

Mathematical, Physical, Electronic and Information Sciences

Course of Mathematics

Algebra



Research Themes

- *Representation Theory, Algebraic Lie Theory
- *Number Theory, Arithmetic of Automorphic Form

Prof.

TERAI Naoki

■ Research Themes

Combinatorial Commutative
Algebra

Assoc. Prof.

SUZUKI Takeshi

■ Research Themes

Representation theory/
Combinatorics/Lie theory/
Integrable systems

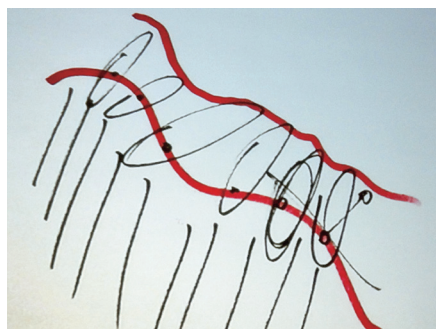
Asst. Prof.

ISHIKAWA Yoshihiro

■ Research Themes

Automorphic forms / Hodge theory/
Zeta integral/Relative representations/
Covering groups

Geometry



Geometry is the study of figures, which are technically called manifolds.

Differential geometry is the field of the precise study of the shape of manifolds, using cues such as curvature and the behaviour of geodesics of (Riemannian) manifolds. Here geodesics are generalisations of straight lines in Euclidean space. On the other hand, topology is the field of the study of topological properties of manifolds by mapping algebraic invariants onto them.

The basic algebraic invariants, for instance, are fundamental groups, homotopy groups, homology groups and cohomology groups.



Prof. **KONDO Kei**

■ Research Themes

Global Riemannian
geometry (especially geodesic theory)/Non-
smooth analysis/Exotic structures/Minimal
submanifolds from aspects of PDEs/Origami

Prof. **JINZENJI Masao**

■ Research Themes

Geometry/Mathematical Physics/ Fundamentals of Condensed
Matter Physics

Prof. **TORII Takeshi**

■ Research Themes

Algebraic Topology/Homotopy Theory

Assoc. Prof. **MONDEN Naoyuki**

■ Research Themes

Mapping class group/ 4-dimensional
topology

Analysis



We study various problems concerning differential equations, probability theory, functional analysis, dynamical systems, and statistics from the point of analysis.



Prof. OSHITA Yoshihito

■ Research Themes
Nonlinear PDE

Mathematical Analysis



Taniguchi/Taguchi Group

Research Sector of Mathematical Analysis

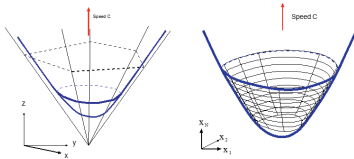
- Nonlinear Partial Differential Equations (Prof. M. Taniguchi)
- Stochastic Differential Equations (Prof. D. Taguchi)



Prof. M. Taniguchi



Prof. D. Taguchi



Pyramidal traveling fronts and axially non-symmetric traveling fronts to the Allen—Cahn Equations (M. Taniguchi, SIAM J. Math. Anal. 2007, 2015, Memoirs of MSJ 2021)

Research Area “Mathematical Analysis” is devoted to theory on partial differential equations, theory of probability, functional analysis, dynamical systems and statistics.

For theory on partial differential equations, we study multi-dimensional traveling fronts appearing in reaction-diffusion models in physics, chemistry and biology. For theory of probability, we study stochastic partial differential equations and their discrete models.



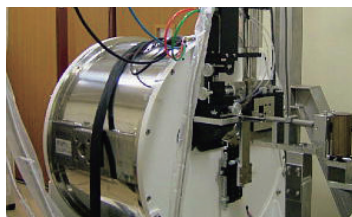
Prof. TANIGUCHI Masaharu

■ Research Themes
Partial differential equations/Theory of probability/Functional analysis/
Dynamical systems/Statistics

Assoc. Prof. KAWAMOTO Masaki

■ Research Themes
Partial Differential Equations/Quantum Mechanics/
Nonlinear Analysis

Quantum Structural Physics in Correlated Matter



In recent years, it is known that topological insulators, topological semimetals, etc. undergo large physical property changes in small electric and magnetic fields, related to the even-oddity of wave functions and bands. However, its creation requires control of the Fermi surface, control of spin-orbit interaction, and control of space and time reversibility. We create and study pure topological materials by means of quantum structural physics.



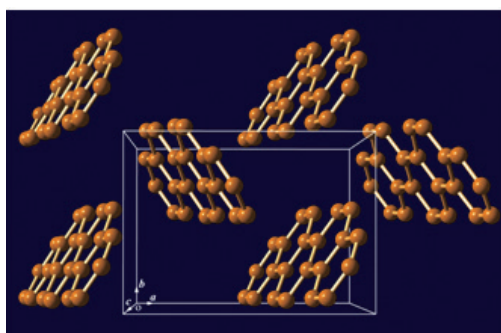
Prof. NOGAMI Yoshio

■ Research Themes
Quantum structural physics/
Topological insulators

Assoc. Prof.
KONDO Ryusuke

■ Research Themes
Quantum structural physics/
Topological insulators

Physics in Advanced Functional Materials



Novel magnetism and superconductivity in molecular materials.

Development of superconductor and magnetism in molecular materials, layered compounds and van der Waals compounds.

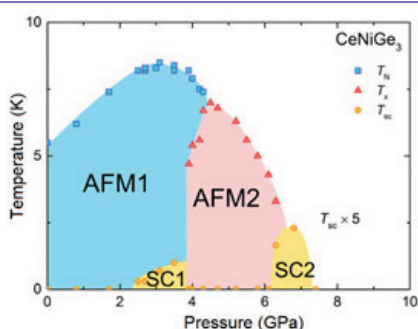
Prof. IKEDA Naoshi

■ Research Themes
Solid state physics/
Magnetism/Superconductivity

Assoc. Prof.
KAMBE Takashi

■ Research Themes
Solid state physics/
Magnetism/Superconductivity

Materials Physics in Extreme Environments



The properties of material under extreme conditions, such as under high pressure and high magnetic field, exhibit unconventional and anomalous characteristics. Our research group is dedicated to investigating the unexplored states of matter under these extreme conditions. In order to accomplish this objective, we are actively developing the advanced experimental techniques. We are seeking the original research using the advanced experiment techniques.

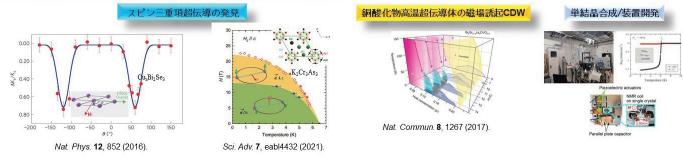
Prof. KOBAYASHI Tatsuo

■ Research Themes
Solid state physics/Magnetism/
Superconductivity

Assoc. Prof. ARAKI Shingo

■ Research Themes
Solid state physics/Magnetism/
Superconductivity

Low Temperature Condensed Matter Physics



We use nuclear magnetic resonance (NMR) technique to study various quantum physical phenomena at low temperatures. In particular, we search for spin-triplet, topological superconductivity, and are interested in understanding the mechanism of superconductivity in various classes of materials including copper

oxides, iron pnictides, heavy fermion compounds, non-centrosymmetric materials. One of our current projects is on topological superconductors, whose surface states can be used for quantum computing. Here, the term "topological" means that the wave function describing superconductivity has a non-zero topological invariant, just as a donut where the number of hole is invariant against deformation.

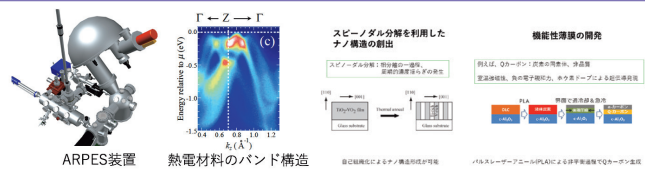


Prof. ZHENG Guo-qing
 ■ Research Themes
 Topological superconductivity/ Spin-triplet superconductor/NMR



Assoc. Prof. KAWASAKI Shinji
 ■ Research Themes
 Topological superconductivity/ Spin-triplet superconductor/NMR

Physics of Solid Surfaces and Interfaces



Functionalities of solid materials are studied from the viewpoint of electronic states. Experimental studies of electronic states lead to elucidating the origin and/or mechanism of the functionalities and also give the strategy to improve the functionalities in materials. Advanced electron spectroscopy techniques are employed to conduct the research for electronic states in materials in detail.

Researches of self-organized nanostructured thin films and development of new thin films with functionalities such as superconductivity and metal-insulator transition are performed. The physical properties of the films are investigated from the viewpoint of electronic states.

Prof. YOKOYA Takayoshi
 ■ Research Themes
 Electronic states/ photoemission spectroscopy/Elucidation of the mechanism of functionality

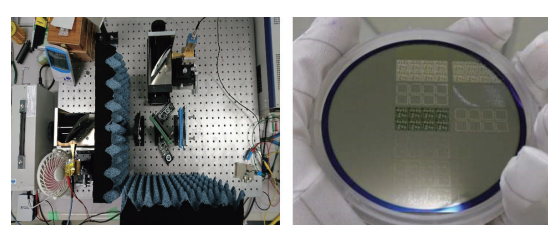


Assoc. Prof. MURAOKA Yuji
 ■ Research Themes
 Thin films/Surface/ Interface

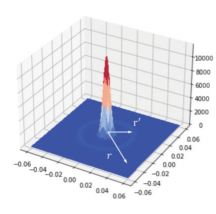
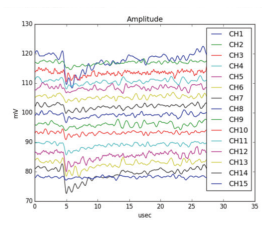


Assoc. Prof. OOTSUKI Daiki
 ■ Research Themes
 Electronic Structure/ Photoemission Spectroscopy/Strongly Correlated Electron Systems/Functional Materials

Astroparticle Physics

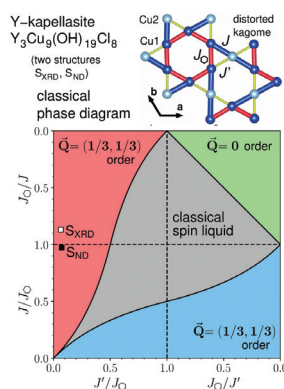
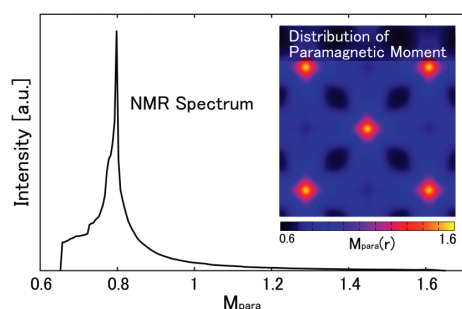


We are studying the advanced analysis methods to measure the CMB polarization to search for the imprint of the cosmic inflation. We are also developing superconducting detectors to study neutrinos from the sun.



Prof. ISHINO Hirokazu
 ■ Research Themes
 Cosmic Microwave Background/LiteBIRD/ Superconducting Detectors

Quantum Many-Body Physics



We are interested in modern problems of solid state theory and computational materials science. We focus on connecting the microscopic structure of materials to experimental measurements. The objective is to understand complex properties like magnetism and superconductivity and to discover and design new materials. Our method development aims at more precise and realistic description of materials and at making more physical quantities accessible by increasing computational efficiency.



Prof. ICHIOKA Masanori

■ Research Themes
 Magnetism/Superconductivity/Solid state physics/Computational physics



Assoc. Prof. ADACHI Hiroto

■ Research Themes
 Magnetism/Superconductivity/Solid state physics/Computational physics



Prof. JESCHKE Harald Olaf

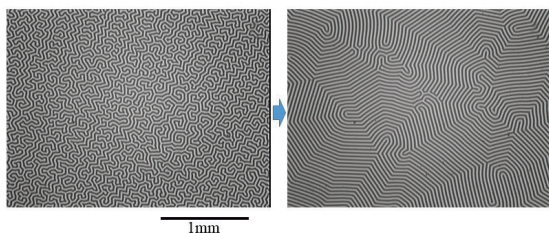
■ Research Themes
 Magnetism/Superconductivity/Solid state physics/Computational physics



Assoc. Prof. OTSUKI Junya

■ Research Themes
 Magnetism/Superconductivity/Solid state physics/Computational physics

Quantum Physics in Correlated Matter



Space-time chaos and nonequilibrium pattern formation in magnetic materials. Spin-wave Relaxation.



Prof. MINO Michinobu

■ Research Themes
 Spin-Wave/Magnetic domain structure/Chaos

High Energy Physics



Particle physics is the study of the properties of elementary particles, which are the smallest units that make up matter, and the forces (interactions) that connect them. Particle physics is also closely connected to understanding the universe. Our laboratory promotes experimental research through accelerator experiments and astrophysical observations. In particular, we focus on particles called neutrinos and are trying to elucidate their properties and

the mysteries of the universe through a variety of experiments.

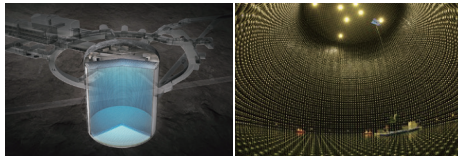


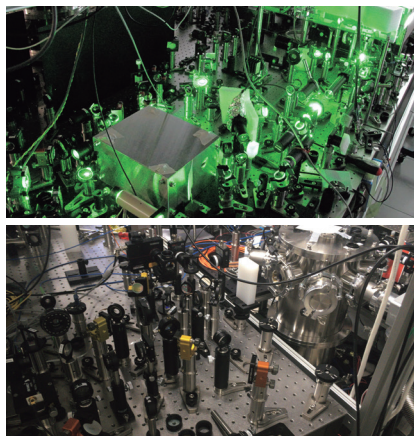
Photo courtesy of J-PARC Center and Kamioka Observatory, ICRR, University of Tokyo



Assoc. Prof.
KOSHIO Yusuke

■ Research Themes
Astro-particle physics/nuclear physics/neutrino physics/supernova

Extreme Quantum Physics



We are creating new research fields, e.g. innovative quantum optics using the nucleus, and a coherent quantum beam based on a novel principle and so on, aiming at future development of both fundamental and applied science.

Prof.
YOSHIMURA Koji

■ Research Themes
Nuclear physics/Low-energy particle physics/Atomic physics



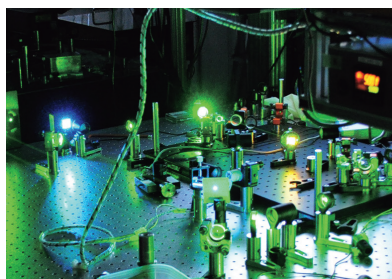
Assoc. Prof.
YOSHIMI Akihiro

■ Research Themes
Nuclear physics/ Low-energy particle physics/Atomic physics

Physics of Quantum Universe



Based on knowledge and techniques developed in various fields of physics, such as particle-nuclear physics, astrophysics, and atomic, molecular, optical physics, experimental research leading to the construction of physics models beyond the new laws of fundamental physics: the particle standard theory. We are mainly carrying out table-top experiments that do not use high-energy accelerators. We have developed various key technologies such as high-performance lasers, high-performance detectors, targets with high quantum coherence, and molecular cooling techniques, and are conducting research using experimental apparatuses that are unique in the world.



Assoc. Prof.
UETAKE Satoshi

■ Research Themes
Atomic physics/
Quantum optics/Particle physics



Assoc. Prof.
MASUDA Takahiko

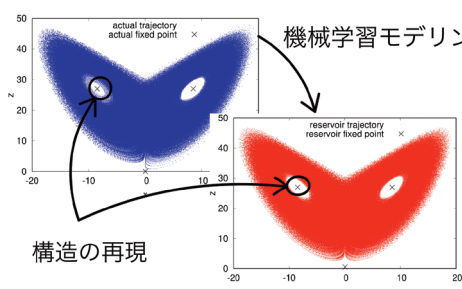
■ Research Themes
Particle·Nuclear Physics/
Atomic·Molecular Physics/Table-top experiment



Mathematical, Physical, Electronic and Information Sciences

Course of Mathematical and Data Sciences

Mathematical Science for Data Engineering



We develop mathematical theories (topology, dynamical systems, etc.), methods, and software for data analysis and utilization and apply them to various fields such as materials science, geology, meteorology, and life science.



Prof. OBAYASHI Ippei

■ Research Themes
Topological data analysis/
Persistent homology /
Applied mathematics

Senior Asst. Prof.
NAKAI Kengo

■ Research Themes
Applied mathematics/
Machine learning

Applied Mathematics



The main research theme of our group is developing and explicating fundamental theories for mathematical models via applications of commutative algebra and probability theory to computational algebra and stochastic models.



Prof. HAYASAKA Futoshi

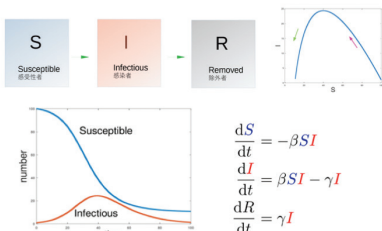
■ Research Themes
Algebra/Commutative algebra



Assoc. Prof.
KAWAMOTO Yosuke

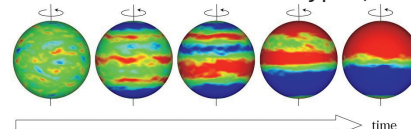
■ Research Themes
Probability theory/Analysis/Random
matrices/Infinite particle systems

Mathematical Analysis of Models



$$\begin{aligned}\frac{dS}{dt} &= -\beta SI \\ \frac{dI}{dt} &= \beta SI - \gamma I \\ \frac{dR}{dt} &= \gamma I\end{aligned}$$

This group deals differential equations, which are often mathematical models describing natural phenomena. We investigate mathematical methods for analysing the equations and also the applications of equations. The equations involved are various types, and the methods used include analysis, dynamical systems theory, numerical analysis, and so on.



Prof. SASAKI Toru

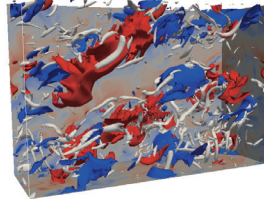
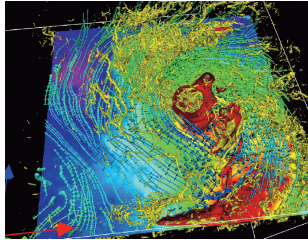
■ Research Themes
Differential equations/Applied analysis/
Mathematical biology



Prof. OBUSE Kiori

■ Research Themes
Nonlinear dynamics/Fluid dynamics

Numerical Analysis of Flow Phenomena



Computational and data science of multi-scale and multi-physics complex flow phenomena using supercomputers; information reduction, extraction, and visualization of big data of complex flow phenomena by mathematical and scientific methods; collaborative research to understand complex flow phenomena in various fields such as astronomy, meteorology, environment, and engineering.



Prof. ISHIHARA Takashi

Research Themes

Fluid dynamics/Turbulence physics/
Numerical simulation/Computational
Science/Data Science



Assoc. Prof. SEKIMOTO Atsushi

Research Themes

Thermal fluid/Turbulence/Dynamical
systems / Numerical simulation /
Transport phenomena/Adjoint inverse
analysis/Data-driven computation

Statistical Data Analysis

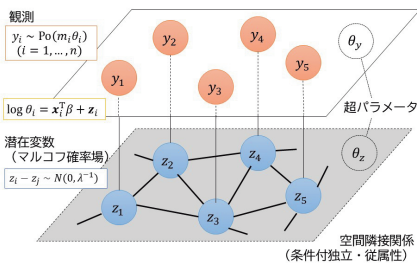


We conduct education and research on statistical theories and methodologies required to analyze data on various issues in the environmental and life sciences, natural and social sciences.

Statistical science is a fundamental technology of data analysis and machine learning, and provides the most effective means of presenting an objective view based on scientific evidence. We wish to contribute

to solving various issues, with making use of drastically improving computer ability.

潜在マルコフ確率場による疾病地図データの空間解析



Prof. SAKAMOTO Wataru

Research Themes

Computational statistics/
Biostatistics/Statistical
model selection



Senior Asst. Prof. TAKAGISHI Mariko

Research Themes

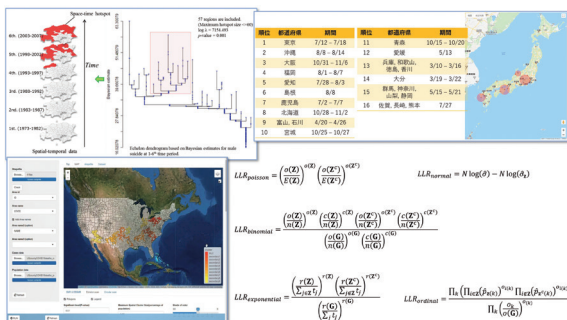
Multivariate data analysis/
Psychometrics

Spatio-Temporal Statistics



The detection of problems such as the occurrence of infectious diseases or the mapping of natural disaster hazards is crucial and fundamental. While there are powerful and useful tools like geographical information systems (GISs) available, determining the location of space-time clusters for large quantities of spatial data or extensive time series poses significant challenges. This study aims to establish

methods for identifying disease clusters or contaminant clusters, commonly referred to as hotspots, in various types of spatio-temporal data, as well as develop corresponding software.



Prof. ISHIOKA Fumio

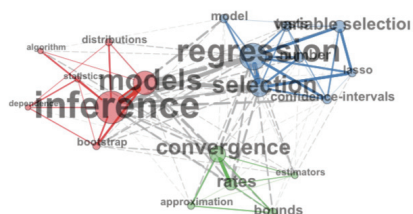
Research Themes

Spatial statistics/Computational statistics/
Echelon analysis/Spatial clusters/Spatial
scan statistics/Spatial epidemiology

Computational Statistics



Keyword Co-occurrences



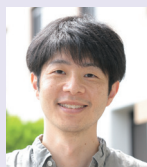
There are various types of data in data analysis. It is important to analyze obtained multivariate data, text data, picture data, and other data types. We apply and develop computational statistical approaches and methods to understand these data.



Prof. IIZUKA Masaya

■ Research Themes

Categorical data analysis/Software/
Principal component Analysis/IR



**Senior Asst. Prof.
OHKUBO Yusaku**

■ Research Themes

Life sciences/Ecology and environmental
studies/Ecostatistics

Computer Engineering



We aim to establish new technologies of hardware and software for computer infrastructures. In computer hardware, we conduct interdisciplinary research on cutting-edge optical technologies (e.g., hologram memory and laser) and integrated circuits (VLSI) which act as the brain of computers. In computer software, we focus on the following research topics: construction methods of new operating systems (OS) and security technologies for OS, mobile devices, and IoT; technologies for supporting group collaboration with computers and networks; and interdisciplinary issues in artificial intelligence and computing technologies.



Prof. YAMAUCHI Toshihiro

■ **Research Themes**
Operating System/System Software/
Computer Security/System Security/
IoT Security



Prof. WATANABE Minoru

■ **Research Themes**
Information and communication/Computer
system/Reconfigurable system/FPGA/
Optically reconfigurable gate array

Assoc. Prof. NOMURA Yoshinari

■ **Research Themes**
Operating system/groupware



Assoc. Prof. Lin Donghui

■ **Research Themes**
Multiagent Systems/Services
Computing/Intelligent Computing



Asst. Prof. KOBAYASHI Satoru

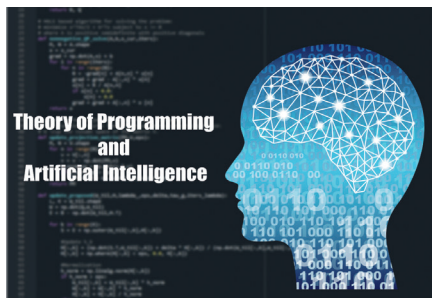
■ **Research Themes**
Network management/
System operation



Asst. Prof. WATANABE Nobuya

■ **Research Themes**
Programming Language Processor/
Parallel Processing/Hardware Design
System/Computer Architecture/
Reconfigurable System/FPGA/Hardware
Design Automation/Language Processor

Theory of Programming and Artificial Intelligence



We conduct a wide range of research on basic theory and applications of computational intelligence, mathematical informatics, and software engineering. Specifically, we promote research on machine learning algorithms, mathematical programming, distributed algorithms, software measurement and analytics, mining software repositories, human behavior analysis, human-machine interaction, computer vision and so on.

Prof. TAKAHASHI Norikazu

■ **Research Themes**
Information and mathematical
engineering



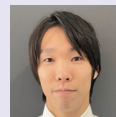
Prof. NAKAGAWA Hiroyuki

■ **Research Themes**
Autonomous software/Self-adaptive software/
Agents/Software engineering/Requirements
engineering/Software design



Asst. Prof. INAYOSHI Hiroki

■ **Research Themes**
Computer security/Privacy leakage
detection



Prof. MONDEN Akito

■ **Research Themes**
Empirical software engineering



Asst. Prof. MIGITA Tsuyoshi

■ **Research Themes**
Computer vision

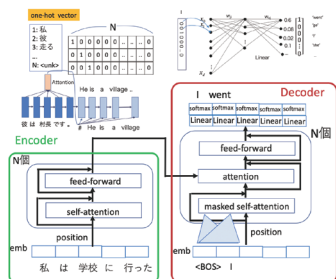


Asst. Prof. OISHI Keiichiro

■ **Research Themes**
privacy-preserving data mining



Pattern Information Processing



Our research interests include basic theories of pattern recognition and understanding, and applied fields of visual information processing, language information processing, and speech information processing. As research on Pattern Information Processing, we apply methods from neuroscience and artificial intelligence such as machine learning, statistics, artificial intelligence, and data mining to design appropriate feature representations and discriminative models for images, videos, texts, and speeches.

Prof. OKABE Takahiro



Research Themes

Computer vision/Computational photography/ Image processing/ Computer graphics

Assoc. Prof. TAKEUCHI Koichi



Research Themes

Natural language processing/Deep neural network model/Large language model

Asst. Prof. YOSHIDA Michitaka

Research Themes

Computer vision/ Computational photography/ Compressive sensing

Prof. AKASHI Takuya



Research Themes

Artificial intelligence / Computer vision / Neuroscience/ Image recognition/ Human interface

Assoc. Prof. HARA Sunao



Research Themes

Speech processing/Signal processing/ Spoken dialog system/Lifelogs/ Multimodal information processing

Asst. Prof. ENDO Yoshitaka

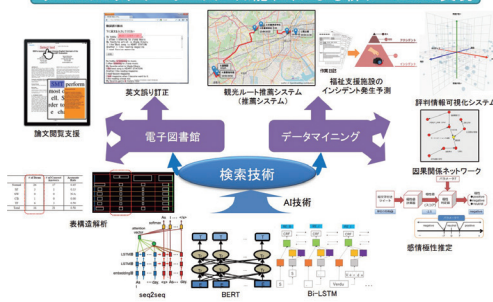
Research Themes

Computer vision/ Computational photography/ Compressive sensing

Intelligent Design



ウェブのビッグデータ×人工知能(AI)による新サービスの実現



In the division of Intelligent Design, our research focuses on developing technologies that efficiently search for desired information and discover valuable insights from the vast amount of Big Data available on the Web, utilizing artificial intelligence and other related approaches. Additionally, we explore digital libraries that enable users to seamlessly navigate between the virtual world of cyberspace, connected by the Internet, and the physical reality. Our research also includes stream delivery technologies for multimedia information, including audio and video, with a particular emphasis on the integration of Internet broadcasting and data communications.

Prof. OHTA Manabu



Research Themes

Web Information Retrieval/ Web Mining/Digital Library

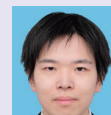
Senior Asst. Prof. MATSUDA Yuki



Research Themes

Internet of Things/Sensing/Information Network

Asst. Prof. UWANO Fumito



Research Themes

Reinforcement Learning/Distributed Artificial Intelligence

Assoc. Prof. GOTOH Yusuke



Research Themes

Streaming Delivery in Broadcasting Environments/Spatial Computing

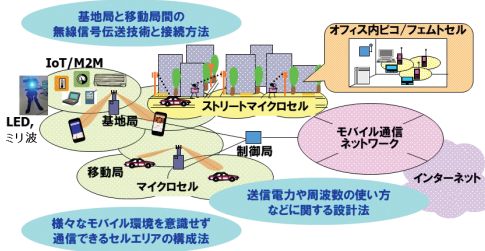
Senior Asst. Prof. WEI Bo



Research Themes

Adaptive media transmission/ Intelligent network management/ Integrated communication and sensing

Mobile Communications



This laboratory is working on research on new wireless technologies with the aim of realizing next generation mobile radio communication systems beyond 5G. Our major research challenges include OFDM/OFDMA and MIMO channel signal transmission to realize ultra high-speed and large-capacity systems with more than 10 Gbps, radio wave propagation and link budget technologies for seamless and flexible service area implementation. Furthermore, we are researching LED visible light communication as a new communication system, and wireless signal separation/demodulation technology aiming at the ultimate effective use of frequencies.



Prof. UEHARA Kazuhiro
 ■ Research Themes
 Mobile communication engineering

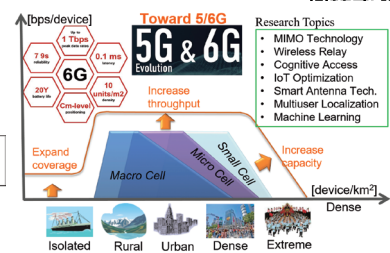
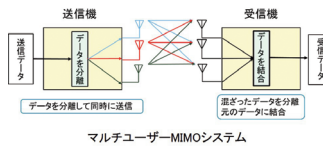


Assoc. Prof. TOMISATO Shigeru
 ■ Research Themes
 Mobile communication engineering

Multimedia Radio Systems



Our laboratory aims to 5G/6G wireless communication systems which can realize the high-speed wireless communication as "anytime, anywhere, anyone." Our research topics are most on the MIMO wireless communication system, MIMO relay, Overload MIMO system, IoT relay, smart antenna technology as ESPAR, LCX and RIS, wireless communication with machine learning, IoT devices localization. We are also developing the wireless technology for smart sensing and communication, cognitive radio, learning technique and prediction methods for wireless environment.

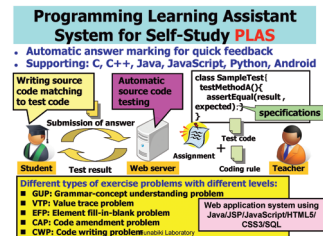


Prof. DENNO Satoshi
 ■ Research Themes
 Wireless communication/Signal processing/5G,6G wireless system/MIMO system/relay communications



Assoc. Prof. HOU Yafei
 ■ Research Themes
 5G,6G wireless system/IoT localization/Smart antenna technology/Machine learning for wireless system

Distributed System Design



We study practical and useful research topics in the Information Communication Technology (ICT), including programming learning assistant systems, wireless local-area networks, distributed computing systems, multimedia application systems, AR-based navigation systems, big data analysis, IoT application systems, to achieve our mission of the human resource developments for next generations. Currently, 38 international students from five countries are studying together with Japanese students in our laboratory.



Prof. FUNABIKI Nobuo
 ■ Research Themes
 Programming learning/WLAN/Multimedia/IoT application/Distributed computing system



Senior Asst. Prof. HTOO SANDI KYAW
 ■ Research Themes
 serious game/gamification/programming learning assistant system/graph theory

EMC Design



Optical and Electromagnetic Waves (OEW) Lab studies research topics that aim to improve electrical, electronic, and telecommunication systems in speed and reliability. Our research is related to specific design technology to intentionally control and reduce unintentional electromagnetic waves, or electromagnetic noise, generated by electrical, electronic, and telecommunication equipment. Such design technology is called EMC design. EMC is short for electromagnetic compatibility

and means the ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable disturbance to anything in that environment. EMC consists of two aspects, EMI (electromagnetic interference) and EMS (electromagnetic susceptibility). The former is the ability that a system cannot interfere with other systems or subsystems. In contrast, the latter is the one that system must continue to operate correctly in the presence of interference from others or transient.



Prof. TOYOTA Yoshitaka

Research Themes
Electromagnetic Compatibility (EMC)/Hardware Security/Safe and Security

Secure Hardware Design

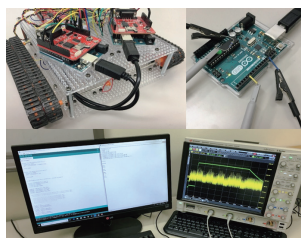


In an era where various devices are connected to the internet, and data is exchanged and stored, information security technology is essential for using services with confidence. Our research lab focuses on studying hardware design technologies.

Assoc. Prof. IOKIBE Kengo

Research Themes
Hardware security / Electromagnetic information leakage / Electronics packaging / Modeling / IoT / Electromagnetic Compatibility / LiDAR

Information Security



Consequently, securing and safeguarding communication and service delivery has become a critical issue.

In our research laboratory, we are committed to the research and development of cryptography, random number generation, and related technologies. Our goal is to ensure that internet-connected devices, such as medical devices, automobiles, and smart home appliances, can operate securely and safely in this changing scenario. By applying encryption and random number techniques, we aim to provide reliable solutions that safeguard sensitive data and prevent security threats. Our research explores enhancing encryption algorithms, producing high-quality random numbers, and designing secure communication protocols. Through these endeavors, we aspire to create a dependable environment where individuals and organizations can confidently use internet-connected devices without jeopardizing their security and privacy.



Prof. NOGAMI Yasuyuki

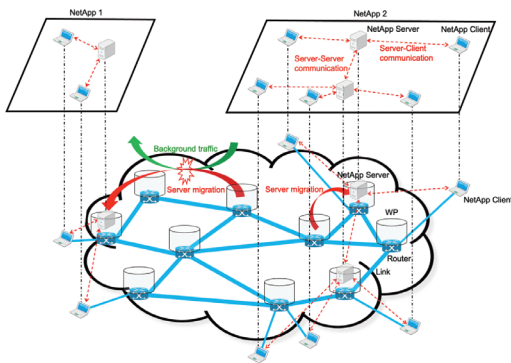
Research Themes
Information security/Discrete mathematics/Modern cryptography/Post-quantum cryptography/Homomorphic encryption/IoT/AI-related security/Secure protocols



Assoc. Prof. KODERA Yuta

Research Themes
Information security/Discrete mathematics/Modern cryptography/Post-quantum cryptography/Homomorphic encryption/IoT/AI-related security/Secure protocols

Network Systems



In the after-corona era, a remote world (decentralized society) is expected to arrive, and social and economic activities that do not require face-to-face interaction will take root as the new normal. In this research field, we focus on the Internet, which is becoming increasingly important as an ICT infrastructure supporting the new normal. We design the future Internet by predicting the services that will be needed on the Internet in the future and identifying the possibilities and limitations of various newly created technologies.



Assoc. Prof. FUKUSHIMA Yukinobu

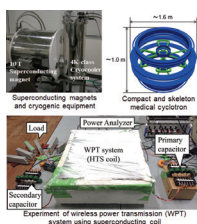
■ Research Themes

Information network/Network virtualization/
Edge computing/Knowledge-defined networking

Mathematical, Physical, Electronic and Information Sciences

Course of Electrical and Electronic Engineering

Applied Superconductivity Engineering



Superconducting technology is expected to contribute to our society by improving the efficiency of energy systems derived from the high current density of superconductors and creating new technologies through the application of high magnetic fields. In our laboratory, we have been developing high-efficiency and low-loss superconducting electrical devices using low-temperature superconducting wires and high-temperature superconductors (bulk and thin-film wires). We have also developed compact and/or high-field superconducting magnets for medical and/or fusion applications.

Prof. KIM Seokbeom

Research Themes

Superconductivity/
Energy applications/
Medical and fusion applications/
Wireless power transmission/
Electromagnetic field analysis



Assoc. Prof. UEDA Hiroshi

Research Themes

Superconductivity/
Energy applications/Medical and fusion applications/Wireless power transmission/Electromagnetic field analysis



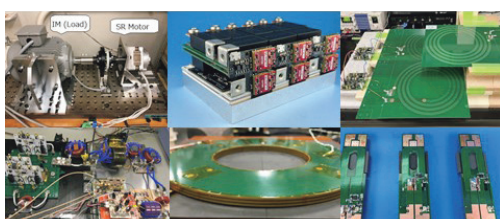
Asst. Prof. INOUE Ryouta

Research Themes

Superconductivity/
Energy applications/Medical and fusion applications/Wireless power transmission/Electromagnetic field analysis



Electric Power Conversion System Engineering



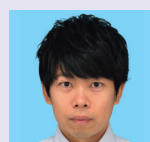
The following are examples of specific research topics.

- *SR motor drive method that achieves both low torque ripple and low input current ripple
- *High power density three-phase inverters using GaN-HEMTs for EV applications
- *Stable resonant inductive coupling wireless power transfer system independent of manufacturing variation and magnetic interference
- *High frequency resonant inverter for plasma generator applications
- *Ultra-thin and low-loss coils for IH cooking heaters
- *Rectifier-integrated printed-circuit-board winding structures



Prof. HIRAKI Eiji

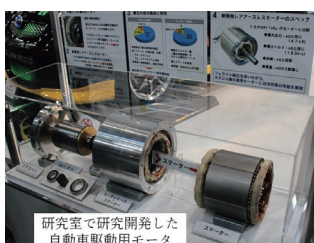
Research Themes
Power Electronics



Asst. Prof. ISHIHARA Masataka

Research Themes
Power Electronics

Motor System Engineering

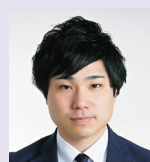


Currently, motors are used in a variety of locations from industry and transportation to the home, and more than half of all electricity generated in Japan is consumed by motors. Therefore, the improvement of motor efficiency is very effective in reducing energy-related carbon dioxide emissions, and is a very important research topic from the perspective of countermeasures against global warming and the depletion of energy resources. Accordingly, we are conducting research on "high performance motors" and "bearingless motors and magnetic bearings utilizing magnetic levitation" with the aim of "reducing the environmental burden caused by motors."



Prof. TAKEMOTO Masatsugu

Research Themes
Electrical machines/Generators/Electrical machinery/Motor drive/Power electronics



Asst. Prof. TSUNATA Ren

Research Themes
Electrical machines/Generators/Electrical machinery/Motor drive/Power electronics

Optoelectronic and Electromagnetic Wave Engineering



Research on wireless power transfer systems and devices using electromagnetic and acoustic waves, measurement systems for antenna system characteristics for mobile communications beyond 5G, network construction of IoT devices and sensor devices, medical devices using light, and sensor systems using optical fiber, etc.



Prof. TAKAHASHI Yasushi

■ **Research Themes**

High-Q Nanocavity/photonic Charge Sensor/Silicon Photonics/Space Photonics

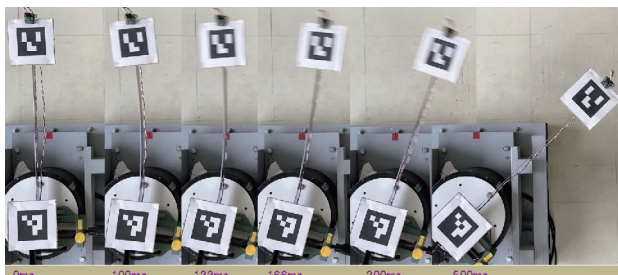


Assoc. Prof. FUJIMORI Kazuhiro

■ **Research Themes**

Wireless power transfer/Electromagnetic field measurement/IoT network/Optical fiber sensor

Electronic Control Engineering



Control system optimization and its application are under research to develop theories and techniques, aiming to enhance electronic control technology widely employed in the current society.

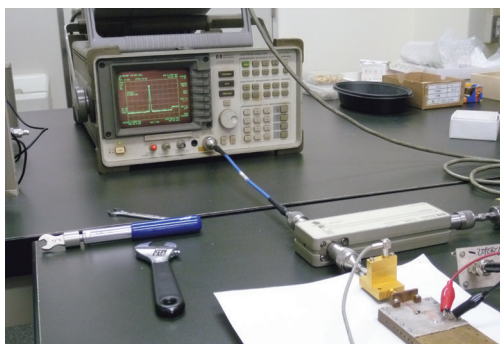


Assoc. Prof. IMAI Jun

■ **Research Themes**

Control engineering/Distributed parameter systems / Robust control

Microwave Circuits



The microwave circuits laboratory principally conducts research on microwave circuits such as oscillators, microwave passive circuits such as power dividers/combiners, and other electromagnetic circuits for applications such as mobile communications, satellite broadcasting/communications, and wireless electric power transmissions.

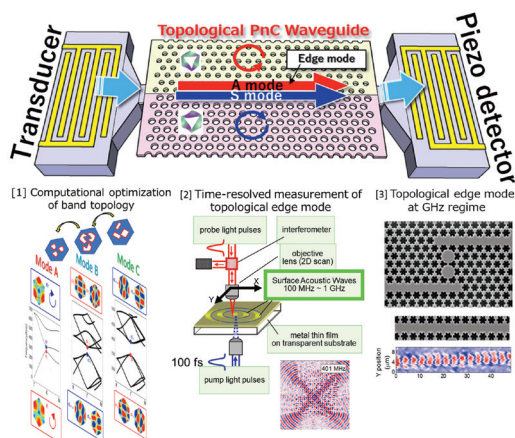


Assoc. Prof. SANAGI Minoru

■ **Research Themes**

Electrical and electronic engineering/
Electronic devices and equipment/
Microwave engineering

Multiscale Device Design



Research themes:

- i) Design and application of novel artificial materials "metamaterials" that enable one to control light, electromagnetic, acoustic, and elastic waves as needed.
- ii) Nanomaterials/devices design by first-principles and large-scale molecular simulation methods.
- iii) Quantum-classical hybrid computation methods, machine learning, and artificial intelligence for designing the novel functionality of materials/devices.

In particular, we are currently focusing on "topological phononics" that is, as an analogy of physics on topological insulators/superconductors, a novel approach to the design of extremely efficient acoustic/elastic wave devices operating at ultra high-frequency (GHz) regimes.



Prof. TSURUTA Kenji

Research Themes

Applied physics/Nano-micro sciences/Nanomaterials engineering/Electronic materials engineering

Nanodevice and Materials Engineering



Semiconductors are used not only in computers, but also in various other places, such as solar cells, thermoelectric conversion devices and other power generation elements, and sensors that sense temperature and light. In addition to silicon, which is widely used today, our research targets new semiconductor materials with mechanical flexibility and excellent electrical properties, such as carbon nanotubes and semiconductive nanosheets, and we are conducting a series of research from structural control and design at the nanoscale (one billionth of a meter) to practical scale. We also perform research on defect properties and engineering in semiconducting materials.



Prof. HAYASHI Yasuhiko

Research Themes

Semiconductor/Nanocarbons/Two-dimensional materials/Flexible devices/Crystal defect and engineering



Assoc. Prof. YAMASHITA Yoshifumi

Research Themes

Semiconductor/Nanocarbons/Two-dimensional materials/Flexible devices/Crystal defect and engineering



Asst. Prof. SUZUKI Hiroo

Research Themes

Semiconductor/Nanocarbons/Two-dimensional materials/Flexible devices/Crystal defect and engineering



Asst. Prof. NISHIKAWA Takeshi

Research Themes

Semiconductor/Nanocarbons/Two-dimensional materials/Flexible devices/Crystal defect and engineering