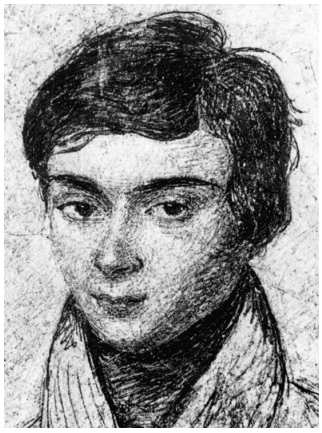
Mathematical, Physical, Electronic and Information Sciences

Department of Mathematics

Algebra



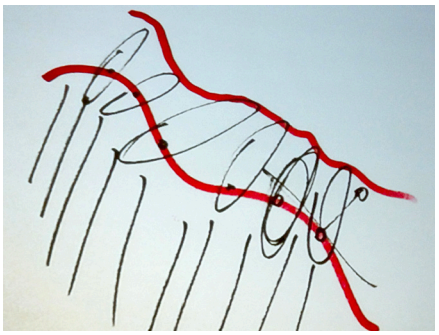
Research Themes
*Representation Theory, Algebraic Lie Theory
*Number Theory, Arithmetic of Automorphic Form

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/Relativerepresentations/ 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.

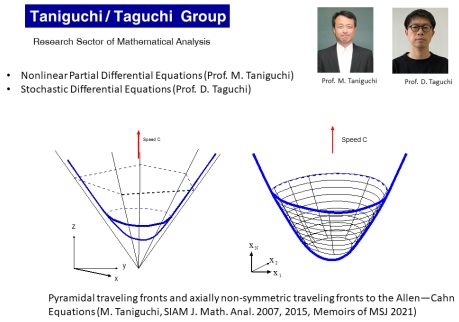
Prof. OSHITA Yoshihito

■Research Themes
Nonlinear PDE

Assoc. Prof. UEHARA Takato

■Research Themes
Complex analysis/Dynamical system

Mathematical Analysis



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

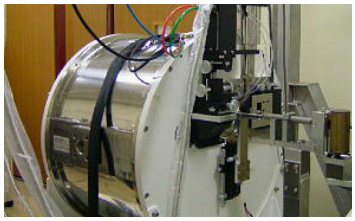
Assoc. Prof. KAWAMOTO Masaki

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

Mathematical, Physical, Electronic and Information Sciences

Department of Physics

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.

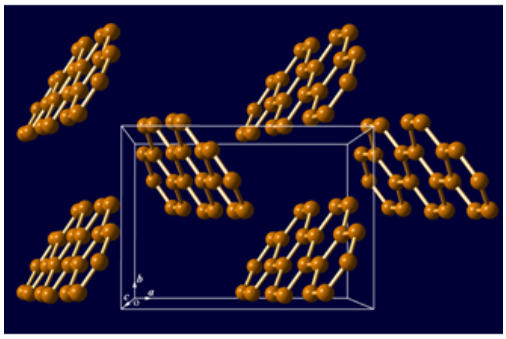
Prof. NOGAMI Yoshio

■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.

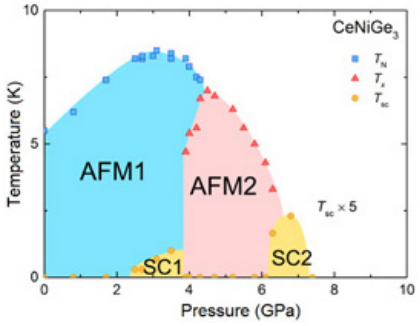
Prof. IKEDA Naoshi

■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.

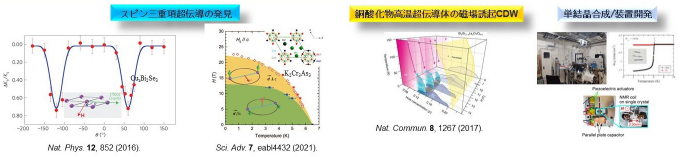
Prof. KOBAYASHI Tatsuo

■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-centrocymmetric 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

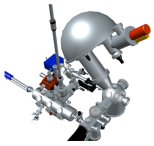
Assoc. Prof.
KAWASAKI Shinji

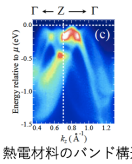
■Research Themes
Topological superconductivity/
Spin-triplet superconductor/NMR

Asst. Prof.
MATANO Kazuaki

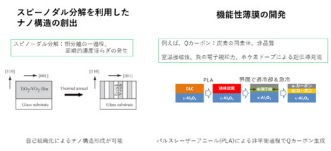
■Research Themes
Topological superconductivity/
Spin-triplet superconductor/NMR

Physics of Solid Surfaces and Interfaces


ARPES装置



熱電材料のバンド構造



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.

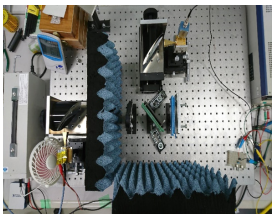
Prof. YOKOYA Takayoshi

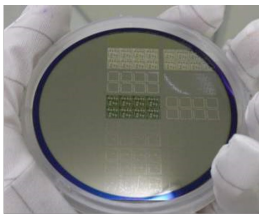
■Research Themes
Electronic states/
photoemission spectroscopy/Elucidation of the mechanism of functionality

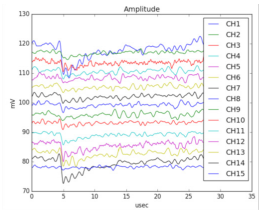
Assoc. Prof. MURAOKA Yuji

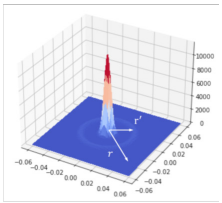
■Research Themes
Thin films/Surface/Interface

Astroparticle Physics







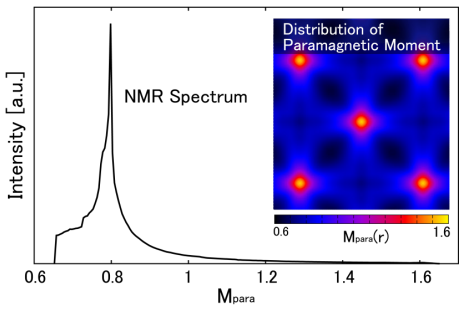


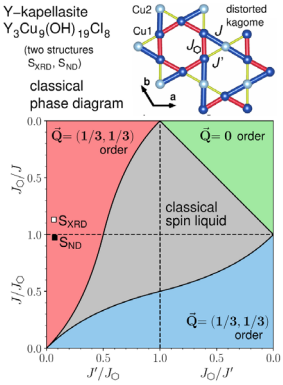
We are studying the advanced analysis methods to measure the CMB polarization to search for the imprint of the cosmic inflation. We are also developing superconducting detectors to study neutrinos from the sun.

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

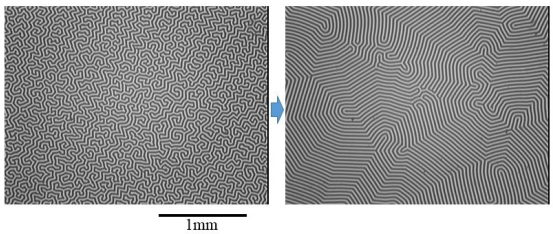
Prof. JESCHKE Harald Olaf

■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.

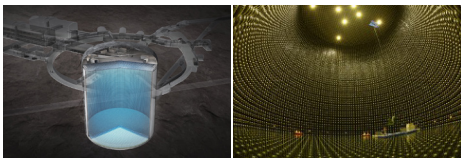
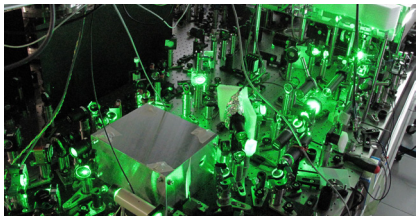


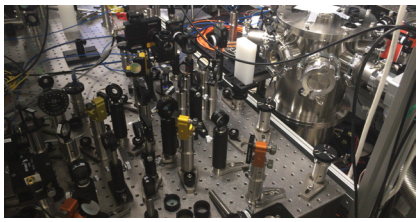
Photo courtesy of J-PARC Center and Kamioka Observatory, ICRR, University of Tokyo

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

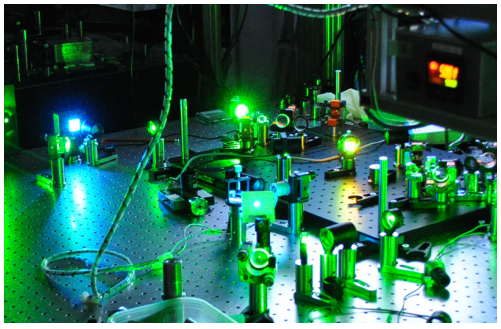
■Research Themes
Nuclear physics/Low-energy particle physics/ Atomic physics

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.



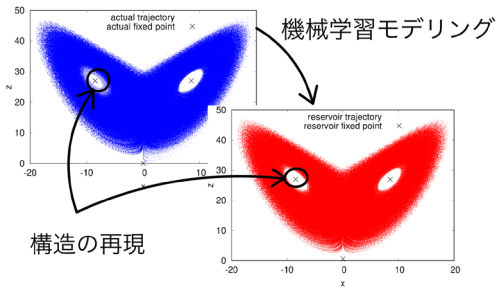
Assoc. Prof. UETAKE Satoshi

■Research Themes
Atomic physics/Quantum optics/Particle physics

Mathematical, Physical, Electronic and Information Sciences

Department 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 Assist. 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.

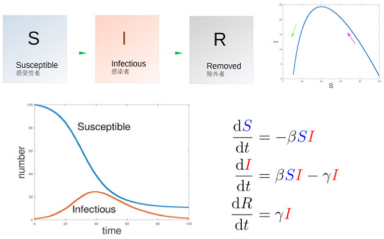
Prof. HAYASAKA Futoshi

■Research Themes
Algebra/Commutative algebra

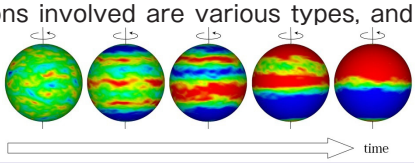
Assoc. Prof. KAWAMOTO Yosuke

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

Mathematical Analysis of Models



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.



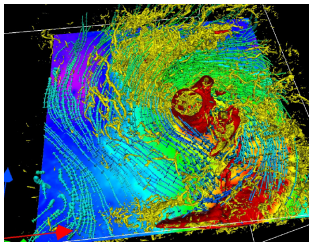
Prof. SASAKI Toru

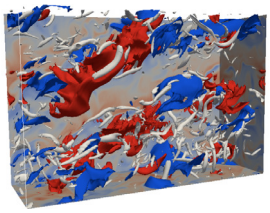
■Research Themes
Differential equations/Applied analysis/ Mathematical biology

Assoc. 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

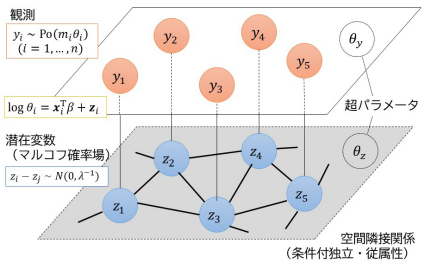
Assoc. Prof. SEKIMOTO Atsushi

■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.



Prof. SAKAMOTO Wataru

■Research Themes

Computational statistics/ Biostatistics/Statistical model selection

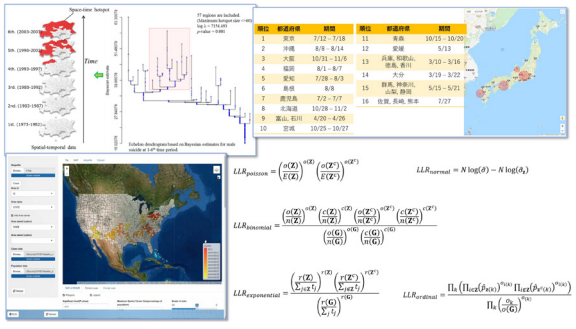
Senior Assist. Prof. TAKAGISHI Mariko

■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.

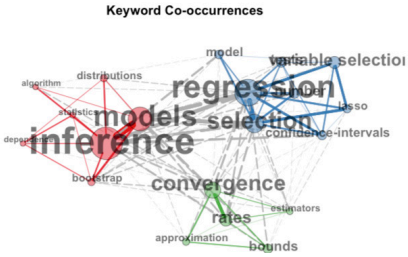


Prof. ISHIOKA Fumio

■Research Themes

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

Computational Statistics

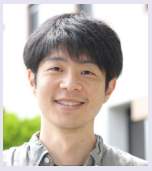


There are various types of data in data analysis. It is important to analyze obtained multivariate data, text data, picture data, and other data types. We apply and develop computational statistical approaches and methods to understand these data.

Prof. IIZUKA Masaya

■ Research Themes

Categorical data analysis/Software/
Principal component Analysis/IR



Senior Assist. 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

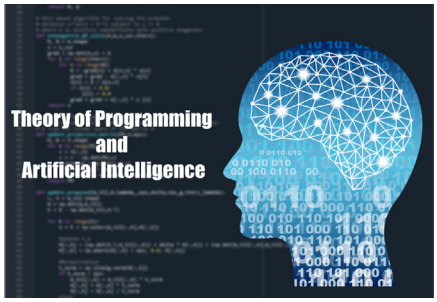
Asst. Prof. KOBAYASHI Satoru

■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. MONDEN Akito

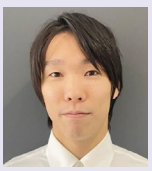
■Research Themes
Empirical software engineering

Prof. NAKAGAWA Hiroyuki

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

Asst. Prof. MIGITA Tsuyoshi

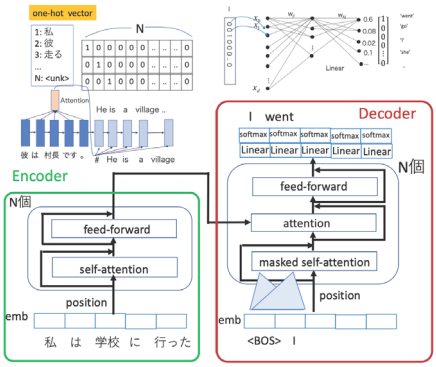
■Research Themes
Computer vision



Asst. Prof. INAYOSHI Hiroki

■Research Themes
Computer security/Privacy leakage detection

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

Prof. AKASHI Takuya

■Research Themes
Artificial intelligence / Computer vision /Neuroscience/ Image recognition/ Human interface

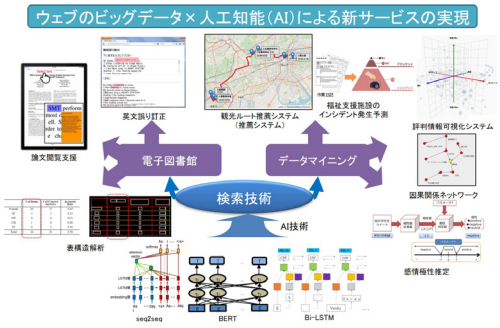
Assoc. Prof. TAKEUCHI Koichi

■Research Themes
Natural language processing/Deep neural network model/Large language model

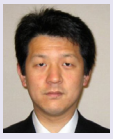
Assoc. Prof. HARA Sunao

■Research Themes
Speech processing/Signal processing/ Spoken dialog system/Lifelogs/ Multimodal information processing

Intelligent Design



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

Assoc. Prof. GOTOH Yusuke

■Research Themes
Streaming Delivery in Broadcasting Environments/Spatial Computing

Senior Asst. Prof. MATSUDA Yuki

■Research Themes
Internet of Things/Sensing/Information Network

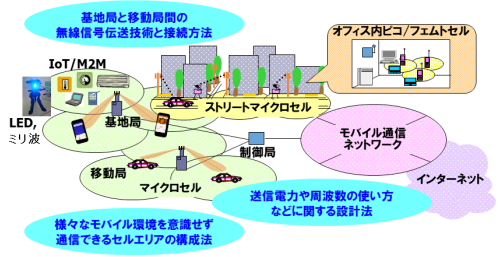
Asst. Prof. UWANO Fumito

■Research Themes
Reinforcement Learning/Distributed Artificial Intelligence

Mathematical, Physical, Electronic and Information Sciences

Department of Information and Communication Systems

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

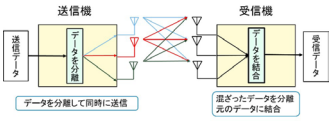
Assoc. Prof. TOMISATO Shigeru

■Research Themes

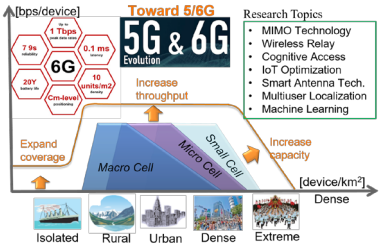
Mobile communication engineering

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.



マルチユーザーMIMOシステム



Prof. DENNO Satoshi

■Research Themes

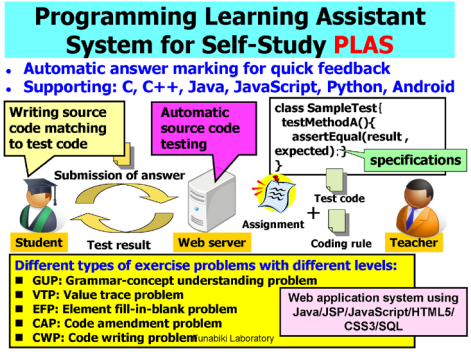
Wireless communication/Signal processing/5G,6G wireless system/MIMO system/relay communications

Assoc. Prof. HOU Yafei

■Research Themes

5G,6G wireless system/IoT localization/Smart antenna technology/Machine learning for wireless system

Distributed System Design



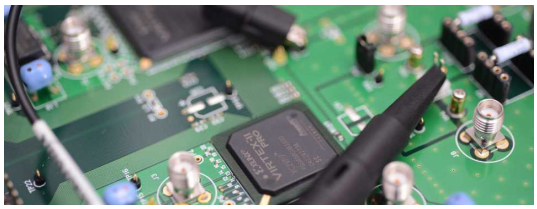
We study practical and useful research topics in the Information Communication Technology (ICT), including programming learning assistant systems, wireless local-area networks, distributed computing systems, multimedia application systems, AR-based navigation systems, big data analysis, IoT application 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

EMC Design

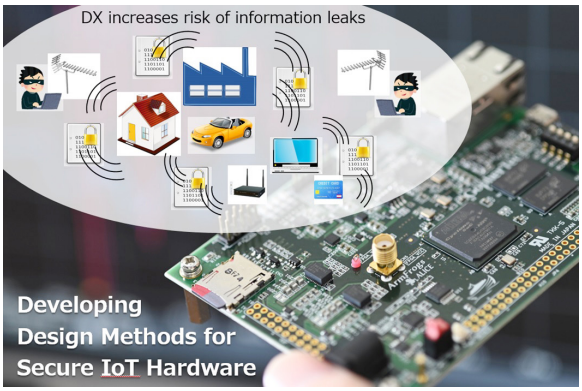


Optical and Electromagnetic Waves (OEW) Lab studies research topics that aim to improve electrical, electronic, and telecommunication systems in speed and reliability. Our research is related to specific design technology to intentionally control and reduce unintentional electromagnetic waves, or electromagnetic 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

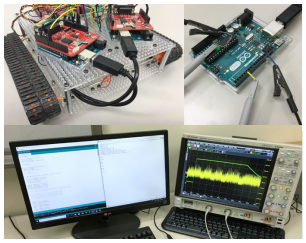


In an era where various devices are connected to the internet, and data is exchanged and stored, information security technology is essential for using services with confidence. Our research lab focuses on studying hardware design technologies.

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.

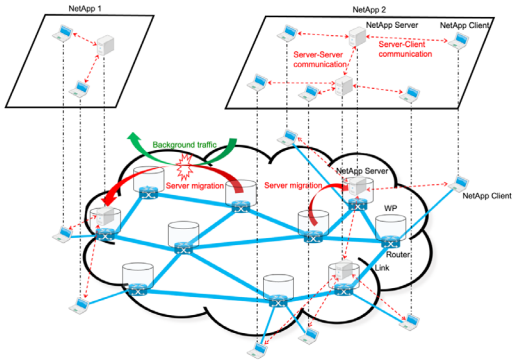
Prof. NOGAMI Yasuyuki

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

Asst. 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

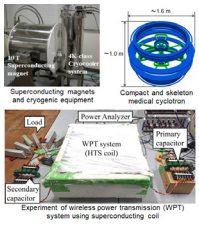
■Research Themes

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

Mathematical, Physical, Electronic and Information Sciences

Department 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

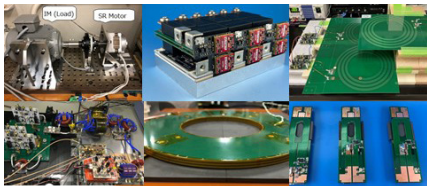
Assoc. Prof. UEDA Hiroshi

■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

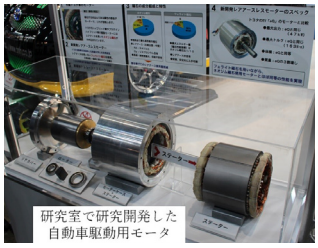
Assoc. Prof. UMETANI Kazuhiro

■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.

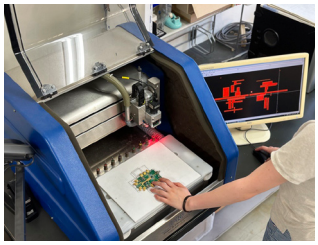
Prof. TAKEMOTO Masatsugu

■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. FUKANO Hideki

■Research Themes

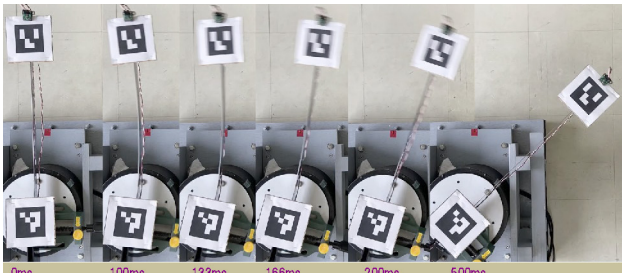
Wireless power transfer/Electromagnetic field measurement/IoT network/Optical fiber sensor

Assoc. Prof. FUJIMORI Kazuhiro

■Research Themes

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

Electronic Control Engineering



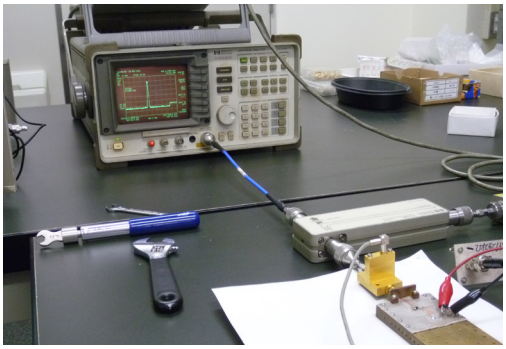
Control system optimization and its application are under research to develop theories and techniques, aiming to enhance electronic control technology widely employed in the current society.

Assoc. Prof. IMAI Jun

■Research Themes

Control engineering/Distributed parameter systems / Robust control

Microwave Circuits



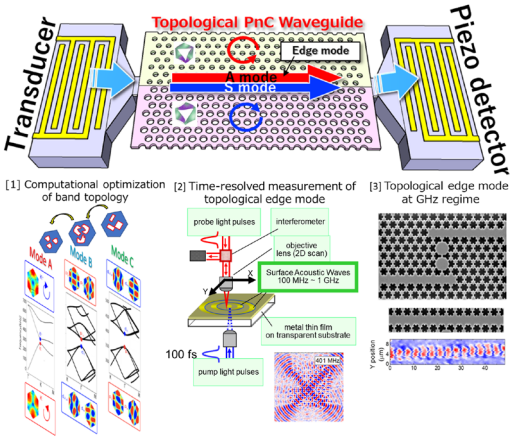
The microwave circuits laboratory principally conducts research on microwave circuits such as oscillators, microwave passive circuits such as power dividers/combiners, and other electromagnetic circuits for applications such as mobile communications, satellite broadcasting/communications, and wireless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

Assoc. Prof. SANAGI Minoru

■Research Themes

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

Multiscale Device Design



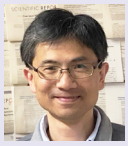
Research themes:

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.

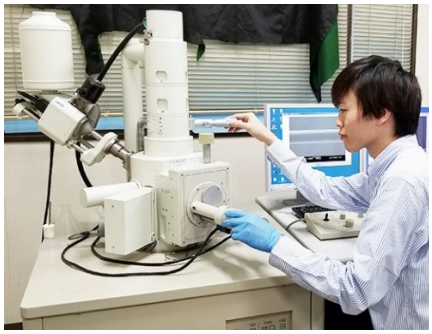


Prof. TSURUTA Kenji

■ 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

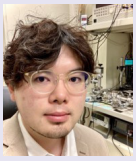
■ Research Themes

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