication of invasive alien species such as the American crayfish, which have a negative impact on their survival, but also striving to raise awareness of this issue through the media.

3) Natural history and biogeographical research aimed at elucidating the biodiversity of Nagasaki

Nagasaki Prefecture, which has many islands such as Tsushima, Iki, and the Goto Islands, is an ideal field for studying island biology, which pursues species differentiation and the unique evolution of each island. One of the most representative studies conducted on Nagasaki Prefecture's islands is the study of the Genji firefly. It was discovered that the Genji firefly population in the Goto Islands exhibits a unique flashing pattern that had not been previously reported, and this finding was widely covered by the media. Additionally, research has begun on intraspecific variation in external morphology and phenotypes of well-known beetles such as beetles. It is anticipated that this interdisciplinary research will integrate various insights to shed light on the formation history of islands.



Examples of research subjects: From left, a male *Kirkaldyia deyrolli* caring an egg mass, male carrying eggs on their backs and male in *Appasus japonicus*, Genji firefly, and 'small' horned beetle from Fukue Island in the Goto Islands.

2. Keywords

Life history, sexual selection, parental care, endangered species, rice paddy ecosystems, islands, phylogeography

3. Remarks and Websites

Our study can contribute to the understanding of biodiversity and propose methods for its conservation, which are necessary for building a sustainable society, such as elucidating the actual state of reproduction in the animal kingdom and how to create environments and conservation areas.

researchmap: https://researchmap.jp/read0204583

Laboratory: https://sites.google.com/site/oobalabsince2012/home/english

Name	Job Title	Area of Expertise
HAYASHI Mikihiro	Associate Professor	Functional Materials Chemistry Supramolecular Chemistry

1. Main Research Topics

Molecular pairs give opportunities to investigate fundamental chemical processes such as proton transfer and redox reactions. My research focuses on crystalline solids that emerge from the aggregation of molecules, with a particular emphasis on revealing how ion motions or redox combine with electronic properties of the assemblies. Through the synthesis, structural analysis, and measurement of the physical properties of these solids, we aim to elucidate the mechanisms underlying chemical phenomena, derived from specific molecular configurations and electronic interplays.

① An investigation into the functional properties of crystalline solids stabilized by hydrogen bonds with an emphasis on the coupling of proton displacements with electronic states.

Hydrogen bonds are crucial for molecular assembly. Biomolecules utilize hydrogen bonds to facilitate electron-transfer reactions by displacing proton positions, known as proton-coupled electron transfer. From the mechanistic point of view, the fundamental aspect of this chemical phenomenon is the linkage between proton displacements and changes in redox potential within hydrogen-bonded molecular pairs. Our research focuses on examining the relationship between proton displacement and electronic state alterations in hydrogen-bonded crystalline solids. Our objective is to elucidate the peculiar mechanisms responsible for the proton displacement in condensed states of molecules and to develop unique functional hydrogen-bonded materials.

② The development of molecules to exhibit changes in color or redox potential in response to their protonation/deprotonation reactions.

We make efforts to develop molecules wherein releasing and catching proton are intricately linked to changes in electronic states. As evidenced by proton tautomerization, protonation/deprotonation reactions of molecules could exert an influence on π-conjugated structures. Our research has demonstrated that the impact of proton transfer on π-electronic systems can be modulated through metal substitution in molecules where π-conjugated ligands and metal ions are coupled electronically, such as in dithiolene complexes. Furthermore, we have observed that even molecules with poor π-conjugation, such as cyclic molecules, receive the protonation/deprotonation impact on their electronic states.

2. Keywords

Crystalline solids, Hydrogen-bonding molecular pairs, Proton transfer, π-conjugated structure

3. Remarks and Websites

Molecular assembly is ubiquitous in nature. The judicious selection of molecular components and assembly methods enable to develop materials with novel functionalities. Hydrogen bonding, protons, and proton-coupled electron transfer are vital concepts in the science and technology underpinning the hydrogen society. Although our current research is foundational, we are exploring its potential applications across various fields.

researchmap: https://researchmap.jp/mhayashi0827

Name	Job Title	Area of Expertise
TAKESHITA Satoshi	Associate Professor	Biological Chemistry

1. Main Research Topics

① **Research on risk management**

Risk management in universities is an initiative aimed at minimizing risks by proactively identifying, evaluating, analyzing, and implementing countermeasures against various risks that may arise in university operations and faculty/staff activities. This supports the achievement of university (faculty/staff) operational goals and contributes to sustainable development. It is crucial not only to respond to risks when they occur but also to anticipate potential risks in advance.
Specific risks that may arise in universities include: ① risks related to educational and research activities, ② risks related to organizational operations, ③ risks related to facilities and equipment, and ④ risks related to stakeholders, among others. In this study, I focus on risks related to ①, specifically "research integrity," "conflicts of interest," and "ABS based on the Nagoya Protocol."

2. Keywords

risk management, research integrity, new risks, due diligence, reputation risk, conflicts of interest, ABS

3. Remarks and Websites

Currently, I am in the process of accumulating a track record of management decisions deemed to be the best for each case that has arisen in in the daily operations of our university.

researchmap: https://researchmap.jp/read0192057

Name	Job Title	Area of Expertise
BALU ALAGAR Venmathi Maran	Associate Professor	Marine Fish Parasitology & Marine Biotechnology

1.Main Research Topics

We do research on cultured fish parasites, taxonomy, ecology and its control/treatment using natural products, in addition to the research on extraction of collagen from marine living organisms using jelly fish, sea cucumbers, fish wastes, etc.

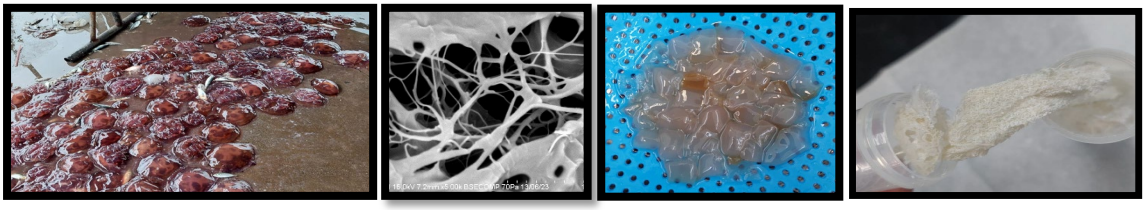
①Marine Fish Parasitology

I do research in the field of parasitology for the past 25 years and my research contributions in the field of marine parasitology and biodiversity, particularly focusing on parasitic copepod, sea lice *Caligus, Lepeophtheirus* and leech *Pterobdella arugamensis*, their taxonomy, ecology, life cycle, and biogeography. I have significantly advanced our understanding of parasitic copepod diversity and distribution in tropical and subtropical regions, shedding light on the intricate relationships between copepods and their marine fish hosts through molecular and phylogenetic analyses. My taxonomic studies have led to the discovery and description of about 50 novel copepod species, 3 different genera and 1 family, enriching our knowledge of marine biodiversity and contributing to the cataloging of parasitic copepod diversity in the Indo-Pacific region. I conceived of this study as a way to use my previous research findings to investigate around the coastal waters of Kyushu, which has not yet been surveyed.



②Marine Biotechnology – Jellyfish and Fish wastes

In Japan and around the world, jellyfish is considered as a bane and not utilized effectively. My research group is focusing on jellyfish to extract collagen. Japanese consumers enjoy a wide variety of fish daily, often as raw sashimi, which generates large amounts of by-products such as skin, bones, and fins during preparation. While some of these materials are processed into fish meal or fried dishes, much is discarded, causing waste and pollution despite their rich nutritional and functional potential. Collagen derived from fish waste is known for its biodegradability, biocompatibility, and medical promise, yet research on its wound-healing properties remains scarce, particularly from calcified tissues like fins, scales, and bones. This project seeks to develop medical-grade collagen from fish waste through acidic and enzymatic extraction, followed by purification, characterization, and biological evaluation in vitro and in vivo. By transforming underutilized fish by-products into valuable biomedical materials, the research aims to promote environmental sustainability while offering innovative solutions for wound and burn treatment.



2. Keywords

Marine Parasitology, Copepods, Sea lice, Leech, Aquaculture, Biological Control, SDG, Jellyfish, Ecology, Marine Biotechnology, Collagen, Fish wastes, Environment-friendly.

3. Remarks and Websites

researchmap: Venmathi Maran Balu Alagar - My portal - researchmap

ORCID: https://orcid.org/0000-0003-1090-5295

- Our Goal: Enriching our knowledge of marine biodiversity and contributing to the cataloging of parasite diversity in the Indo-Pacific region.
- Unraveling the wound healing properties of collagen extracted from various marine resources.

Graduate School of Integrated Science and Technology,

Nagasaki University

RESEARCH PROFILES

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Appendix

Name	Job Title	Area of Expertise
Shintaro Matsui	Assistant-professor	Fish hemostatic thrombology

1. Main Research Themes

Blood transports oxygen and nutrients throughout the body and removes metabolic waste. Its continuous circulation is essential for sustaining life and maintaining health. If blood flow is obstructed, tissues are deprived of oxygen. Conversely, if bleeding cannot be stopped when a blood vessel is damaged, survival may be threatened. Organisms have therefore developed sophisticated mechanisms that keep blood fluid under normal conditions while rapidly stopping bleeding only when and where necessary.

The mechanisms of hemostasis in humans have been studied extensively because of their importance in clinical medicine and drug development. Many details of these mechanisms have been elucidated through decades of research. In contrast, the mechanisms by which non-human animals, particularly fish, achieve hemostasis remain poorly understood.

My research aims to elucidate the hemostatic mechanisms of fish and apply the resulting knowledge to the prevention and diagnosis of fish diseases, the stable production of farmed fish, and the maintenance of seafood quality, ultimately contributing to a sustainable fisheries and aquaculture industry.

1. Potential Role of Fish Mucus in Hemostasis

Fish live in an aquatic environment and must seal wounds under conditions very different from those experienced by terrestrial animals. When the body surface of a fish is injured, blood components released from the wound can disperse into the surrounding water. The wound is also exposed to pathogens present in the aquatic environment. Therefore, mechanisms that rapidly seal wounds and prevent infection are essential for fish survival.



Figure. The body surface of fish is extremely delicate, and even brief struggling can cause injury and bleeding.

The surface of a fish is covered with a slippery layer of mucus. I hypothesize that this mucus is not merely a protective barrier but also plays an important role in fish hemostasis by promoting blood coagulation and wound closure. I am currently investigating the relationship between body-surface mucus and hemostatic mechanisms in fish.

2. Changes in Hemostatic Factors during Fish Disease

In mammals, an uncontrolled host response to infection can lead to sepsis, a life-threatening condition involving systemic inflammation. During sepsis, the blood coagulation system can also become excessively activated, resulting in the formation of numerous microthrombi in small blood vessels. As the condition progresses, platelets and coagulation factors are consumed, which can conversely increase the risk of bleeding. This condition is known as disseminated intravascular coagulation, or DIC. Because DIC can cause impaired circulation and organ dysfunction, early detection and treatment are critically important. However, it remains unclear whether comparable coagulation abnormalities occur in fish during infection. My research seeks to characterize changes in the blood coagulation system during the progression of fish diseases and to determine whether these changes can be used as novel indicators of fish health and the risk of disease progression.

Establishing such indicators could make it possible to assess how severely individual fish are affected, providing information that cannot be obtained solely through PCR-based detection of pathogens. Ultimately, this research may lead to new diagnostic approaches that enable the early detection of disease in farmed fish and the initiation of treatment before mortality and disease transmission become widespread.

2. Keywords

Hemostasis, Blood coagulation, Fish disease

3. Remarks and Websites

researchmap: https://researchmap.jp/Matsu-Shing

Laboratory:

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https://www.instagram.com/kaiyoseikagaku.nagasaki.univ?vrfl=Zjk3NjNlOGV4enlt&utm_source=qr