School of Engineering

2024

東京工業大学
Tokyo Institute of Technology

School of Engineering

—Creating new industries and advancing civilization—

Engineering contributes to civilization – the framework that guarantees the happiness of human being – and creates technologies that make human lives richer and more comfortable.

• Message from the Dean •

The School of Engineering is the largest educational and research organization in Tokyo Institute of Technology with more than 200 faculty members in five research fields of engineering: Mechanical Engineering, Systems and Control Engineering, Electrical and Electronic Engineering, Information and Communications Engineering, and Industrial Engineering and Economics, which are considered as the core fields of engineering. Through the innovative educational curricula established by the educational reform in 2016, we are fostering creative engineers, researchers, and educators who can play an active role globally, and promoting world-class research activities. This booklet provides a wide range of research fields in the School of Engineering, and lists the research topics of each faculty member.

Regarding the composition of research fields, in order to meet the needs of society, the research fields in each department are divided into research groups, and the research groups are further subdivided into research fields consisting of small number of faculty members. In addition to this classification, there are four interdisciplinary research groups, the Smart Power Grid Group, the Integrated IoT Technology Group, the Human Centric Group, and the Super Bio Robotics Group in order to respond to global research issues such as the SDGs. Furthermore, in response to the merger of Tokyo Institute of Technology with Tokyo Medical and Dental University to form Institute of Science Tokyo in October 2024, we aim to contribute to the well being of people by strengthening various medical-engineering collaborative researches. Through these research organizations, we will promote not only creative research by faculty members, but also collaboration research between industry and academia, and international joint research with some of the world's top universities and corporations.

Please look forward to the education and research of the School of Engineering that will contribute to the future society.

Kotaro Inoue
Dean, School of Engineering

Steering Committee

Hideaki Fujita, Associate Dean for Education
Daisuke Kurabayashi, Associate Dean for Finance and Campus Management
Dai Senoo, Associate Dean for Planning and Safety
Mamoru Tanahashi, Associate Dean for Research, International Affairs, and Public Relations
Atsushi Takahashi, Associate Dean for General Affairs and Human Resources
Wakaha Ogata, Associate Dean for Diversity

Departments and Research Groups in School of Engineering

Department	Graduate Major	Group	Field
Mechanical Engineering	Mechanical Engineering Energy Science and Informatics* Engineering Sciences and Design* Human Centered Science and Biomedical Engineering* Nuclear Engineering *	Nanosystems	Multiscience, Ultrahigh Precision Processing, Biomedical Fusion
		Human Centric Design	Robotics, Human-machine Interface, QOL Design, Medical Engineering
		Carbon Neutral	Energy, Environmental Thermofluid
		Aerospace Systems	Space Engineering, Aeronautical Engineering
		Advanced Solution	Simulation Engineering, Advanced Materials & Manufacturing, Intelligent Sensing, Advanced Designing
Systems and Control Engineering	Systems and Control Engineering Engineering Sciences and Design*	Control Theory	Intelligent Robot, Cyber Physical Systems, Complex Network Systems
		Advanced Measurement	Mechanical Design and Functional Evaluation, Computer Vision and Image Processing, Applied Measurement Using Acoustic and Radio Waves
		System Analysis	Nonlinear and Stochastic Dynamics, Computational Mechanics, Power Systems for Transportation
		System Integration	Bio-robot, AI-robotics
Electrical and Electronic Engineering	Electrical and Electronic Engineering Energy Science and Engineering* Human Centered Science and Biomedical Engineering* Nuclear Engineering*	Circuit	Integrated Circuit
		Photonics, Ultrasonics, and Communications	Wireless Communications, Informatics, Photonics, Ultrasonics
		Device	Compound Semiconductor Device, Quantum Functional Device, Intelligent Device, Terahertz Device, Green Device
		Electronic Materials	Energy Electronics, Spintronics, Nano- and Bio-photonics, Organic Electoronics, Integrated Electronics, Bioelectronics
		Electric Power and Energy	Electric Power System, Power Electronics, Electric Machinery, Plasma and Environment
Information and Communications Engineering	Information and Communications Engineering Human Centered Science and Biomedical Engineering* Engineering Science and Design*	Human Information Systems	Sensory Information Processing, Intelligent Information Processing, Media Information Processing, Biological Information Processing
		Signal Processing	Media Signal Processing, Inverse Problems
		Communication, Networks, and Security	Communication Systems, Information Theory and Security
		Integrated Circuit and Computer	Digital Integrated Circuits, Analog Integrated Circuits
		Integrated Information and Communications	Distributed Information and Advanced Communication Systems
Industrial Engineering and Economics	Industrial Engineering and Economics Engineering Sciences and Design*	Advanced Management and Paradigm Creation	Industrial System, Human Centered System, Operations Management
		Analysis Method Creation	Mathematical Sciences and Informatics, Econometrics, Business Data Science
		Corporate System Creation	Corporate Governance System, Management Strategy/Marketing
		Economic Science	Macroeconomics/Cliometrics, Microeconomics/Game Theory, Humanomics, Global Environmental Research

* interdisciplinary graduate majors that span multiple schools or departments

Interdisciplinary Research Groups		
	Integrated IoT	Super Smart Society System
		Cyber Physical System
		Smart Wireless Technology
		Quantum Science Innovation
	Human Centric	Human Centric Design
		Perceptional AI
		Humanomics
		Cybernetics
	Smart Power Grid	Electric Power Conversion
		Electro Mechanical Energy Conversion Field
		Renewable Power Generation
		Electric Power Control
		Electric Energy Storage
	Super Bio Robotics	Algorithm and Control
		Soft Robotics
		Cyber Physical Sensing

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering
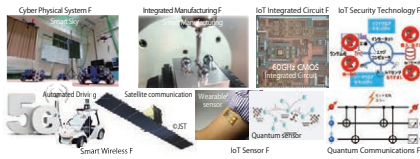
Information and Communications Engineering

Industrial Engineering and Economics

Interdisciplinary Research Groups

Integrated IoT Group

Super smart society realized with IoT

In order to realize super smart society using IoT technology, we are conducting research activities with a department-transverse research group in the school of engineering.

Faculty

Integrated IoT Group
Super Smart Society System Field

Kei Sakaguchi, Professor
Wireless communication engineering
B5G/IoT/Millimeter-wave/Wireless energy transmission
Connected car/Automated driving

Tran Gia Khanh, Associate Professor
Gbps-class wireless backbone network, Radio resource management using AI, IoT networks employing drones

Teruya Fujii, Specially Appointed Professor
Wireless transmission technologies for the 6th mobile communication system / The 3D cell layout and network cooperation control / UAV Temporary Wireless Relay System / Cellular drone repeater system for disaster

Yoshichika Ohta, Specially Appointed Associate Professor
Mobile communication system / HAPS communication system / Radio propagation for mobile radio / Wireless power transfer

Dai Taguchi, Associate Professor
Analysis of electrical and electronic materials, and novel electrical and optical techniques for probing these materials based on dielectric physics.

Hiroshi Sasaki, Associate Professor
Computer Architecture, Computer Security, Computer Systems, Internet of Things (IoT), Workload Characterization

Hideharu Takahashi, Associate Professor
Smart agriculture and forestry engineering, remote sensing, environmental recovery, utilization of unused resources, zero carbon energy

Integrated IoT Group
Cyber Physical System Field

Koichi Suzumori, Professor
Development of new actuators and their application to biomimetic robots, soft robots, body support wears, tough robots and micro robots.

Hiroyuki Nabae, Assistant Professor
Study on component technologies with a focus on new actuators, and their application to micro robots and mechatronics devices

Takeshi Hatanaka, Professor
Cyber-Physical-Human systems, Coordinated control of robotic networks Distributed control and decision for Smart Sky, Ocean, and Agriculture

Tomohisa Tanaka, Associate Professor
Development of new production technologies by using hight frequency vibration and laser energy, development of practical devices with additive manufacturing technology

Jiang Zhu, Assistant Professor
Digital engineering, Intelligent manufacturing system, advanced machining and measurement system

Integrated IoT Group
Smart Wireless Technology Field

Jiro Hirokawa, Professor
Millimeter-wave high-efficiency planar antenna, 2D beam-switching circuit, fast analysis for antenna design, 2D orthogonal multiplexing

Takashi Tomura, Tenure-track Assistant Professor
Research based on electromagnetic engineering: small-satellite onboard antennas, Origami deployable membrane antennas, millimeter- & THz-wave-band antennas & material characterization

Kazuhiko Fukawa, Professor
Transmission and network techniques for wireless communications by developing digital signal processing, adaptive filters, and statistical based algorithms.

Yuyuan Chang, Assistant Professor
Mobile communication, millimeter-wave communication, MIMO system, MU-MIMO system, user scheduling, wireless sensor networks

Satoshi Suyama, Visiting Professor
Next generation mobile communication system/Radio access technologies/Radio Access Networks/Mobile Radio Applications

Kenichi Okada, Professor
Millimeter-wave Wireless Transceiver/5G/Battery-less IoT Wireless Sensor Node/CMOS Integrated Circuits/PLL/Atomic Clock/Terahertz Communication & Sensing & Imaging

Atsushi Shirane, Associate Professor (FIRST)
5G, IoT, Satellite Communication, Wireless Communication, Wireless Power Transfer, RF ngerprint, Rad-Hard Transceiver

Yuncheng Zhang, Assistant Professor
Wireless Transceivers, PLL, IoT Sensors, 5G, CMOS Integrated Circuits, Automated Circuits Design

Integrated IoT Group
Quantum Science Innovation Field

Mutsuko Hatano, Professor
Quantum sensors and power devices using widegap semiconductors, Developing wide-field technologies from materials to systems for energy and medical applications

Takayuki Iwasaki, Associate Professor
Quantum sensing and quantum emitter using atomic-scale structures in diamond toward next-generation low-loss power devices and biological/medical applications

Keigo Arai, Associate Professor
Quantum informatics
Quantum transformation
Next-generation IoT and green technology

Ryutaroh Matsumoto, Professor
Quantum information
Quantum transformation
Next-generation IoT and green technology

Tadashi Sakai, Specially Appointed Professor
Research on synthesis of carbon-based materials (diamond, graphene, CNT, etc.) and their application to devices (quantum sensors, electron sources, interconnects, power devices) / International standardization of nanoelectronic material and product technologies
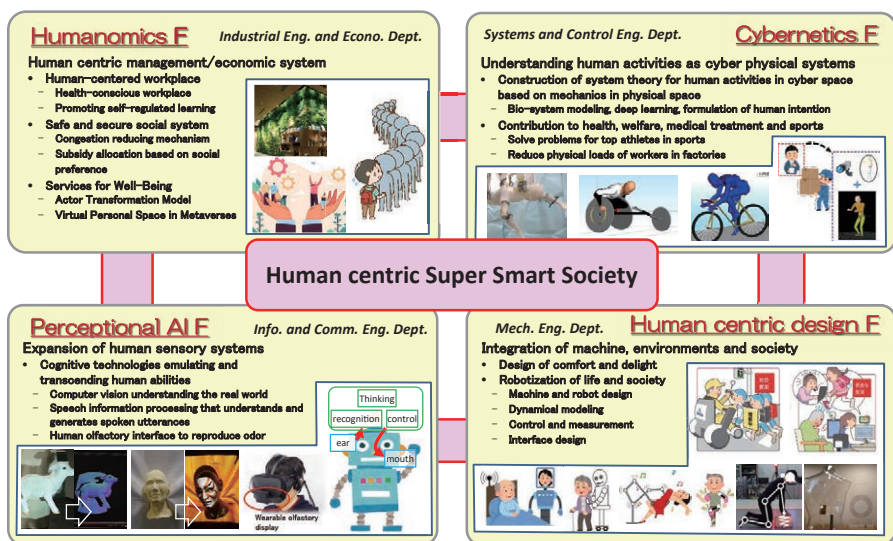
Naota Sekiguchi, Specially Appointed Assistant Professor
Developing precision magnetometer using nitrogen-vacancy centers in diamond towards measurement of biomagnetic field.

Interdisciplinary Research Groups

Human Centric Group → Human centric engineering

We are working to create and develop the field of Human centric engineering from the various points of view, such as design, humanomics, human information processing, cybernetics.

Humanomics F — *Industrial Eng. and Econo. Dept.*
Human centric management/economic system
- Human-centered workplace
  - Health-conscious workplace
  - Promoting self-regulated learning
- Safe and secure social system
  - Congestion reducing mechanism
  - Subsidy allocation based on social preference
- Services for Well-Being
  - Actor Transformation Model
  - Virtual Personal Space in Metaverses

Cybernetics F — *Systems and Control Eng. Dept.*
Understanding human activities as cyber physical systems
- Construction of system theory for human activities in cyber space based on mechanics in physical space
  - Bio-system modeling, deep learning, formulation of human intention
- Contribution to health, welfare, medical treatment and sports
  - Solve problems for top athletes in sports
  - Reduce physical loads of workers in factories

Human centric Super Smart Society

Perceptional AI F — *Info. and Comm. Eng. Dept.*
Expansion of human sensory systems
- Cognitive technologies emulating and transcending human abilities
  - Computer vision understanding the real world
  - Speech information processing that understands and generates spoken utterance
  - Human olfactory interface to reproduce odor

Human centric design F — *Mech. Eng. Dept.*
Integration of machine, environments and society
- Design of comfort and delight
- Robotization of life and society
  - Machine and robot design
  - Dynamical modeling
  - Control and measurement
  - Interface design

Faculty

Human Centric Group
Human Centric Design Field

Masafumi Okada, Professor
Robot design and control from mathematical or physical point of view, and its application to human motion instruction.

Motoki Shino, Professor
Our research focuses on Wellbeing Science and Assistive Technology for improving the quality of human life. To ensure the mobility and usability of human beings, we thoroughly analyze human-machine interaction and design advanced human-machine interfaces.

Yoshifumi Nishida, Professor
Methodology on observing daily behavior of persons who faces the physical and cognitive changes, and designing a daily life system that enables to maintain quality of life based on data-driven ergonomics and statistical mathematics.

Yusuke Sugahara, Associate Professor
Mechanism, design and control of robots and mechanical systems. Bipedwalking vehicle, stair-climbing wheelchair, Aero-Train, human-poweredrobotics, cable-driven parallel robots, mechanism of mobile robots.

Wataru Hijikata, Associate Professor
Study on medical device and mechanical system based on mechatronics and biomedical engineering. Development of implantable power generator, artificial heart, wireless power transfer, control of muscle contraction.

Atsushi Takata, Assistant Professor
Design methodology and mechanical verification of custom-made mechanisms that assist human action.

Yuki Hashimoto, Assistant Professor
Research on elemental technologies, mainly new sensors, that will solve social problems related to medical and health care, and R&D of new monitoring device systems that integrate the above technologies with the IoT

Human Centric Group
Perceptional AI Field

Takamichi Nakamoto, Professor (FIRST)
Human Olfactory Interface / Olfactory Display / Odor Sensing System / Sensory Information Processing / Embedded System / Biomimetic Sensing System

Takahiro Shinozaki, Associate Professor
Speech recognition and understanding, Speech and Language Processing, Machine learning

Yoshihiro Watanabe, Associate Professor
Computer vision, Augmented reality, Visual display, Digital archiving, Human computer interaction

Human Centric Group
Humanomics Field

Dai Senoo, Professor
Theory of Organization, Strategy, Knowledge Management and Information Systems. Main projects are Creative Office, Open Innovation and Business Ecosystem.

Emiko Fukuda, Associate Professor
Industrial economics / experimental economics / numerical analysis of game theory model / congestion management / security and disaster-relief service

Human Centric Group
Cybernetics Field

Motomu Nakashima, Professor
Modeling of human motion in sports, optimization of human motion as well as design and development of optimal tools and equipment using simulation and humanoid robot

Akisue Kuramoto, Assistant Professor
Biomechanical analysis of worker posture / Anomaly detection in work movement / Optimal work environment design / Biological measurement / Surrounding environment recognition technology for transportation systems

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Interdisciplinary Research Groups

Smart Power Grid Group ▸ Advanced usage of renewable energy

To accelerate the advanced usage of renewable energy based on the research and development on distributed and cooperative control with a core of power electronics and secondary batteries, the School of Engineering organizes Smart Power Grid Group beyond the framework of Departments, and various research activities are conducted.
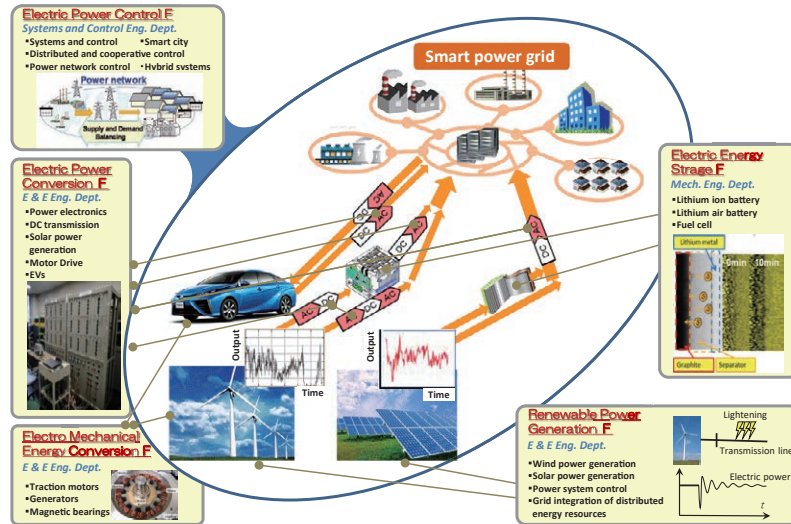
Faculty

Smart Power Grid Group
Electric Power Conversion Field

Hideaki Fujita, Professor
Power electronics, Electric machinery, Photovoltaic inverters, Micro hydropower generation

Makoto Hagiwara, Associate Professor
Application of power electronics to next-generation electric power systems, battery energy storage systems, electric vehicles and renewable energies.

Kenichiro Sano, Tenure-track Assistant Professor
Power electronics in electric power systems: High voltage DC transmission for offshore wind farms, transient analysis of power systems, power qualities in distribution systems

Smart Power Grid Group
Electro Mechanical Energy Conversion Field

Akira Chiba, Professor
Power Mechatronics and Inteligent Drive: Bearingless motor drive with integrated motor and magnetic bearing functions. Switched reluctance motors for high efficiency and compactness for EV, hybride vehicles, and next generation automotives.

Kyohei Kiyota, Associate Professor
Electric machinery/Mechatronics/Rare-earth Free Motors/Reluctance motors/Motors for vehicles/Bearingless motors/Magnetic bearing

Yusuke Fujii, Assistant Professor
Electric machinery/power electronics/control theory/magnetic suspension/ motor drive

Smart Power Grid Group
Renewable Power Generation Field

Kenichi Kawabe, Associate Professor
Power system engineering/Power engineering/Wind power/Photovoltaic power/Energy storage/Power electronics-based devices/Mathematical Programming

Smart Power Grid Group
Electric Power Control Field

Jun-ichi Imura, Professor
Control theory of harmonized power systems accepting massive renewable energy of photovoltaic/wind power, Design theory of global power systems with power markets

Takayuki Ishizaki, Associate Professor
Distributed power systems stabilization based on retrofit control and electricity market design under high penetration of storage and renewable energy resources

Hampei Sasahara, Assistant Professor
Hierarchical glocal power system control theory/Mathematical analysis of cybersecurity and privacy in smart grids/Design of demand response via game theory

Smart Power Grid Group
Electric Energy Storage Field

Shuichiro Hirai, Professor
X-ray, MR In-situ measurements and numerical simulations of fuel cell, lithium battery, lithium air battery, etc.

Takashi Sasabe, Associate Professor
In-situ X-ray imaging/reaction and transport simulation of fuel cell, Liion batteries and electrolysis, Development of high performance electrode by contolling dispersion structure of slurry
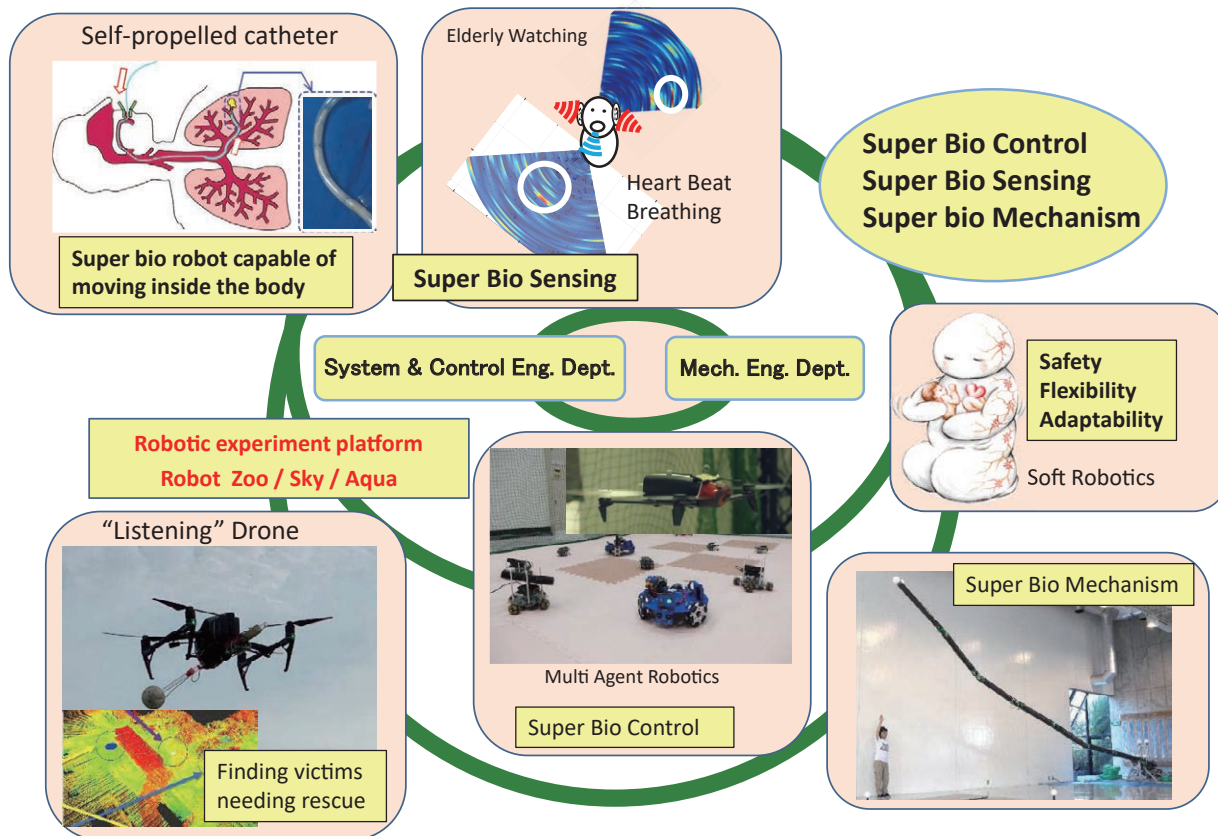
Manabu Kodama, Associate Professor
Operando X-ray CT Internal Structure Measurement of Fuel Cell and All Solid-state lithium-ion Battery. Study of High Efficiency Energy Conversion with Multi-physics (Electrochemistry-Thermodynamics-Two phase flow) Large Scale Numerical Simulation.

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Interdisciplinary Research Groups

Super Bio Robotics Group ▶ Creation of next-generation robot technology

By evolving sensing, actuators, and algorithms, we aim to create next-generation robots that surpass living organisms, and break through issues that were unsolved by conventional technology.

Self-propelled catheter
Super bio robot capable of moving inside the body

Elderly Watching
Heart Beat Breathing
Super Bio Sensing

Super Bio Control
Super Bio Sensing
Super bio Mechanism

System & Control Eng. Dept.
Mech. Eng. Dept.

Robotic experiment platform
Robot Zoo / Sky / Aqua

Safety
Flexibility
Adaptability
Soft Robotics

"Listening" Drone
Finding victims needing rescue

Multi Agent Robotics
Super Bio Control

Super Bio Mechanism

Faculty

Super Bio Robotics Group
Algorithm and Control Field

Daisuke Kurabayashi, Professor
Analysis of Adaptive Behavior by using Bio-machine Hybrid Systems, Integration of Distributed Autonomous Robotic Systems, Motion and Path Planning for Robotic Systems

Hideyuki Tsukagoshi, Professor
Study on fluid powered actuators referring to the muscular structure and the working principle of creatures, and their application to medical robot and rescue.

Super Bio Robotics Group
Soft Robotics Field

Koichi Suzumori, Professor
Development of new actuators and their application to biomimetic robots, soft robots, body support wears, tough robots and micro robots.

Gen Endo, Professor
Design and development of practical robot and mechanical system. Study on mobile robot, decommissioning robot, super redundant manipulator, tendon-driven robot, welfare robot.

Super Bio Robotics Group
Cyber Physical Sensing Field

Masayuki Tanaka, Professor
Image Analysis, Multispectral Imaging, Multi-Modal Image Fusion, Image Processing Based on Generative Model, Optimization and Machine Learning.

Kazuhiro Nakadai, Professor
Key research topics are robot audition and computational scene analysis, and wide areas are covered such as robotics, signal and speech processing, AI, and machine learning.

Kotaro Hoshiba, Assistant Professor
Surrounding environment recognition by sound / Computational auditory scene analysis / Acoustic measurement / Acoustic signal processing / Robot audition / Drone audition / Rescue robot / Ultrasonics.

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Department of Mechanical Engineering
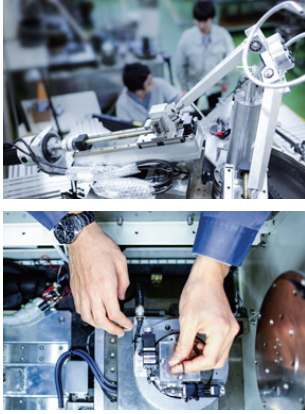
Education and research at the Department of Mechanical Engineering is designed to discover new phenomena, principles, and methods and to create new machinery capable of achieving a balance between humanity and the environment.

Students at the Department of Mechanical Engineering acquire advanced, specialized knowledge in the field of mechanical engineering and much more. By teaching students how to identify and solve problems, and by instilling in them the abilities they need to communicate with people around the world, our aim is to cultivate individuals who will be active in industry and academia, and contribute to maintaining and improving Japan's competitiveness on the global stage into the future. In the excellent education and research environment, discover your own potential alongside faculty who work on the frontier of mechanical engineering.

Hirotsugu
Inoue
Department Chair

Research

The Department of Mechanical Engineering is actively working toward expanding the fundamental areas of study and research in the field of mechanical engineering. The department is building an educational/research framework that thoroughly displays the strengths of mechanical engineering as an integrated technological field, thereby contributing to the advancement of research into advanced energy applications, advanced functional materials, digital manufacturing, and other such areas. In addition, we are producing outstanding results in the fields of robotics and advanced manufacturing technologies, both of which share strong ties with industry, and are putting forth great effort in frontier fields such as aerospace and medical engineering. Moreover, we promote safe, secure technological development from a mechanical engineering viewpoint, as we conduct research and development aimed at achieving human-centric design. In terms of collaboration with society, our department provides opportunities to meet faculty members conducting various types of research with support by the Industry-University Cooperation Office in the School of Engineering, and then contributes to the creation of useful mechanical engineering for society.

Education

The Department of Mechanical Engineering offers courses such as Engineering Mechanics, Mechanics of Materials, Thermodynamics, Fundamentals of Fluid Mechanics, Mechanical vibrations, and Machine Elements and Machine Drawing. Through courses like these, student learn how to analyze the behavior of mechanical systems, and gain the knowledge they need to integrate that understanding into the creation of new mechanisms. In addition to these disciplines, which serve as the core of mechanical engineering, students set their sights on a broad array of research fields, including control, robotics and mechatronics; precision engineering; mechanical design; processing, production and materials; biomedical and welfare engineering; design engineering; space engineering and more. Students learn not only how to analyze various phenomena theoretically; they also learn how to apply that knowledge to solve issues that arise in engineering. Our aim is to cultivate individuals capable of devising innovative mechanical systems that will help humanity achieve balance with its environment.

In addition to the undergraduate program, the department offers graduate programs in Mechanical Engineering, Energy Science and Informatics, Engineering Sciences and Design, Human Centered Science and Biomedical Engineering, and Nuclear Engineering.

Research Groups and Fields of Research
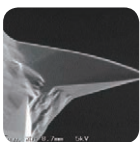
Nanosystems Group
Evolve nanotechnologies broadly
Multiscience Field, Ultrahigh Precision Processing Field, Biomedical Fusion Field

Human Centric Design Group
Design comforts and delights
Robotics Field, Human-machine Interface Field, QOL Design Field, Medical Engineering Field

Carbon Neutral Group
Combine wisdoms for energy and environment
Energy Field, Environmental Thermofluid Field

Aerospace Systems Group
Explore the frontiers of sky and space
Space Engineering Field, Aeronautical Engineering Field

Advanced Solution Group
Make the most of engineering knowledge
Simulation Engineering Field, Advanced Materials & Manufacturing Field, Intelligent Sensing Field, Advanced Designing Field

Faculty

Nanosystems Group
Multiscience Field

Tomohiro Nozaki, Professor
Plasma engineering, Electron-driven catalysis, Carbon dioxide utilization technology, Hydrogen energy/Low-carbon technology, Process simulation, etc.

Kazuyoshi Fushinobu, Professor
Thermal/energy phenomena, from fundamental to applications. Laser processing, Electronic packaging, Digital Printing, Energy Equipment. Strong ties with industries.

Yoichi Murakami, Professor (ZC)
Developments of next-generation CO_2 separation materials and all solid-state battery materials/Liquid thermoelectric power generation/Energy and environmental technologies.

Masami Kadonaga, Specially Appointed Professor
Fundamental research and simulation of evaporation/penetration/drying/dot-formation for inkjet printing.

Koichi Kato, Specially Appointed Associate Professor(Lecturer)
Fundamental research and simulation of evaporation/penetration/drying/dot-formation for inkjet printing.

Dae-Yeong Kim, Assistant Professor
Electrification / Low-carbon technology / Plasma catalysis / Synthesis of carbon materials / Secondary batteries, etc.

Byunggi Kim, Assistant Professor
Laser microfabrication, Ultrafast spectroscopy, Nanoscale imaging technology / Integrated photonics and phononics.

Nanosystems Group
Ultrahigh Precision Processing Field

Atushi Hirata, Professor
Ultraprecision polishing, coating, laser processing, tribology and material characterization with micro/nano materials for surface function design.

Masahiko Yoshino, Professor
Nano/micro Manufacturing, Metalforming, Machining Development of functional materials /surfaces.

Yuko Aono, Associate Professor
Laser modification of mechanical and chemical property, Digital manufacturing with shape and function design, Fabrication and application of functional film.

Daijiro Tokunaga, Assistant Professor
Control method and application development of internal modification of transparent materials induced by laser/Ultrashort-pulsed laser/Fiber fuse/shape processing of hard and brittle materials

Nanosystems Group
Biomedical Fusion Field

Satoshi Ii, Professor
Study on biophysical phenomena using computational science technologies/Digital twin modeling for cerebral circulation by large-scale physics simulations/Development of mathematical and computational models applied for hierarchical living body systems

Joon-wan Kim, Professor (FIRST)
Micro hydraulic pressure sources integrating MEMS technology with Electro-conjugate fluid (ECF) and its application systems.

Takeshi Hatsuzawa, Professor (FIRST)
MEMS/NENS application and development to bio-assay and diagnosis devices by interdisciplinary technology including mechanical and bio engineering.

Katsuko Furukawa, Professor
Tissue Engineering/Artificial Organs/Cellular Biomechanics/Mechanical stress/Organ Simulator/Mechanosensor

Yasuko Yanagida, Professor (FIRST)
Development of MEMS/NENS and bioMEMS devices applied for bioscience, medical engineering and environmental analysis.

Kazuhiro Yoshida, Professor (FIRST)
Development of innovative mechano-devices/systems such as new actuator systems for advanced soft microrobots that perform power-needed tasks in micro space.

Tadashi Ishida, Associate Professor (FIRST)
Biomicrofluidic devices for drug discovery and medical applications by the combination of nano/micro technologies and cellular characteristics.

Takasi Nisisako, Associate Professor (FIRST)
Innovative nano- and microfluidics for Lab-on-a-Chip applications and functional materials production, and their industrialization.

Takatoki Yamamoto, Associate Professor
Micro/nanodevices fabricated by microfabrication, mainly for life science applications. Micro/nano engineering, Lab-on-a-chip, biomimetics, etc.

Yusuke Kanno, Assistant Professor (FIRST)
Research on micro/nano devices for biochemical analysis and advanced materials production.

Tetsuya Yamada, Assistant Professor (FIRST)
MEMS biosensor/Artificial cell membrane/Electromicrobiology/Photocatalyst/Nanoparticles.

Human Centric Design Group
Robotics Field

Gen Endo, Professor
Design and development of practical robot and mechanical system. Study on mobile robot, decommissioning robot, super redundant manipulator, tendon-driven robot, welfare robot.

Koichi Suzumori, Professor
Development of new actuators and their application to biomimetic robots, soft robots, body support wears, tough robots and micro robots.

Yukio Takeda, Professor
Mechanical systems design, kinematics, mechanisms, machine elements, robotics, industrial robot, assistive device.

Shingo Maeda, Professor
Soft Material, Soft Robotics, Chemomechanical system

Yukio Tsutsui, Specially Appointed Professor
Innovative motors & actuators for robot/Mechatronics

Yusuke Sugahara, Associate Professor
Mechanism, design and control of robots and mechanical systems. Biped walking vehicle, stair-climbing wheelchair, Aero-Train, human-powered robotics, cable-driven parallel robots, mechanism of mobile robots.

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Hiroto Tanaka, Associate Professor
Biomechanics and fluid dynamics of swimming / flying animals. Bioinspired swimming / flying robots.

Mitsuru Endo, Specially Appointed Associate Professor
Human Collaborative Robot, Lightweight Actuator, Mechatronics.

Ming Jiang, Assistant Professor
Assistive device, Robotics, Machine element design, Biomedical engineering, Optimal design

Hiroyuki Nabae, Assistant Professor
Study on component technologies with a focus on new actuators, and their application to micro robots and mechatronics devices.

Human Centric Design Group
Human-machine Interface Field

Tohru Yagi, Professor
Our goal is to understand the neural mechanisms, and to exploit its findings in biomedical engineering applications, e.g. neural interfaces.

Satoshi Miura, Associate Professor
Human-Machine Interface/Brain-Machine Interface/VR AR/AI/Surgical Robotics/Medical Robotics/Welfare Robotics.

Takako Yoshida, Associate Professor
Brain science, human perception and psychophysics, visuo-haptic multimodal man-machine interface, attention/inattention.

Human Centric Design Group
QOL Design Field

Masafumi Okada, Professor
Robot design and control from mathematical or physical point of view, and its application to human motion instruction.

Shigeki Saito, Professor
Robotics based on Micro-mechanics, adhesional device by bio-inspired structure, creativity in engineering design.

Motoki Shino, Professor
Our research focuses on Wellbeing Science and Assistive Technology for improving the quality of human life. To ensure the mobility and usability of human beings, we thoroughly analyze human-machine interaction and design advanced human-machine interfaces.

Yoshifumi Nishida, Professor
Methodology on observing daily behavior of persons who faces the physical and cognitive changes, and designing a daily life system that enables to maintain quality of life based on data-driven ergonomics and statistical mathematics.

Hiroshi Yoshitake, Specially Appointed Associate Professor
Research on methodologies that contribute to safe driving and traffic safety assistance based on analysis of human behavior data in real and simulator environments to understand and model naturalistic behaviors and processes leading to human errors.

Atsushi Takata, Assistant Professor
Design methodology and mechanical verification of custom-made mechanisms that assist human action.

Yuki Hashimoto, Assistant Professor
Research on elemental technologies, mainly new sensors, that will solve social problems related to medical and health care, and R&D of new monitoring device systems that integrate the above technologies with the IoT

Human Centric Design Group
Medical Engineering Field

Tadahiko Shinshi, Professor (FIRST)
Medical mechatronics and micro / nano mechatronics based on magnetic force control.

Toshio Takayama, Associate Professor
Robot hands mechanism, Soft material based mobile devices and actuators, Mechatronics for medical devices, Microdevices for cell culture.

Kotaro Tadano, Associate Professor (FIRST)
Research and development of surgical robots for laparoscopic surgery, vitreous surgery and plastic surgery, human-machine interfaces and pneumatic systems.

Wataru Hijikata, Associate Professor
Study on medical device and mechanical system based on mechatronics and biomedical engineering, development of implantable power generator, artificial heart, wireless power transfer, control of muscle contraction.

Naohiro Sugita, Assistant Professor (FIRST)
Bubble dynamics/Medical ultrasound/Control of acoustic cavitation bubbles/Vibration measurement of ultrasound contrast agents (microbubbles)/Transdermal drug delivery

Carbon Neutral Group
Energy Field

Yoshihiro Okuno, Professor
Applications of magnetohydrodynamic technology, especially a high efficient MHD electrical power generation with non-equilibrium plasma flow.

Mamoru Tanahashi, Professor
Physics and modeling of turbulence, turbulent heat/mass transfer and turbulent combustion in gas turbine combustors and internal combustion engines.

Shuichiro Hirai, Professor
X-ray, MR In-situ measurements and numerical simulations of fuel cell, lithium battery, lithium air battery, etc.

Manabu Kodama, Associate Professor
Analysis of all solid-state batteries using X-rays, Research on high-efficiency energy conversion using multiphysics simulation, Advanced analysis using machine learning

Takashi Sasabe, Associate Professor
In-situ X-ray imaging/reaction and transport simulation of fuel cell, Li-ion batteries and electrolysis, Development of high performance electrode by controlling dispersion structure of slurry.

Masayasu Shimura, Visiting Associate Professor
Investigation of turbulent flow and combustion in gas turbine and internal combustion engines using laser diagnostics and simulations. Development of combustion control methods.

Tsutomu Hozumi, Assistant Professor
Study on active control methods of supercooling and measurements of thermal properties for cold reserving materials, heat storage materials and foods.

Carbon Neutral Group
Environmental Thermofluid Field

Tetsuji Okamura, Professor
Research on refrigeration and cooling technologies, such as the development of cooling systems for superconducting magnets and superconducting devices, and the development of room-temperature magnetic refrigerators.

Takushi Saito, Professor (FIRST)

Development of thermal design technology for electrification of construction machinery, analysis of transport phenomena including interface, development of heat transfer control technology using nanomaterials

Tetsuya Suekane, Professor

Study on multiphase flows in porous media in geological storage of carbon dioxide and enhanced oil recovery based on X-ray microtomography and digital rock physics.

Sayaka Suzuki, Associate Professor

Fundamental research on fire phenomena through thermal engineering, evaluation of environmental effects of fires, development of environmentally-friendly strategies to prevent fires

Tuyoshi Nagasawa, Associate Professor

Thermal engineering/Energy conversion and environmental load reduction technologies/Solid oxide fuel cell/Combustion synthesis of functional nanomaterials/Advanced internal combustion engine/Exhaust after-treatment system

Jun Hasegawa, Associate Professor (ZC)

Fundamental researches on generation of high-brightness quantum beams composed of ions, clusters, neutrons, or EUV light, and their applications in the field of fusion energy.

Tatsuya Kawaguchi, Assistant Professor

Experimental and numerical investigation of multiphase and transport phenomena and their interaction by means of the optical techniques.

Yuji Suzuki, Assistant Professor

Research and development of heat transfer devices based on the heat pipe technology for the thermal control of space equipment and so on.

Shintaro Matsushita, Assistant Professor

Development of practical numerical models to achieve high-resolution multi-phase flow simulation, and elucidation of fluid phenomena by numerical simulation that combines surface science such as surfactant effect and viscoelastic effect.

Aerospace Systems Group
Space Engineering Field

Hiraku Sakamoto, Professor

Through investigating dynamic structural analysis methods for lightweight and flexible structures, we aim at generating innovative space structure systems.

Takanori Iwata, Visiting Professor

Guidance, navigation, control & dynamics of aerospace systems (e.g. spacecraft attitude & orbit control systems, estimation systems, components), spacecraft design, and project management/systems engineering.

Satoru Ozawa, Visiting Professor

Satellite system (communications satellite / earth observation satellite), design, analysis and verification of large deployable reflector, nonlinear finite element method, flexible multibody structural analysis, synthetic aperture radar, flight software, FPGA.

Hiroki Nakanishi, Associate Professor

Research on mechanism, dynamics, and control for advanced space systems including space robotics, orbital service, astronaut support, and micro/nano satellites.

**Yasutaka Satou,** Visiting Associate Professor

Development, design, testing and verification of spacecraft structures and mechanisms, deployable space structures, and structural and mechanical technologies such as landing and drilling to realize exploration

Toshihiro Chujo, Tenure-track Assistant Professor

Astrodynamics, Trajectory design, Guidance, Navigation, and Control, Deep space mission design, Spacecraft system, Solar sail, Dynamics simulation.

Aerospace Systems Group
Aeronautical Engineering Field
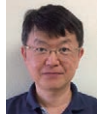
Akira Todoroki, Professor

Mechanics of materials and mechanics of composite materials; new fabrication process of composites and novel products of 3D printed composites.

Advanced Solution Group
Simulation Engineering Field

Takayuki Aoki, Professor (GSIC)

Challenge to exa-scale simulation of gas-liquid and solid-gas-liquid multiphase flows by means of GPU-accelerated supercomputers.

Ryo Onishi, Professor (GSIC)

Integrated technologies of simulation and processing for utilizing the environmental Big Data/Numerical simulations of environmental multi-phase turbulence.

Feng Xiao, Professor

Computational fluid dynamics, high-fidelity numerical methods for various complex flows, development of practical numerical models for real-case applications.

Yoshiro Suzuki, Assistant Professor

Artificial intelligence, deep learning, medical imaging, structural optimization, and composite material.

Ye Wang, Assistant Professor

Direct numerical simulation of turbulent combustion; Research on the near-wall flow, flame dynamics and flame-wall interaction.

Advanced Solution Group
Advanced Materials & Manufacturing Field

Wakako Araki, Professor

Mechanics of materials, Fracture mechanics, Solid state ionics, Mechanics and ionics of ion-conducting oxides

Naoto Ohtake, Professor (FIRST)

Main field of interest is materials processing and technology, including plastic forming, fabrication of hard carbon films and their application to industrial uses.

Chiaki Sato, Professor (FIRST)

Research on the mechanical aspects of carbon fiber reinforced composite material (CFRP) and adhesively bonded joints between CFRP and dissimilar materials frequently used for transportation such as automobiles and aircraft.

Hayato Yoshioka, Visiting Professor (FIRST)

Research on Nano-machining and Nano-measurement technologies based on originally developed precision mechanical elements and controllers.

Hiroki Akasaka, Associate Professor

Main research field is carbon and related materials. Related keywords are thin film engineering, material science and engineering, materials analysis, inorganic carbon materials.

Masatoshi Kondo, Associate professor (ZC)

Fusion reactor engineering, Fast reactor engineering, Seawater desalination, Seawater resource, Resource recycling, Low melting point metal, Liquid metal coolant, Material compatibility, Additive manufacturing

Motoki Sakaguchi, Associate Professor

Research in mechanics of materials, especially focusing on deformation and fracture of high temperature materials for jet engine application.

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Yu Sekiguchi, Associate Professor (FIRST)
Design, strength evaluation and strength improvement of adhesively bonded joints, especially reversible adhesives mimicking gecko.

Tomohisa Tanaka, Associate Professor
Development of new production technologies by using high-frequency vibration and laser energy. Development of practical devices with additive manufacturing technology.

Yuki Hirata, Associate Professor
Synthesis and evaluation of amorphous carbon film by plasma process / Elucidation of coating mechanism by numerical simulation and control its properties

Takahisa Yamazaki, Associate Professor
Joining by various heating source, dissimilar materials like carbon based materials and heat resistant metals are joined using advanced material filler based on the change of interfacial energy in joining process.

Jiang Zhu, Assistant Professor
Development of new technology for freeform surface machining and measurement, digital manufacturing and intelligent manufacturing.

Advanced Solution Group
Intelligent Sensing Field

Hirotsugu Inoue, Professor
Research topics in the field of mechanics of materials: non-destructive testing (infra-red thermography, ultrasonic), impact problem, and inverse analysis.

Yoshihiro Mizutani, Professor
Non-destructive testing, structural health monitoring/evaluation/control for aerospace vehicles, chemical/power plants, automobiles and large construction machines. Application of AI to the above issues.

Yu Kurokawa, Assistant Professor
Non-destructive evaluation and flaw size measurement by ultrasonic testing. Flaw evaluation, stress analysis, and fatigue limit evaluation by infrared thermography.

Kotaro Hoshiba, Assistant Professor
Surrounding environment recognition by sound / Computational auditory scene analysis / Acoustic measurement / Acoustic signal processing / Robot audition / Drone audition / Rescue robot / Ultrasonics.

Advanced Solution Group
Advanced Designing Field

Kazuaki Inaba, Professor
Research and design of various scale machines and structures from viewpoints of mechanics and material sciences; e.g., composites, automobiles, and power plants.

Nobuyuki Iwatsuki, Professor
Kinematics and dynamics of robotic mechanisms, functional material actuator, estimation of machinery noise and structural optimization to reduce noise.

Hiroki Takahara, Professor
Focusing on the mechanism of vibration, we conduct research on the nonlinear vibration of fluid-related vibration, dynamics of uncertain systems, etc. We aim at improving the function, reliability and safety of mechanical structures.

Hiroshi Yamaura, Professor
Research on dynamics, control and tribology of machinery for construction machinery, earthmoving machinery, vehicles, rover, mechatronics equipment, etc.

Tsune Kobayashi, Specially Appointed Professor
Analysis and design of contact and deformation condition of mechanical elements such as gears, screws and so on, development of drive-train system of automotive vehicles.

Satoshi Momozono, Specially Appointed Professor (FIRST)
Research on tribology of machine elements such as rolling bearings and seals: lubrication mechanisms, contact problems with rough surfaces, and development of various visualization techniques

Hiroshige Kikura, Associate Professor (ZC)
For safety improvement and advancement of nuclear reactors, we are researching thermal hydraulics, fluid measurement, nuclear safety, robot remote measurement.

Hideharu Takahashi, Associate Professor
Smart agriculture and forestry engineering, remote sensing, environmental recovery, utilization of unused resources, zero carbon energy
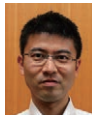
Yutaka Nakano, Associate Professor
We are studying the generation mechanisms of self-excite vibrations and their suppression (e.g. friction vibration, chatter, and so on).

**Shinji Tanaka,** Specially Appointed Associate Professor (FIRST)
Tribological technologies for hydraulic equipment of construction machinery, such as visualization of lubrication condition of real machine, lubrication analysis, evaluation of sliding characteristics of sliding materials and lubricants.

Daisuke Matsuura, Specially Appointed Associate Professor
Analysis and design of mechanical elements, robotics, mechatronics, visual measurement and servoing, noncontact manipulation and welfare device development.

Department of Systems and Control Engineering
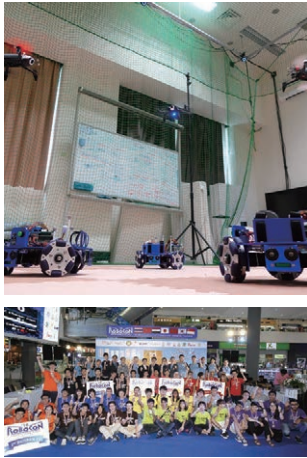
Unify the real world (physical) and information (cyber) as one system to create new values for future society.

Our modern life is supported by a huge number of complex artificial systems. To design valuable systems. we need to understand their dynamical properties so that they will safely work and surely satisfy our requirements. The Department of Systems and Control Engineering provides courses that offer insights into a variety of systems, which enable us to predict and control their dynamics. Our interests includes not only artifidal systems. e.g.. robots. cars. planes. medical systems. and intelligent systems. but even life,s ociety. and nature. The Departrl)ent of Systems and Control Engineering prepares students to become creative and innovative individuals who can make beneficial contributions to our society.

Motomu Nakashima
Department Chair

Research

System control, used to measure, analyze, and control various phenomena, is essential in many fields in modern society including those in industry. A wide variety of technologies and techniques are required to design. Mathematical models take important roles in clarifying system structures so that we know dynamical properties of them. Control theory provides systematic design of control and measurement functions. We also need to find appropriate measurement methods, communication protocols, information processing, actuators, sensors, micro-controllers, and ways of integration. We have formed research groups and are conducting high level researches so that we achieve the ability to innovate novel systems to bring values into our society.

The department's primary fields of research are as follows: systems control theory, network control, precision mechanical instrumentation, sensing theory, computer vision, image processing, wave application instrumentation, chaotic vibrations, stochastic dynamics, nonlinear dynamics, inverse analysis, smart power grids, biomechanics, biorobotics, combustion engines, combustion control, exhaust treatment, autonomous systems, signal processing, artificial intelligence, intelligent robots, rescue robots, and radiation biology.

Education

In the Department of Systems and Control Engineering, we foster the basic ability necessary to objectively analyze everything — concrete and abstract — in nature and society as a system and to create new systems of value based on this knowledge. Students gain scholastic abilities in measurement, control, design, and system science as well as in areas such as machines, electricity, and information. We cultivate in our students flexible, creative thinking they need to construct systems that offer new value through many unique educational initiatives that focus on the importance of projects and practical learning. Students can take classes in which they participate in robot contests, and classes through which they form teams to examine societal needs and to build systems that tackle those issues. Students proceed to research works in specific issues conducted at affiliated laboratories, and through their master's thesis research they will acquire the technological and organizational skills needed to develop new systems. They learn not only research protocols and methods but also ethical attitudes to be responsible engineers contributing to make a better future.

Undergraduate programs
* School of Engineering
* Department of Systems and Control Engineering

Graduate programs
* Systems and Control Engineering
* Engineering Sciences and Design

Research Groups and Fields of Research

Control Theory Group
Researching cutting-edge systems theory targeting various systems, from next-generation robots to smart cities
Intelligent Robot Field
Cyber Physical Systems Field
Complex Network Systems Field

System Analysis Group
Using mathematical approaches to analyze systems both natural and artificial, and research methods that allow for deeper quantitative and qualitative understanding of their behavior
Nonlinear and Stochastic Dynamics Field
Computational Mechanics Field
Power Systems for Transportation Field
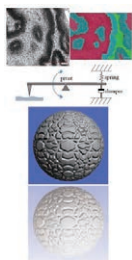
Advanced Measurement Group
Researching cutting-edge measurement technologies that allow observation of objects both visible and invisible, to gain an understanding of various phenomena found in our world
Mechanical Design and Functional Evaluation Field
Computer Vision and Image Processing Field
Applied Measurement Using Acoustic and Radio Waves Field

System Integration Group
Realizing future robot systems based on various approaches, such as sports engineering, speech recognition, machine learning and biomimetics, in order to bring happiness to the people
Bio-robot Field
AI-robotics Field

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Faculty

Control Theory Group
Intelligent Robot Field

Mitsuji Sampei, Professor
Nonlinear Control Theory and its Application, Control of Under-Actuated Mechanical Systems, Design and Control of Multi-Rotor Systems.

Masaki Yamakita, Associate Professor
Theoretical studies on adaptive and learning control and state estimation and model predictive control for nonlinear systems, and their applications to robotic and industrial systems

Riku Funada, Assistant Professor
Cooperative Control and Strategic Sensing for Networked Robotics, Path and Sensing Planning for Robots

Control Theory Group
Cyber Physical Systems Field

Yoshihiro Miyake, Professor (Dept. Computer Science)
From Communication Science to Interface Creation

Takeshi Hatanaka, Professor
Cyber-Physical-Social Systems, Cyber-Physical-Human Systems, Networked Robotics, and Smart Agriculture/Ocean

Control Theory Group
Complex Network Systems Field

Jun-ichi Imura, Professor
Development of control theory of large-scale complex network systems, and applications to smart grids, intelligent transportation systems, and biological systems

Tomohisa Hayakawa, Associate Professor
Control Theory, Nonlinear Dynamical Systems Theory, Digital Society Mechanism Design, Smart Cities, and Game Theory

Hideaki Ishii, Visiting Professor
Large-scale networked control, Coordinated control of multi-agent systems, Distributed algorithms for PageRank computation, Cyber security for power systems

Hampei Sasahara, Assistant Professor
Cybersecurity and privacy in control systems/Mathematical analysis and system design via non-cooperative game theory/Control of large-scale complex systems/Application to smart grids

Jonatan Pena Ramirez, Specially Appointed Associate Professor
Nonlinear dynamics / Nonlinear phenomena / Synchronization and control of complex systems

Xun Shen, Visiting Assistant Professor
Development of data-driven control theory for uncertain complex systems based on probabilistic constrained optimization and statistical learning, and its application to biological network systems and intelligent driving systems.

Takashi Nakakuki, Visiting Professor
Model-based analysis and design of biomolecular reaction system / Molecular robotics / Molecular cybernetics

Shun-ichi Azuma, Visiting Professor
Control theory of network systems, Data-driven control, Swarm intelligence, Systems biology, and Sparse estimationv

Kenji Kashima, Visiting Associate Professor
Control theory for large scale systems and stochastic systems /Statistical learning

Masaki Inoue, Visiting Associate Professor
Human-in-the-loop control systems, Energy management systems, Traffic management systems

Advanced Measurement Group
Mechanical Design and Functional Evaluation Field

Atsushi Hirata, Professor (Dept. Mechanical Engineering)
Ultraprecision polishing, coating, laser processing, tribology and material characterization with micro/nano materials for surface function design

Seiichiro Hara, Associate Professor
Sensing method of surface texture and machining information, Processing and evaluation of measurement information, Design applying quality and sensitivity engineering, Modeling of surface texture

Advanced Measurement Group
Computer Vision and Image Processing Field

Masatoshi Okutomi, Specially Appointed Professor
Computer vision and image processing, covering both their theory and applications. Recent topics include 3D scene reconstruction, stereo vision, structure from motion, inverse rendering, multispectral imaging, computational imaging, and super resolution.

Masayuki Tanaka, Professor
Image Analysis, Multispectral Imaging, Multi-Modal Image Fusion, Image Processing Based on Generative Model, Optimization and Machine Learning.

Rei Kawakami, Associate Professor
Physics-based vision, anomaly detection, video-based recognition, multimodal recognition, AR/VR

Yusuke Monno, Specially Appointed Associate Professor
Computer Vision, Image Sensing, Image Processing, Computational Imaging, Color and Multispectral Imaging, 3D Scene Reconstruction, Biomedical Image Processing

System Analysis Group
Systems and Society Field

Hiroya Nakao, Professor
Nonlinear dynamics, Stochastic processes, Rhythmic phenomena, Self-organization phenomena

Misako Takayasu, Professor (Dept. Mathematical and Computing Science)
Analysis and modeling of socio-economic phenomena, big-data analysis, nonlinear transport, group motion, complex network, phase transition

Takayuki Ishizaki, Associate Professor
Decentralized design of large-scale distributed control systems, Electricity market design under high penetration of storage and renewable energy resources

Takahiro Tsuchida, Assistant Professor
Investigation of random phenomena in various fields, Response analysis of non-Gaussian randomly excited systems, Dynamics of fractional-order systems

System Analysis Group
Computational Mechanics Field

Kenji Amaya, Professor
Implementation of inverse analysis for industry, Electrical chemistry simulation such as Localized corrosion analysis, Electroplating analysis, Corrosion monitoring using data assimilation, Aberration analysis

Yusuke Miyazaki, Associate Professor
Development of Detailed Digital Human Models, Injury Mechanism and Prevention, Quantitative Injury Risk Assessment of Products and Living Environment, Measurement of Human Motions and Forces in Real World Environment, Sports Engineering

Isao Ono, Professor (Dept. Computer Science)
Development of evolutionary computation algorithms for various optimization problems and reinforcement learning algorithms for various tasks

Yuki Onishi, Assistant Professor
Large deformation analysis using state-of-the-art FEM, Peeling analysis of plastic film, Electrodeposition of automobile body, Localized corrosion in saltwater

System Analysis Group
Power Systems for Transportation Field

Hidenori Kosaka, Professor
High Efficiency Mobility Systems, High Efficiency Clean Internal Combustion Engines, Investigation of Combustion via Laser Diagnostics, Combustion Control

Susumu Sato, Associate Professor
Improvement of Environment Load in Transportation System, High Efficiency After-treatment System, Alternative Fuel Engines

Tsuyoshi Nagasawa, Associate Professor (Dept. Mechanical Engineering)
Thermal engineering/Energy conversion and environmental load reduction technologies/Solid oxide fuel cell/Combustion synthesis of functional nanomaterials/Advanced internal combustion engine/Exhaust after-treatment system

System Integration Group
Bio-robot Field

Daisuke Kurabayashi, Professor
Analysis of Adaptive Behavior by using Bio-machine Hybrid Systems, Integration of Distributed Autonomous Robotic Systems, Motion and Path Planning for Robotic Systems

Motomu Nakashima, Professor
Modeling of human motion in sports, Optimization of human motion as well as design and development of optimal tools and equipment using simulation and humanoid robot

Hideyuki Tsukagoshi, Professor
Study on fluid powered actuator referring to the muscular structure and the working principle of creatures, and their application to medical robot and rescue.
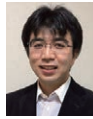
Masahiro Takinoue, Professor (Dept. Computer Science)
Construction and understanding of self-assembled artificial cell-like systems and molecular robots based on DNA nanotechnology and microfluidic technology

Akisue Kuramoto, Assistant Professor
Biomechanical analysis of worker posture / Anomaly detection in work movement / Optimal work environment design / Biological measurement / Surrounding environment recognition technology for transportation systems

Hayato Dan, Assistant Professor
Construction of control systems using optimization and machine learning technologies, Control and applications of multi-agent systems

System Integration Group
AI-robotics Field

Kazuhiro Nakadai, Professor
Key research topics are robot audition and computational scene analysis, and wide areas are covered such as robotics, signal and speech processing, AI, and machine learning.

Minoru Nakayama, Professor
(Dept. Information and Communications Engineering)
Human visual perception is analyzed using behavioral metrics such as EEG, eye movement, pupil responses and other responses

Masayuki Yamamura, Professor (Dept. Computer Science)
Artificial Intelligence with personality and emotion, Evolvable Digital Artificial Life, Wet Artificial Life enhanced by Synthetic Biology, Molecular Robots

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Department of Electrical and Electronic Engineering

Acquisition of new scientific knowledge and pioneering new electrical and electronic engineering technologies. Contribution to society by nurturing human resources who can achieve these objectives.

Various knowledge is required to adapt to a diverse and highly developed modern society. In the Department of Electrical and Electronic Engineering, we study and develop a broad range of technologies related to energy, electronics, and communication, which are the core of society. Each of the laboratories in the EEE department is leading the world in each cutting edge of advanced technologies. Our students studying in the EEE department will be trained to acquire the capability to contribute to such society through our research and educational activities.

Jiro Hirokawa
Department Chair

Research

The field of electrical and electronic engineering includes the study of hardware and software technologies that sustain electrical power, information processing and communications technology systems, and the physical properties, devices, and other elemental technologies that keep such systems working properly. The Department of Electrical and Electronic Engineering provides an education that serves as the core of the field of study, and conducts cutting-edge academic and practical research, the results of which are presented at top-level conferences and in leading journals around the world. This allows us to contribute to both academia, and through collaborations with industry and government bodies, to the resolution of issues faced by our society.

Our primary fields of research are as follows: power electronics, electric power systems, power mechatronics, plasma engineering, light wave communications, photonic devices, wireless communication engineering, electronic devices, magnetic devices, spintronics, semiconductor processes, semiconductor devices, sensor devices, solar cells, organic electronic materials/properties, organic electronics, nonlinear optics, analog-digital hybrid integrated circuits, electronic circuits, nanoelectronics, nanophotonics, applied properties, and more.

Education

At the Department of Electrical and Electronic Engineering, students acquire the fundamental knowledge and abilities required in this diverse field that studies large-scale electric energy production and control, information transmission systems that harness optical and radio wave phenomena, information processing and communication, the circuits and signal processing that serve as the foundation of computers, integrated circuits, and electronic devices. Classes teach students the fundamental theories the field is based upon, and provide a more practical understanding through a curriculum that offers simulation exercises, the opportunity to construct integrated circuits, and micro-processing experience. Our goal is to cultivate individuals who will become pioneering researchers, leading engineers and educators with open minds, creativity, and originality - individuals capable of succeeding in the related industries and fields of research and education.
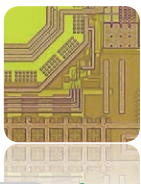
Undergraduate programs
* School of Engineering
* Department of Electrical and Electronic Engineering

Graduate programs
* Electrical and Electronic Engineering
* Energy Science and Engineering
* Human Centered Science and Biomedical Engineering
* Nuclear Engineering

Research Groups and Fields of Research

Circuit Group
Studying the most sophisticated analog and digital circuit design technologies necessary for advanced electronic devices
Integrated Circuit Field

Electric Power and Energy Group
Gaining a thorough understanding of advanced power systems, power conversion, electrical equipment, high voltage and environmental technologies
Electric power system Field
Power electronics Field
Plasma and environment Field
Electric machinery Field

Photonics, Ultrasonics, and Communications Group
Researching the hardware and software needed to build the next generation of communications networks
Photonics Field
Informatics Field
Wireless communications Field
Ultrasonics Field

Electronic Materials Group
Developing cutting-edge devices and methods to control the physical properties of new functional materials
Informatics Field
Energy Electronics Field
Spintronics Field
Nano- and Bio-photonics Field
Organic electronics Field
Integrated electronics Field
Bioelectronics Field

Device Group
Researching the innovative devices needed to create advanced low power and ultra-fast electronics
Green Device Field
Compound Semiconductor Device Field
Terahertz device Field
Quantum Functional Device Field
Intelligent Device Field

Faculty

Circuit Group
Integrated Circuit Field

Kenichi Okada, Professor
Millimeter-wave Wireless Transceiver / 5G / Battery-less IoT Wireless Sensor Node / CMOS Integrated Circuits / PLL / Atomic Clock / Terahertz Communication&Sensing&Imaging

Atsushi Shirane, Associate Professor (FIRST)
5G, IoT, Satellite Communication, Wireless Communication, Wireless Power Transfer, Machine Learning

Yuncheng Zhang, Assistant Professor
Wireless Transceivers, PLL, IoT Sensors, 5G, CMOS Integrated Circuits, Automated Circuits Design

Takashi Tokuda, Professor (FIRST)
Integrated Circuits, Sensors, Optoelectronics, Biomedical Devices, IoT Devices, Wireless Circuits

Hiroyuki Ito, Associate Professor (Nano Sensing Unit)
Integrated Circuit Technology / Sensing System with Ultra High Sensitivity / Intelligence of Things / Edge AI / IT for Agriculture

Sangyeop Lee, Assistant Professor (FIRST)
MEMS acceleration sensor/microwave, millimeter-wave (mmW), sub-terahertz (sub-THz) circuits/Beyond 5G (B5G) communication system

Photonics, Ultrasonics, and Communications Group
Wireless Communications Field

Jiro Hirokawa, Professor
Millimeter-wave high-efficiency planar antenna, 2D beam-switching circuit, fast analysis for antenna design, 2D orthogonal multiplexing

Takashi Tomura, Tenure-track Assistant Professor
Research based on electromagnetic engineering: small-satellite onboard antennas, Origami deployable membrane antennas, millimeter- & THz-wave-band antennas & material characterization

Kei Sakaguchi, Professor
Wireless communication engineering
B5G / IoT / Millimeter-wave / Wireless energy transmission
Connected car/Automated driving

Tran Gia Khanh, Associate Professor
Gbps-class wireless backbone network, Radio resource management using AI, IoT networks employing drones

Zongdian Li, Assistant Professor
V2X communication network/radio resource management/ cooperative perception/smart mobility/cyber physical system

Takahiro Aoyagi, Associate Professor
Electro Magnetic Comatibility (EMC), Measurement of Electrical Properties, Wave Propagation, Wireless Communication System, Body Area Networks

Atsuhiro Nishikata, Associate Professor
EMC / RF material evaluation / EM shielding and absorption MMW's biological thermal effect / Radio retroreflector EM source estimation / Spatial acoustics

Teruya Fujii, Specially Appointed Professor
Wireless transmission technologies for the 6th mobile communication system / The 3D cell layout and network cooperation control / UAV Temporary Wireless Relay System / Cellular drone repeater system for disaster

Yoshichika Ohta, Specially Appointed Associate Professor
Mobile communication system / HAPS communication system / Radio propagation for mobile radio / Wireless power transfer

Photonics, Ultrasonics, and Communications Group
Photonics Field

Nobuhiko Nishiyama, Professor
Photonic-electronic convergence integrated circuits based on heterogeneous integration / High-speed semiconductor lasers / Lidar system for car

Shigeru Nakagawa, Professor (FIRST)
Vertical Microcavity Single Photon Source / Integrated Photonics / Photonic Quantum Computer / Photonic Reservoir Computing

Yuya Shoji, Associate Professor (FIRST)
Waveguide optical isolator / Magneto-optical signal processing device / Silicon photonics / Photonic integrated circuit / On-chip photonic network device

Wenbo Lin, Assistant Professor (FIRST)
Trapped-ion quantum computer, Topological photonics, Silicon-nitride photonics

Kensuke Ogawa, Specially Appointed Professor
Photonic integrated circuits/Optical devices on photonic-electronic integration platforms/Ultrafast photonics/Time-resolved spectroscopy/Lightwave sensing/Optical interferometry

Tsuyoshi Horikawa, Specially Appointed Professor
Si-photonics devices / Integrated Photonics Platform / Wafer-level Photonic Device Test System / Photonic Device Statistical Analysis

Yoshitaka Oiso, Specially Appointed Associate Professor
Semiconductor Photonic Devices/Crystal Engineering/Semiconductor Process

Fumio Koyama, Specially Appointed Professor (FIRST)
VCSEL photonics, photonic integrated devices, high-speed semiconductor lasers, optical communications and interconnects, optical sensing for automotive applications, high power semiconductor lasers

Hiroyuki Uenohara, Professor (FIRST)
Photonic network, switching technologies for large capacity, low latency edge/cloud computing / Optical MUX/DEMUX techniques and related photonic integrated device with high spectral efficiency/ Optical nonlinear compensation with machine learning.

Yohei Aikawa, Assistant Professor (FIRST)
Optical communication engineering ／ Optical signal processing for logical operations ／ Optical integrated devices ／ Photonic accelerator with Silicon photonics

Tomoyuki Miyamoto, Associate Professor (FIRST)
Configuration of optical wireless power transmission (OWPT) systems / Development of modules and devices for OWPT / Creation of new applications of OWPT

Photonics, Ultrasonics, and Communications Group
Informatics Field

Tomohiro Amemiya, Associate Professor
Optical informatics ／ Next-generation optical semiconductor technology ／ Integrated photonics ／ Photonic nanostructures

Photonics, Ultrasonics, and Communications Group
Ultrasonics Field

Kentaro Nakamura, Professor (FIRST)
Ultrasonic transducers and industrial applications of ultrasonics; Medical applications of optical/ultrasonic methods; Optical fiber sensors and their applications

Marie Tabaru, Associate Professor (FIRST)
Biomedical Engineering Measurement / Agricultural Engineering Measurement / Medical Engineering / Wave Engineering / Advanced Diagnostic Imaging

Yuji Wada, Assistant Professor (FIRST)
Ultrasonic engineering / Acoustic streaming / Ultrasonic levitation of droplet / Numerical analysis / Multiphase topology optimization

Minoru Kuribayashi Kurosawa, Associate Professor
Acoustics / Ultrasonics / Mechatronics / Transducers Surface acoustic wave motor / Piezoelectric device Energy harvesting / Hi-Fi audio / Passive intermodulation

Device Group
Compound Semiconductor Device Field

Yasuyuki Miyamoto, Professor
Compound Semiconductor electron devices / Steep Slope FET / InP / GaN / Crystal growth/Ultrafine process

Masahiro Watanabe, Associate Professor
Nanostructure devices, Function design of electronic and photonic devices: Nanostructure-silicon photonics, Nonvolatile quantum effect memory, Advanced nano-heterostructure process technology

Hitoshi Wakabayashi, Professor (Integrated Green-niX+ Research Unit)
Electron Devices: Advanced 3D MISFET (Silicon) and 2D FET

Iriya Muneta, Assistant Professor
Spintronics / Transition-metal chalcogenides / 2D layered materials / Magnetism / Valleytronics / Electron correlation / Magnetoresistance / Spin injection

Takuya Hoshii, Assistant Professor
Semiconductor devices / process technology / MISFET and MIS-HEMT / power devices / atomic level analyses of doped impurities / crystal growth

Device Group
Intelligent Device Field

Shun-ichiro Ohmi, Professor
Semiconductor devices, Integrated electron device. Research on new functional device utilizing high-k and ferroelectric thin films

Device Group
Terahertz Device Field

Safumi Suzuki, Associate Professor
Terahertz Devices, Resonant Tunneling Diodes, Active Metamaterials, THz Wireless Communication, THz Radar System, THz 3D Imaging

Device Group
Green Device Field

Mutsuko Hatano, Professor
Quantum sensors and power devices using widegap semiconductors. Developing wide-field technologies from materials to systems for energy and medical applications.

Tetsuo Kodera, Associate Professor
Fundamental technologies toward quantum communication and quantum computers, Group IV semiconductor physics, Quantum spin physics, New functional devices using quantum technologies.

Takayuki Iwasaki, Associate Professor
Quantum sensing and quantum emitter using atomic-scale structures in diamond toward next-generation low-loss power devices and biological/medical applications.

Kuniyuki Kakushima, Associate Professor
Interface control based on process and material development for semiconductor devices including memory, energy, power (Si, wide bandgap), medical imaging.

Electronic Materials Group
Informatics Field

Keigo Arai, Associate Professor
Precision sensing and imaging via quantum manipulation of spins in diamond / From development of new measurement protocols to applications in life science and electronics for the IoT era

Electronic Materials Group
Energy Electronics Field

Akira Yamada, Professor
Photovoltaic materials (Cu(In,Ga)(SSe)$_2$) / Transparent conductive oxides (ZnO, Zn(O,S)) / Semiconductor Physics / Device simulation

Shinsuke Miyajima, Associate Professor
Semiconductor / Photoelectric conversion materials and devices / Group IV amorphous and nanocrystalline, Oxide, and Organic-inorganic perovskite materials

Takahito Nishimura, Assistant Professor
Photoelectric conversion materials and devises / Flexible devices / Multinary inorganic compounds / Transparent conductive oxides / Chalcogenide thermoelectric materials

Electronic Materials Group
Spintronics Field

Shigeki Nakagawa, Professor
Spintronics (Perpendicular MRAM, Half-metallic ferromagnets), Magnetic films for energy conversion, Magnetic film devices with high magnetic anisotropy, High density magnetic recording technology

Yota Takamura, Assistant Professor
Spintronics (Half-metallic ferromagnets, Si-based devises, Perpendicular magnetic anisotropy, Superconductors) Soft magnetic thin films for power electronics applications

Pham Nam Hai, Professor
Spintronics / Ferromagnetic semiconductor / Topological Insulator / Magnetoresistive Random Access Memory / Magnetic sensor / Semiconductor spin device

Electronic Materials Group
Nano- and Bio-photonics Field

Kotaro Kajikawa, Professor
Our group aims at developing the fields of nanophotonics, surface plasmon, and meta and the related for novel optical devices.

Mana Toma, Associate Professor
Plasmonics/Nano·Micro Structure Science/Biosensor

Haruhiko Ito, Associate Professor
We study Nanophotonics with near-field light and Atomphotonics for controlling laser-cooled atoms, and develop quantum-functional devices with atoms and spins.

Maria Vanessa Balois Oguchi, Assistant Professor
Low-frequency Raman spectroscopy for semiconductor characterization, Plasmonics for nanoscale light-matter interaction and sensing

Electronic Materials Group
Organic Electronics Field

Takaaki Manaka, Professor
Organic electronics/Organic devices/Evaluation techniques for organic semiconductor/Organic dielectric materials/Non-linear Optics/Liquid Crystals

Dai Taguchi, Associate Professor
Analysis of electrical and electronic materials, and novel electrical and optical techniques for probing these materials based on dielectric physics.

Hiroaki Iino, Associate Professor (FIRST)
Organic electronics/Imaging devices/Liquid crystalline organic semiconductors/Organic thin film transistors/Printed electronics/Molecular alignment

Electronic Materials Group
Integrated Electronics Field

Satoshi Sugahara, Associate Professor (FIRST)
Integrated Devices and Circuits/High-Speed and Low-Power Devices/Energy-Efficient Circuits/Wearable Electronics

Electronic Materials Group
Bioelectronics Field

Takamichi Nakamoto, Professor
(Dept. Information and Communications Engineering)
Biologically-inspired Sensors/Electronic Measurement/Embedded Systems/Human Olfactory Interface/Odor Sensor/Olfactory Display

Electric Power and Energy Group
Electric Power System Field

Kenichi Kawabe, Associate Professor
Power system engineering/Power engineering/Wind power/Photovoltaic power/Energy storage/Power electronics-based devices/Mathematical Programming

Electric Power and Energy Group
Power Electronics Field

Hideaki Fujita, Professor
Power electronics circuits and systems for solar, wind, micro-hydro power generation. High-efficiency and multifunctional power converters for industrial motor drive and induction heating.

Makoto Hagiwara, Associate Professor
Application of power electronics to next-generation electric power systems, battery energy storage systems, electric vehicles and renewable energies.

Kenichiro Sano, Tenure-track Assistant Professor Power
Electronics in electric power systems: High voltage DC transmission for offshore wind farms, transient analysis of power systems, power qualities in distribution systems

Takahiro Urakabe, Specially Appointed Professor
Power electronics, Modeling of power semiconductor devices

Shigeki Harada, Specially Appointed Associate Professor
Power electronics, Modeling of power semiconductor devices

Electric Power and Energy Group
Electric Machinery Field

Akira Chiba, Professor
Power Mechatronics and Inteligent Drive: Bearingless motor drive with integrated motor and magnetic bearing functions. Switched reluctance motors for high efficiency and compactness for EV, hybride vehicles, and next generation automotives.

Kyohei Kiyota, Associate Professor
Electric machinery/Mechatronics/Rare-earth Free Motors/Reluctance motors/Motors for vehicles/Bearingless motors/Magnetic bearings

Yusuke Fujii, Assistant Professor
Electric machinery/power electronics/control theory/magnetic suspension/motor drive

Yukio Tsutsui, Specially Appointed Professor
Innovative motors & actuators for robot/Mechatronics

Electric Power and Energy Group
Plasma and Environment Field

Nozomi Takeuchi, Associate Professor
Plasma Engineering/High Voltage Engineering/Electrostatic Engineering/Plasma in contact with liquid for advanced water treatment process and treatments of carbon materials/Electrohydrodynamics and its applications

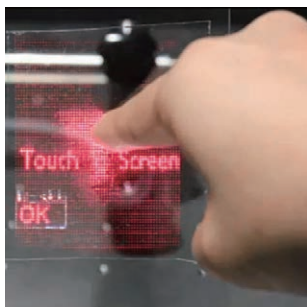**Hiroshi Akatsuka,** Associate Professor (ZC)
Modeling of atomic-molecular processes in plasmas, spectroscopic measurement/Interaction with electromagnetic field/Fundamentals of plasma electronics

Akitoshi Okino, Associate Professor (FIRST)
Development of brand-new atmospheric plasma sources and its applications for medical/analytical/material field

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Department of Information and Communications Engineering

Contributing to a richer, more sustainable society through research and education aimed at advanced information and communication technologies

One of the defining characteristics of our department is the interdisciplinary academic environment designed to aid in the development of information and communications technologies (ICT) designed for human use. The research and education cover a broad range of topics, from the hardware that is the foundation of information processing, to signal processing technologies, machine learning technologies, advanced intelligent information processing, the mechanisms behind human recognition, human interface systems, and medical technology. We are also actively engaged in collaborative research with corporations and research institutions in Japan and around the world, and provide students with numerous opportunities to experience that work first-hand. Information and communications technologies will continue to evolve, and the roles they play in society will likely increase as well. We educate students with hopes and dreams and untamable vitality, who will lead the drive towards a rich and exciting future with ICT.

Tsuyoshi Isshiki
Department Chair

Research

The aim of the Department of Information and Communications Engineering is to contribute to the academic fields that study both fundamental and applicable hardware and software technologies that will allow us to build a sustainable and user-friendly ICT-based society. In order to construct human-centric ICT systems, we need a better understanding of human emotion and the cerebral mechanisms upon which those emotions are based. In addition, we must build structures that allow for effective communication between people and the machines they use, and mechanisms for advanced information processing beyond human capabilities. In order to realize these objectives, we require technologies that can process and transmit vast amounts of information quickly. It is for this reason that the Department of Information and Communications Engineering conducts research in a broad range of technical fields, and puts a strong focus on the intercommunication and exchange between those fields. In concrete terms, our research efforts are directed towards ICT study, in areas that include communications and networks, signal processing, very-large-scale integration (VLSI), computers, security, media information processing, biometric information processing, sense information processing, and intelligent information processing. ICT systems have the potential to change our lives greatly, and our goal is to continuously work towards expanding that potential from the very frontier of the fields.

Education

Students in the master's program gain a fundamental understanding and practical skills as we foster within them a broad overview of the ICT industry as a whole. They simultaneously engage in a variety of activities that provide them with a strong ethical stance needed when viewing the world from the global perspective and engaging in research and development. The aim of these efforts is to graduate future researchers and engineers with a level of competence that is world-class, resulting in leading individuals capable of working in industries around the globe. In the doctoral program, the aim is the help students develop these abilities and perspectives even further, and to cultivate further leaders who will carve a path to new frontiers of science and technology that will make our global society even richer.

Many students who graduate from this department and the specialty program that was its predecessor move on to work in jobs connected to electronic and electrical engineering and in corporations active in the field of ICT. Our graduates are active in a broad range of other fields as well, with some moving on to positions in the mechanical and automobile industries or in chemical/material related work, and some working in the fields of finance and consulting. Graduates of our doctoral degree program can also be found at universities and private research institutes both here in Japan and abroad.

Research Groups and Fields of Research
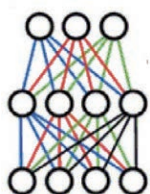
Human Information Systems Group

Clarifying the underlying mechanisms of human senses, perception, cognition, and motor control, engineering mechanisms that mimic those functions, and researching their application systems

Sensory Information Processing Field
Intelligent Information Processing Field
Media Information Processing Field
Biological Information Processing Field
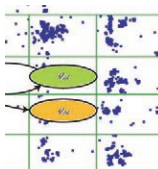
Signal Processing Group

Researching fundamental mathematical technologies and effective algorithms for processing various types of signals
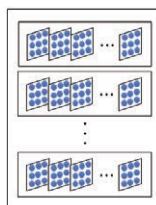
Media Signal Processing Field
Inverse Problems Field
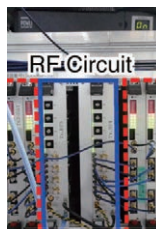
Communication, Networks, and Security Group

Researching algorithms and hardware systems that ensure safe, accurate, and speedy transmission of information

Communication Systems Field
Information Theory and Security Field
Communication Networks Field

Integrated Circuit and Computer Group

Researching the algorithms, design technologies, and mechanical systems required to produce high-performance computational systems

Digital Integrated Circuits Field
Analog Integrated Circuits Field
Distributed Information and Advanced Communication Systems Field

Faculty

Human Information Systems Group
Sensory Information Processing Field

Hirohiko Kaneko, Professor
Visual information processing, Psychophysics, Space perception, Stereopsis, Binocular disparity processing, Multisensory integration, Eye movements, Perceptual adaptation

Yasuharu Koike, Professor (Biointerfaces Unit)
Computational Neuroscience, Human Motor Control Theory, Human interface: Brain Machine Interface, Analysis of subjective feeling based on computational model

Natsue Yoshimura, Professor (Dept. Computer Science)
Brain activity information decoding (motor control, emotion, language, etc) / Brain-machine interfaces / Machine learning / EEG / fMRI

Imari Sato, Visiting Professor
Computer vision, Computer graphics, Spectral imaging, Computational photography, and Modeling reality.

Takehiro Nagai, Associate Professor
Psychophysics/affective engineering/color engineering/color perception/material perception/image processing based on properties of human visual perception

Rumi Hisakata, Assistant Professor
Psychophysics / Human visual processing / Binocular vision and 3D perception / Motion perception / Visual illusions / small eye movements / visual stability

Supat Saetia, Assistant Prpfessor (Biointerfaces Unit)
Computational Neuroscience, Brain Connectivity Modeling, Causal Discovery Algorithm, Episodic Memory, Brain-Machine Interface

Human Information Systems Group
Intelligent Information Processing Field

Nobuhiko Sugino, Professor (GSIC)
Code Optimization Methods for GPGPU, Automatic Parallelizing Compilers, Implementation Techniques of Digital Signal Processing

Masato Motomura, Professor (AI Computing Research Unit)
Reconfigurable Hardware, Intelligent Computing, Deep Learning Processor, Annealing Machine

Minoru Kuribayashi Kurosawa, Associate Professor (Department of Electrical and Electronic Engineering)
Acoustics / Ultrasonics / Mechatronics / Transducers Surface acoustic wave motor / Piezoelectric device Energy harvesting / Hi-Fi audio / Passive intermodulation

Momoko Nakatani, Associate Professor
Human computer Interaction, Service Design, User Experience, Communication Enhancement, Well-being

Daichi Fujiki, Associate Professor
Computer Architecture, Data-Centric Computing, Memory Systems, Privacy-Preserved Computing, Genome Data Processing

Yoshihiro Watanabe, Associate Professor
Computer vision, Augmented reality, Visual display, Digital archiving, Human computer interaction

Thiem Van Chu, Assistant Professor (AI Computing Research Unit)
Computer Architecture, Reconfigurable Hardware, FPGA, AI Computing

Human Information Systems Group
Media Information Processing Field

Manabu Okumura, Professor (FIRST)
Natural language processing, text summarization, computer assisted language learning, sentiment analysis, text data mining

Konstantinos Slavakis, Professor
Signal Processing, Machine Learning, Data Analytics

Takamichi Nakamoto, Professor (FIRST)
Human Olfactory Interface / Olfactory Display / Odor Sensing System / Sensory Information Processing / Embedded System / Biomimetic Sensing System

Masahiro Yamaguchi, Professor
Optical imaging and display / Spectral imaging / Color reproduction / Image analysis for pathology / Holography / Light-field display / 3D user interface

Takahiro Shinozaki, Associate Professor
Speech recognition and understanding, Speech and Language Processing, Machine learning

Shoichi Hasegawa, Associate Professor (FIRST)
Virtual reality / Haptics / Physics engine / Metaverse / Character Motion

Kotaro Funakoshi, Associate Professor (FIRST)
Natural language processing, Multimodal dialogue system, Human-machine interaction

Dani Prasetyawan, Assistant Professor
Odorant analysis / Odor reproduction analysis / multi array gas sensors / multivariate analysis

Saori Takeyama, Assistant Professor
Remote sensing data processing, Signal processing, Image processing, Mathematical optimization

Human Information Systems Group
Biological Information Processing Field

Kenji Suzuki, Professor (Biomedical AI Unit)
We develop computational intelligence that learns, from image examples, physicians' knowledge in interpreting images to help make smart decisions in biomedicine.

Kentaro Nakamura, Professor (FIRST)
Ultrasonics, High power ultrasonics, Optical instrumentation, Optical fiber sensors, Medical measurement and imaging with ultrasonic and optical methods

Takashi Obi, Associate Professor (FIRST)
Medical information system, Medical information network, National e-ID, Medical image processing. Medical information analysis

Marie Tabaru, Associate Professor (FIRST)
Biomedical Engineering Measurement / Agricultural Engineering Measurement / Medical Engineering / Wave Engineering / Advanced Diagnostic Imaging

Ze Jin, Assistant Professor (Biomedical AI Unit)
Medical image processing and image analysis, machine learning and deep learning in the medical field, development of computer-aided diagnosis systems for medical images

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Signal Processing Group
Media Signal Processing Field

Minoru Nakayama, Professor
Human visual perception and their characteristics in various aspects are analyzed using some behavioral metrics such as EEG, eye movement, pupil responses and other responses.

Signal Processing Group
Inverse Problems Field

Isao Yamada, Professor
Mathematical models and algorithms for signal processing, optimization, inverse problems and machine learning

Keita Kume, Assistant Professor
Signal processing, Inverse problems, Manifold optimization, Nonconvex nonsmooth optimization, Sparse modeling

Communication, Networks, and Security Group
Communication Systems FieldF

Kazuhiko Fukawa, Professor
Transmission and network techniques for wireless communications by developing digital signal processing, adaptive filters, and statistical based algorithms.

Satoshi Suyama, Visiting Professor
Next generation mobile communication system/Radio access technologies/Radio Access Networks/Mobile Radio Applications

Communication, Networks, and Security Group
Information Theory and Security Field

Tomohiko Uyematsu, Professor
Information theory for non-parametric data, network information theory, and random number generation

Wakaha Ogata, Professor
Cryptography, Encryption, Digital signature, User authentication, Secret sharing, Cryptographic protocol, Multi-party protocol

Ryutaroh Matsumoto, Professor
Quantum Information Processing, Information Theoretic Security, Algebraic Error-Correcting Code, Adversarial Machine Learning

Kenta Kasai, Associate Professor
Coding Theory / LDPC Codes / Spatially-Coupled Codes / Graphical Models / Fountain Codes / Quantum Error Correcting Codes / Memory Channels

Yutaka Jitsumatsu, Associate Professor
Wireless Communication, Multiple Access Method, Physical Layer Security, MRI reconstruction using deep learning

Fukang Liu, Assistant Professor
Cryptography / Symmetric-key cryptography / Hashfunctoin / Authenticated encryption / Crytanalysis design
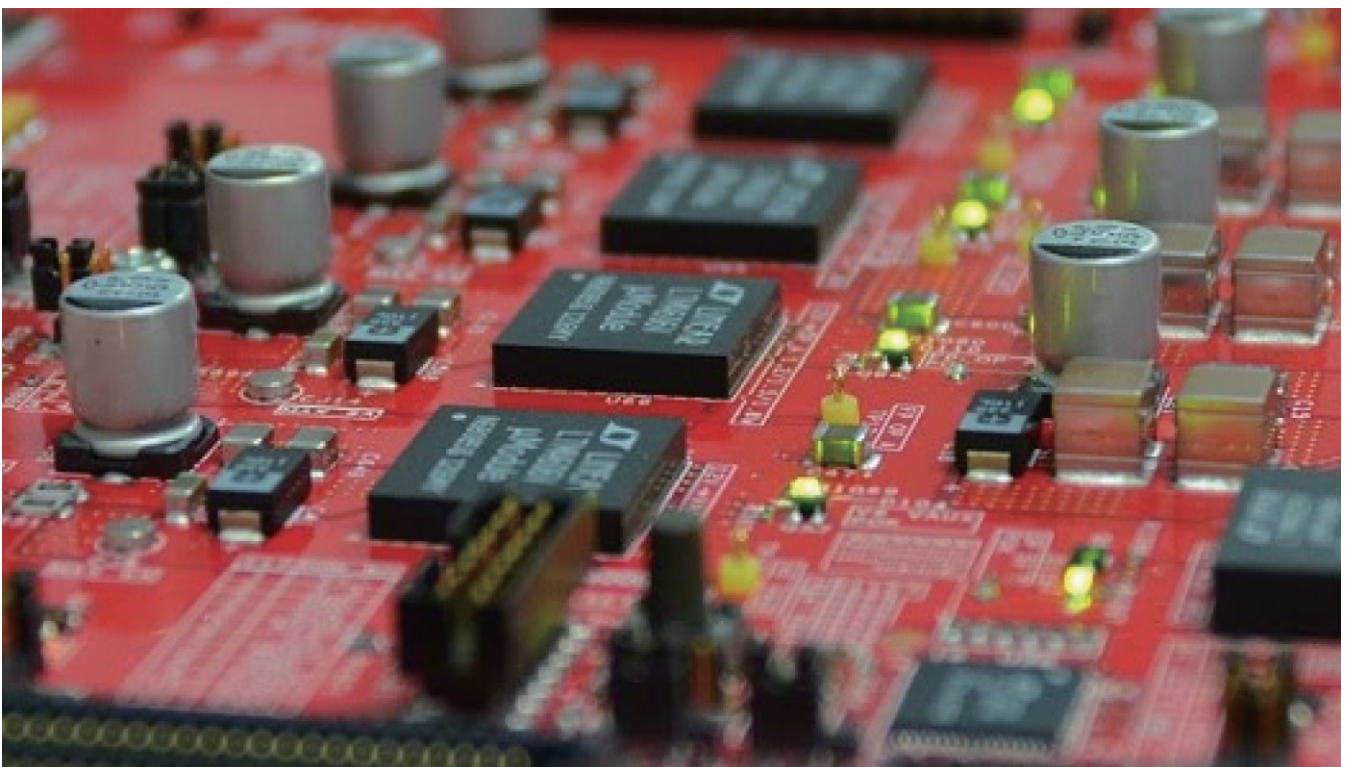
Integrated Circuit and Computer Group
Digital Integrated Circuits Field

Tsuyoshi Isshiki, Professor
System-on-Chip design verification automation, high-performance processor design automation, secure VLSI architecture

Atsushi Takahashi, Professor
High-performance VLSI Design System/Electronic Design Automation (EDA)/Physical Design/Design for Manufacturability (DFM)/Next-Generation Lithography/Graph Theory/Combinational Optimization/Synchronous Circuits/Adaptive Computation

Mahfuzul Islam, Associate Professor
CMOS Integrated Circuit, Analog/Digital Mixed-Signal Integrated Circuit, Low-power Design, IoT, Sensor, A/D Converter, Power Converter, Neuromorphic Hardware

Yuko Hara, Associate Professor
Embedded Systems, Internet-of-Things (IoT), High-Level Synthesis, Logic Synthesis, Hardware/Software Co-design, Computer Aided Design (CAD), Architecture/Microprocessor, FPGA

Satoshi Tayu, Assistant Professor
Graph algorithm/Combinatorial optimization

Dongju Li, Assistant Professor
Fingerprint Authentication/SOC Architecture/Information Security

Integrated Circuit and Computer Group
Analog Integrated Circuits Field

Hiroki Sato, Assistant Professor
CMOS Analog Integrated Circuit, Low-Voltage Circuit Technique, Signal Processing, IP Networking, Computer Security

Integrated Information and Communications Group
Distributed Information and Advanced Communication Systems Field

Katsunori Yamaoka, Professor
Information and Communication Network/Internet Technology/Telecommunication Networking/Next and Future Network/Network Engineering for Multimedia and Application

Hiroki Nakahara, Visiting Professor
Reconfigurable System, FPGA, Deep Learning, Multi-Valued Logic

Hiroshi Sasaki, Associate Professor
Computer Architecture, Computer Security, Computer Systems, Internet of Things (IoT), Workload Characterization

Takayuki Nishio, Associate Professor
Wireless Networks, MAC Protocol, Machine Learning, Computer Vision, Network Computing, IoT, Multimodal Wireless/Sensing

Sumiko Miyata, Associate Professor
Information and Communication Network, Information Security, IoT, Non-Terrestrial Network, IoT Network

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Department of Industrial Engineering and Economics

How do we more effectively produce and offer better products at lower prices? In order to help people live richer, happier lives, we must thoroughly and logically consider scientific and technological perspectives on what sort of society we should build for the future.

It is necessary to utilize scientific tools such as modelling, quantitative analysis, and statistical processing to better respond to constantly changing financial and operational conditions. The knowledge and understanding gleaned using these tools can be used to build even better systems when we utilize the strengths of engineering approaches that have been honed through on-site experience.

This is the strength of the Department of Industrial Engineering and Economics – the ability to combine the theoretical base provided by science and engineering with practical skills and experience.

Akiyoshi Shioura
Department Chair

Research

Our aim is to analyze various issues in corporate management and economics from the perspectives of mathematics, science, engineering, business administration, economics and various other fields of study, and attempt to find solutions. It is for this reason that the areas and topics of research undertaken in this department are so diverse.

Areas of study include: business strategy; capital procurement and investment; organization management; strategic and financial analysis of management activities through marketing and other means; production management; quality management; supply chain management; finding solutions to various corporate operational issues using management information systems; industrial engineering; ergonomics; cognitive engineering; psychological understanding of human behavior; operations research; optimization; development of mathematical problem solving methods such as analysis of big data; game theory; micro/macroeconomics; econometrics; experimental economics; economic behavioral analysis using mathematical and engineering approaches.

Education

Our curriculum is centered on four pillars of mathematics, economics, business administration, and management technology, and it is designed to provide a focus on specific subjects while helping students reach their educational goals. Our students are able to become engineers, researchers, and specialists with rich imaginations, with the ability to come up with theoretical structures that carve out new areas of research, and with open minds that enable them to put their ideas into practical use.

Approximately 70% of our undergraduates advance to graduate study, while the others start working after their undergraduate degree in various industries that include manufacturing and consulting, and financial industries such as banking, insurance, and securities. Graduates with master's degree also go on to work in a broad range of industries, while the relatively high rate of students work in manufacturing and consulting-related fields. Graduates of the Department of Industrial Engineering and Economics have excellent mathematical abilities and are well-versed in both management and economics theory. They can be found in a broad array of fields, and they are highly thought of in all industries in which they work.

Research Groups and Fields of Research

Advanced Management and Paradigm Creation Group

Developing optimization methods through engineering analysis focused on industrial processes including development, production, and sales, and on human behavior in those processes.

Industrial System Field
Human Centered System Field
Operations Management Field

Corporate System Creation Group

Conducting scientific analysis of corporations that act as drivers of innovation, and presentation of strategies for optimal corporate governance, management/organization, marketing, and capital.

Corporate Governance System Field
Management Strategy / Marketing Field
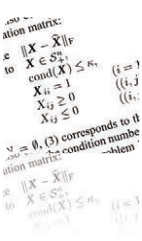
Analysis Method Creation Group

Developing analytical methods for diverse types of information and optimization methods of management and economic activities, based on mathematical and statistical analysis and active utilization of AI.

Mathematical Sciences and Informatics Field
Operations Research Field
Econometrics Field
Business Data Science Field
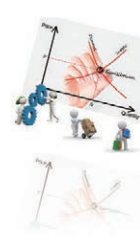
Economic Science Group

Analyzing economic and social systems based on economics, and designing and presenting policies and institutions that could achieve desirable economic and social situations.

Macroeconomics/Cliometrics Field
Microeconomics/Game Theory Field
Humanomics Field
Global Environmental Research Field

Faculty

Advanced Management and Paradigm Creation Group
Industrial System Field

Katie Seaborn, Associate Professor
Human-computer interaction/inclusive design/critical computing/voice user experience/game user research

Advanced Management and Paradigm Creation Group
Human Centered System Field

Hiroyuki Umemuro, Professor
Products or services that provide affective experiences/technology and aging/human-robot(agent)-interaction/management considering affective experiences of stakeholders

Mayu Koike, Assistant Professor
① Human-Agent Interaction ② Anthropomorphism ③ Romantic Relationships ④ Well-being

Advanced Management and Paradigm Creation Group
Operations Management Field

Xiuzhu Gu, Associate Professor
Risk management / patient safety / healthcare operations management / applied ergonomics / occupational health and safety

Ryuji Uozumi, Associate Professor
Biostatistics / Medical Statistics / Design and Analysis of Clinical Trials / Survival Analysis / Statistical Science / Causal Inference / Data Science / Clinical Research

Analysis Method Creation Group
### Mathematical Sciences and Informatics Field

Tomomi Matsui, Professor
Optimization Algorithms based on Mathematics and Informatics./Discrete Optimization/Combinatorics/Operations Research/Algorithm

Akiyoshi Shioura, Professor
Theory of discrete convex analysis/efficient algorithms for discrete optimization problems/application to operations research, mathematical economics, etc.

Nobutaka Shimizu, Assistant Professor
average-case complexity/randomized algorithm/random walk/random graph
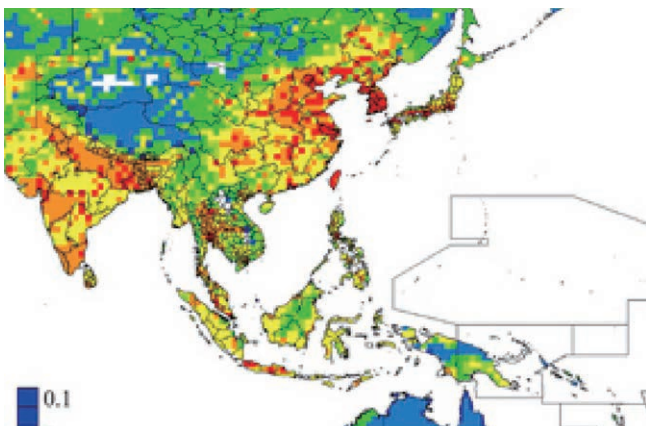
Analysis Method Creation Group
Econometrics Field

Kota Ogasawara, Associate Professor
Cliometrics/Natural Experiments/Health Economics/Human Capital Formation/Empirical Economics/Applied Econometrics

Analysis Method Creation Group
Business Data Science Field

Kazuhide Nakata, Professor
We focus on operations research, machine learning, and optimization. In particular, we develop algorithms for precisely analyzing large scale models.

Ryutaro Ichise, Professor
Artificial Intelligence/Machine Learning/Semantic Web/Data Mining/Relational Learning/Ontology/Knowledge Graph/Knowledge Discovery/Cognitive Architecture

Ken Kobayashi, Assistant Professor
Mathematical optimization/Operations research/Applications of mathematical optimization to management science and engineering

Corporate System Creation Group
Corporate Governance System Field

Kotaro Inoue, Professor
Corporate finance/corporate investment policy/financial policy/corporate govenrnance/behavioral finance

Kyoko Nagata, Professor
Corporate evaluation/corporate governance/profit adjustment/empirical resareach on capital market

Yuki Inoue, Associate Professor
Innovation/Technology management/Management strategy/Platform/Business eco-system

Yosuke Kimura, Assistant Professor
Corporate finance/asset pricing/firm dynamics/macroeconomics

Economic Science Group
Macroeconomics/Cliometrics Field

Takeo Hori, Associate Professor
Macroeconomics/Economic Growth/Technical Progress/Structural Transformation/Heterogeneous Agents/Sustainability of Public Debts/Monetary Policy

Hiroshi Morita, Associate Professor
Macroeconimics, Time series analysis

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Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Interdisciplinary Research Groups

Mechanical Engineering

Systems and Control Engineering

Electrical and Electronic Engineering

Information and Communications Engineering

Industrial Engineering and Economics

Economic Science Group
Microeconomics / Game Theory Field

Takehiko Yamato, Professor
Economic mechanism design / Market and public goods pro-vision mechanisms: theory and experiments / Behavioral game theory and implementation theory

Ryo Kawasaki, Associate Professor
Game theory / Mathematical economics / Application of stable sets in economics / Potential games and their applications / Analysis of markets with indivisibilities

Ryosuke Sakai, Assistant Professor
Mechanism design / Market design / Axiomatic analysis of indi-visible good allocation

Economic Science Group
Humanomics Field

Dai Senoo, Professor
Theory of Organization, Strategy, Knowledge Management and Information Systems. Main projects are Creative Office, Open Innovation and Business Ecosystem.

Emiko Fukuda, Associate Professor
Industrial economics / experimental economics / numerical analysis of game theory model / congestion management / security and disaster-relief service

Heru Prasetyo Eko, Assistant Professor
Digital platform, Strategy, Structure, Knowledge management

Economic Science Group
Global Environmental Research Field

Toshihiko Masui, Visiting Professor
Development of integrated assessment model toward low-carbon and sustainable society, and quantification of fu-ture scenarios by using the developed model.

Yuko Kanamori, Visiting Associate Professor
Developlment and analysis of environmental model of house-hold sector / lifestyle / population and household structure analysis

Yosuke Munesue, Assistant Professor
Impacts of food losses and waste on global food insecurity, natural resources, and greenhouse gas emissions / food loss reduction in the Sustainable Development Goals
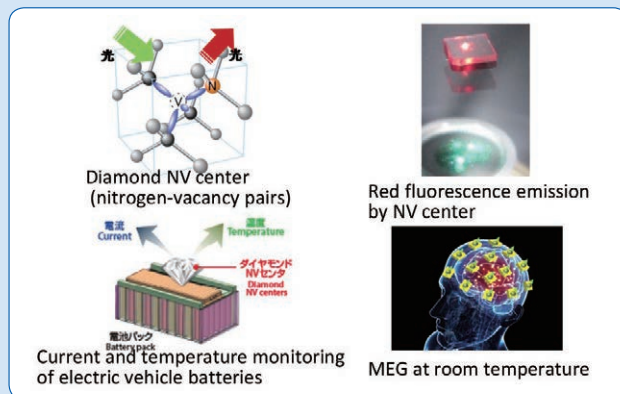
Selected Research and Education Projects

MEXT–Quantum Leap Flagship Program
Quantum Metrology and Sensing

Development of innovative sensor systems by highly sophisticated control of solid quantum sensors

Diamond NV center (nitrogen-vacancy pairs)

Red fluorescence emission by NV center

Current and temperature monitoring of electric vehicle batteries

MEG at room temperature

Research Overview

Overview:

In this research, four companies, two national laboratories, and five universities have established a networked research hub with Tokyo Tech as the core, and are conducting integrated research and development from the physics of solid-state quantum sensors to their applications. Developing prototypes of quantum sensors by utilizing diamond NV center (nitrogen–vacancy pair), whose spin coherence is excellent even at room temperature in the atmosphere and whose quantum states can be initialized and read out by light.

Goals of Research and Development:

· Development of prototypes for magnetoencephalography (MEG) with high sensitivity and high spatial resolution.

· Development of prototypes for systems monitoring the current and the temperature in batteries and power devices.

Members

Mutsuko Hatano, Prof. (Electrical & Electronic Eng., P.18)
Takayuki Iwasaki, Assoc. Prof. (Electrical & Electronic Eng., P.18)
Shigeki Nakagawa, Prof. (Electrical & Electronic Eng., P.18)
Kenichi Okada, Prof. (Electrical & Electronic Eng., P.17)
Yoshitaka Oiso, Specially Appointed Assoc. Prof. (Electrical & Electronic Eng., P.17)
Tadashi Sakai, Specially Appointed Prof. (School of Engineering, P.4)
Keigo Arai, Assoc. Prof. (Electrical & Electronic Eng., P.18)
Nobuhiko Nishiyama, Prof. (Electrical & Electronic Eng., P.17)
Yota Takamura, Assis. Prof. (Electrical & Electronic Eng., P.18)
Naoto Sekiguchi, Specially Appointed Assistant Professor (School of Engineering, P.4)

National Institute of Information and Communications Technology (NICT)

Research Overview

Due to the recent advancement of AI and IoT technologies, wireless traffic is increasing year by year. 1000 times increase in 20 years is estimated for the world-wide wireless traffic. Further advanced technology is required for supporting the wireless traffic.

This research project is for further improvement of 5G technology and new innovative technologies for 6G and 7G. Millimeter-wave wireless communication has been introduced for 5G in addition to the conventional microwave. In this research projects, Tokyo Tech collaborates with related companies for developing wireless and IC technologies for the future 6G and 7G wireless service, especially focusing on low-power and low-post IC technology and satellite communication technology.

Research and Development for Beyond 5G

Members

Kenichi Okada, Prof. (Electrical & Electronic Eng., P.17)
Atsushi Shirane, Assoc. Prof. (Electrical & Electronic Eng. (FIRST, IIR), P.17)
Takashi Tomura, Assis. Prof. (Electrical & Electronic Eng., P.17)
**Hiroyuki Sakai,** Specially Appointed Prof.
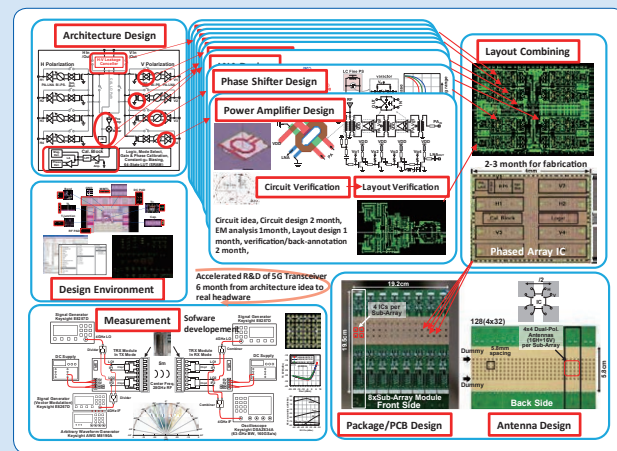
New Energy and Industrial Technology Development Organization (NEDO)
Next Generation Computing Technology

Technology Development of High Efficiency and High Speed Processing Distributed Computing System using Heterogenous Material Integrated Optoelectronics

1) Large-scale photonic integrated circuit using heterogeneous material bonding technology
2) 10-Tbps-class, low power consumption (<10 pJ / bit) optical transceiver
3) Multi-degree elastic network architecture
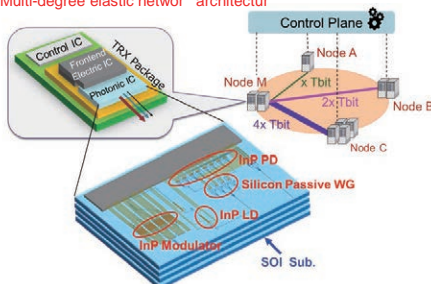
Research Overview

This project aims to realize the distributed computing system that efficiently connects regionally distributed computational resources (edge servers, etc.) as the next-generation computing technology.

To realize this, we are developing 10-Tbps-class photonic transceiver technology with low power consumption (<10pJ / bit), which contains the photonic integrated circuit using heterogeneous semiconductor direct bonding technology, and the multi-degree elastic photonic network architecture.

This project will realize communication technology for next generation computing that can realize future large-scale metaverses.

Members

Nobuhiko Nishiyama, Prof. (Electrical&Elect. Eng., P.17)
Yuya Shoji, Assoc. Prof. (Electrical&Elect. Eng. (FIRST, IIR), P.17)
Tomohiro Amemiya, Asso. Prof. (Electrical&Elect. Eng. (FIRST, IIR) P.17)
Kensuke Ogawa, Specially Appointed Prof.(Electrical&Elect. Eng., P.17)
Tsuyoshi Horikawa, Specially Appointed Prof. (Electrical&Elect. Eng., P.17)
Yoshitaka Oiso, Spe.-Ap. Assoc. Prof. (Electrical&Elect. Eng., P.17)

Japan Science and Technology Agency (JST) Moonshot R&D Program — Large-scale Silicon Quantum Computer
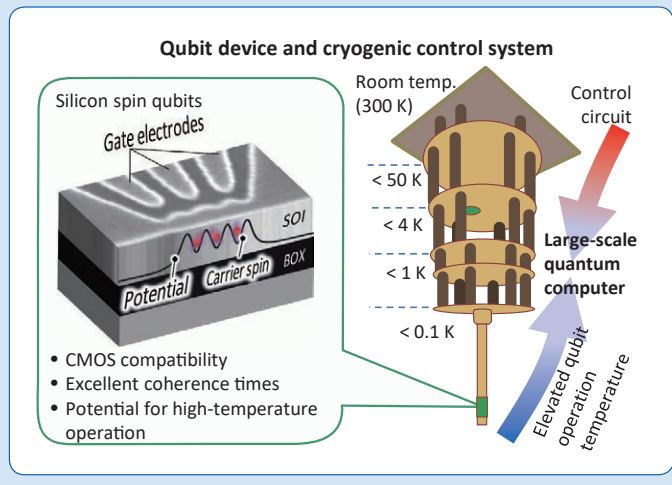
Research Overview

Large-scale quantum computers may be useful to solve global social issues and challenges. In this study, we conduct research and development aimed at realizing a large-scale quantum computer in silicon, which is characterized by high integration and low power consumption. The semiconductor circuit integration technology makes silicon qubits advantageous for large-scale integration. Furthermore, they can be operated at higher temperatures than superconducting quantum computers, in principle. The goal of this study is to raise the operating temperature of qubits to around 1 Kelvin (from the usual 0.1 Kelvin). This will increase the cooling capacity of the refrigerator considerably, offering a solution to the problem of heat generation in the control and readout circuits that becomes more apparent with the size of the quantum computers increased to a practically useful level.

Members

Tetsuo Kodera, Assoc. Prof. (Electrical & Electronic Eng., P.18)
Jun Yoneda, Specially Appointed Assoc. Prof.
(Tokyo Tech Academy for Super Smart Society)

Elevating operation temperatures of silicon qubits towards large-scale silicon quantum computers

Qubit device and cryogenic control system

- CMOS compatibility
- Excellent coherence times
- Potential for high-temperature operation

New Energy and Industrial Technology Development Organization (NEDO)

Collaborative Industry-Academia-Government R&D Project for Solving Common Challenges
Toward Dramatically Expanded Use of Fuel Cells and Related Equipment

Development of non-destructive testing, on-line monitoring, and damage tolerance techniques to assure the integrity of high-pressure hydrogen storage tanks for fuel cell vehicles
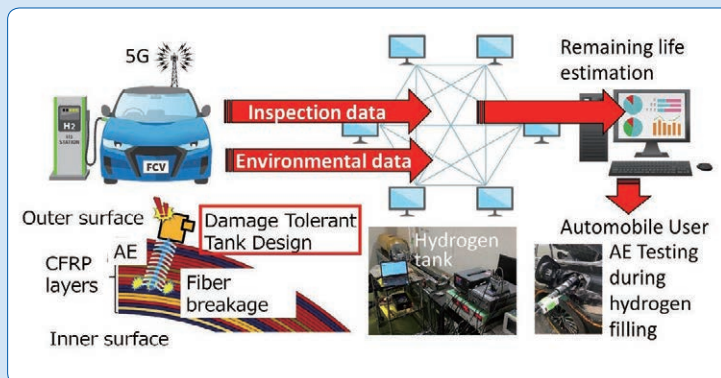
Research Overview

We are developing technologies to reduce the cost and extend the service life of high-pressure hydrogen storage tanks installed in fuel cell vehicles (FCVs), with the aim of further popularizing FCVs. Specifically, we are researching an online inspection technique to evaluate the integrity of the tanks using pressure increase that occur during hydrogen filling. We are also developing a damage tolerant low-cost tank design method based on this inspection. By utilizing the online inspection technology to be developed in this project and the communication function of a connected car, the integrity of tanks can be individually managed, enabling the tanks to be used until the end of their own service life. Several universities and national laboratories are participating in this project, the group leader of this project is our university.

Members

Yoshihiro Mizutani, Prof. (Mech.Eng., P.12)

Japan Science and Technology Agency (JST) Moonshot R&D Project

Research and development on innovative earthwork operations

Research Overview

Targeting the construction of lunar bases and response to natural disasters such as river blockages, we are conducting research and development of a group of robots that can construct infrastructure while responding flexibly to changes in on-site conditions. The robots that combine shape adaptability and high power include (1) an elephant trunk power soft arm using hydraulic and pneumatic pressures, (2) a power soft gripper that grasps objects by entangling them like the tentacles of a sea anemone, and (3) multiple high-speed sandbags installed in the disaster site environment as a work mechanism for working in difficult-to-access areas. As work mechanisms for difficult-to-access areas, we are conducting research and development of (3) a parallel wire robot (Reelbot) that can transport earth and sand in a wide area at high speed by manipulating multiple wire jacks installed in the disaster site environment, and (4) a mechanism (Impactor) that moves by increasing friction force through high-speed driving with an inertial mass.

Members

Koichi Suzumori, Prof. (Mech.Eng., P.9)
Gen Endo, Prof. (Mech.Eng., P.9)
Hiroyuki Nabae, Assis. Prof. (Mech.Eng., P.10)

Collaborative AI robots for adaptation of diverse environments and innovation of infrastructure construction

Power Soft Gripper
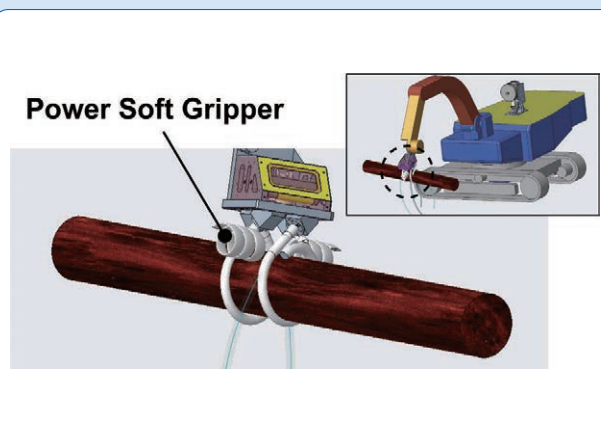
MIC, Research and Development for Expansion of Radio Resources Program (Since April 1st 2022)

Research and Development of Time and Frequency Synchronization Technology with Mobile Atomic Clocks

High Precision Distributed Time Synchronization with Mobile Atomic Clock Network
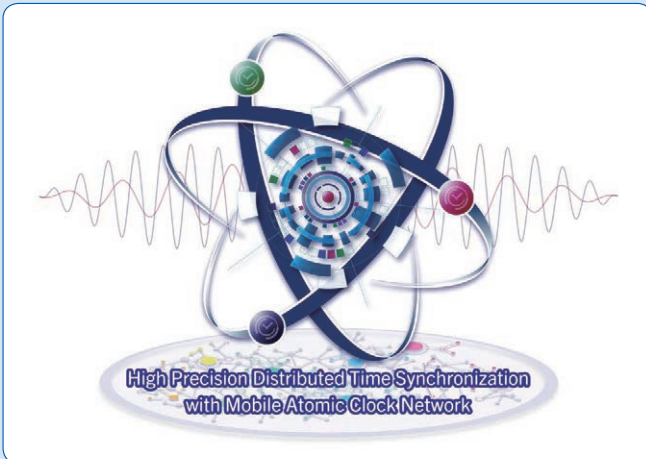
Research Overview

We aim at developing distributed time synchronization technology with a view to the widespread use of mobile atomic clock chips. Specifically, by making use of advanced systems and control theory, we develop a distributed algorithm that achieves precise time synchronization for a cluster of atomic clocks whose network structure changes from moment to moment.

Our algorithm will be validated in a testbed environment owned by National Institute of Information and Communications Technology (NICT), after which it will be implemented in actual equipment developed by two companies. Precise time synchronization using mobile atomic clock networks is expected to find a wide range of applications, including smart grids, financial transactions, broadcasting and automated driving.

Members

Takayuki Ishizaki, Assoc. Prof. (Syst. and Cont. Eng. P.14)
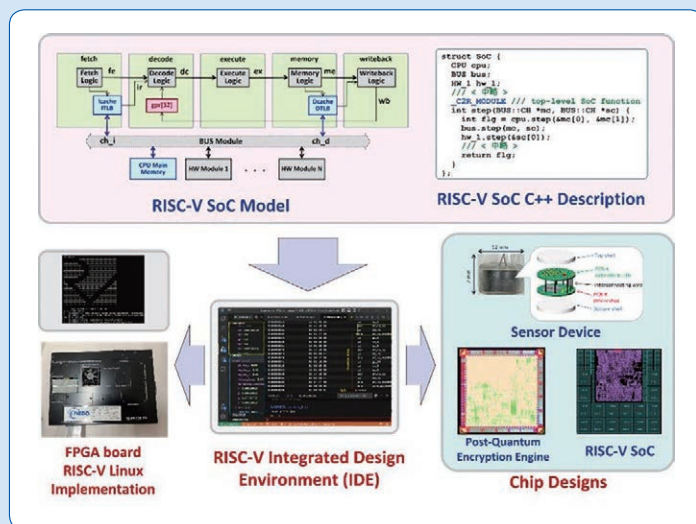
NEDO事業「RISC-V System Design Platform」

RISC-V Based System-on-Chip Design Environment for High-Performance High-Efficiency IoT/AI Edge Devices

Research Overview

While demands on IoT, AI, robotics, automotive applications continue to increase dramatically, it is essential to establish a technology framework for implementing highly complex, highly energy efficient edge compute devices in order to offload the vast amount of compute and network bandwidth concentrated at the cloud. This research project involving two universities and four companies focuses on developing an integrated SW/HW design platform encompassing a variety of RISC-V instruction-set profiles and HW accelerators to boost RISC-V based product development in the industry.

Members

Tsuyoshi Isshiki, Prof. (Info. and Com. Eng., P.23)
Takashi Tokuda, Prof. (Electrical & Electronic Eng., P.17)
Kenji Kise, Prof. (Dept. of Computer Science)
Hiroshi Sasaki, Assoc. Prof. (Info. and Com. Eng., P.23)
Dongju Li, Assis. Prof. (Info. and Com. Eng., P.23)

RISC-V SoC Model

RISC-V SoC C++ Description

FPGA board RISC-V Linux Implementation

RISC-V Integrated Design Environment (IDE)

Sensor Device

Post-Quantum Encryption Engine

RISC-V SoC

Chip Designs

Research Project Promoted by Department of Industrial Engineering and Economics

Optimization Technology in Industrial Engineering and Economics
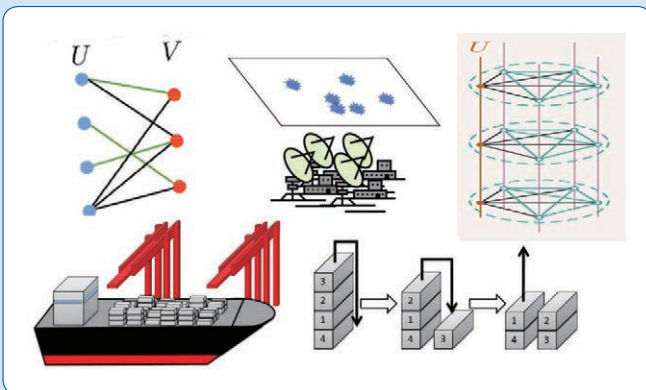
Research Overview

Various problems in practice are often written by a similar optimization model. For example, a problem to assign tasks in a factory to machines is called a matching problem, and a solution technique is used for assigning graduating medical students to their first hospital appointments and fusing databases with multiple sensors. It is known that facility location problems of fire departments have structures similar to those of electronic components location problems on electric circuit boards, container location problems at piers and distortion sensor location problems of buildings. Techniques for solving scheduling problems in the manufacturing industry are used for determining the delivery order of parcels and for determining the hole drilling order of electric circuit boards. The Analysis Method Creation Group aims to expand the scope of application as well as deepening the optimization theory.

Members

Tomomi Matsui, Prof. (Industrial Eng. & Econo., P.25)
Kazuhide Nakata, Prof. (Industrial Eng. & Econo., P.25)

Akiyoshi Shioura, Prof. (Industrial Eng. & Econo., P.25)

Selected Research Projects

MEXT, Doctoral Program for World-leading Innovative & Smart Education
Tokyo Tech Academy for Super Smart Society

School of Engineering is leading Super Smart Society Promotion Project (SSS Promotion Consortium and WISE-SSS)!

Research Overview

School of Engineering is leading Tokyo Tech Super Smart Society (SSS) Promotion Project whose goal is to promote the realization of SSS, and to develop future leaders who are capable of leading the transformation to the new society. In October 2018, we established the SSS Promotion Consortium, and next generation education and research platform that fuses open education and open innovation in collaboration with consortium partners. We also launched the Doctoral Program for World-leading Innovative & Smart Education for SSS (WISE-SSS) to embody the open education in 2020 with a grant from the MEXT Doctoral Program for World-leading Innovative & Smart Education. Accordingly, we have established six SSS research and education fields as open innovation platforms for creating SSS.

Members

Tomohiko Uyematsu, Prof. (Info. and Com. Eng. P.22)
Kei Sakaguchi, Prof. (Electrical and Electronic Eng. P.17)
Kotaro Inoue, Prof. (Industrial Eng., P.25)

Eisuke Fukuda, Specially Appointed Prof.
Nobuyuki Iwatsuki, Prof. (Mech. Eng. P.12)
70 faculties from various schools are participating!

MEXT project: Fostering value-creating professionals
Recurrent Education

Human resource development program to fostering value creation through synergy between technology and creativity

Research Overview

"Technology Creatives Program" aims to develop a program for engineers and designers to acquire value creation skills and seize opportunities for social co-creation through the use of cutting-edge technology.

The six-month program for working professionals, in collaboration with Tama Art University and Hitotsubashi University, aims to cultivate the skills and build a network necessary for value-creating professionals through an all-round guidance system of technology, art and design, and business.

Members

Dai Senoo, Prof. (Industrial Eng. & Econo., P.26)
Shigeki Saito, Prof.(Mech. Eng., P.10)
Tohru Yagi, Prof. (Mech. Eng., P.10)
Kazuaki Inaba, Assoc. Prof. (Mech. Eng., P.12)

Momoko Nakatani, Assoc. Prof. (Info. and Com. Eng. P.21)
Hikaru Sakamoto, Assoc. Prof. (Mech. Eng., P.11)
Wataru Hijikata, Assoc. Prof. (Mech. Eng., P.12)

Collaborative Research Program on mobile communication system

Research Overview

In this course, we are conducting world-leading research to realize a "3D spatial cell construction covered ultra wide area"

This study is integrating the next-generation 5.5G/6G cellular network system that covers both ground and sky areas with the same frequency at each base station and HAPS cellular infrastructure, and consequently that network is available for a usual smart phone.

Members (*: Program Head)

Kei Sakaguchi, Prof. (EEE, P.17)*
Jiro Hirokawa, Prof. (EEE, P.17)
Tran Gia Khanh, Assoc. Prof. (EEE, P.17)
Teruya Fujii, S.A. Prof. (EEE, P.17)
Yoshichika Ohta, S.A. Assoc. Prof. (EEE, P.17)
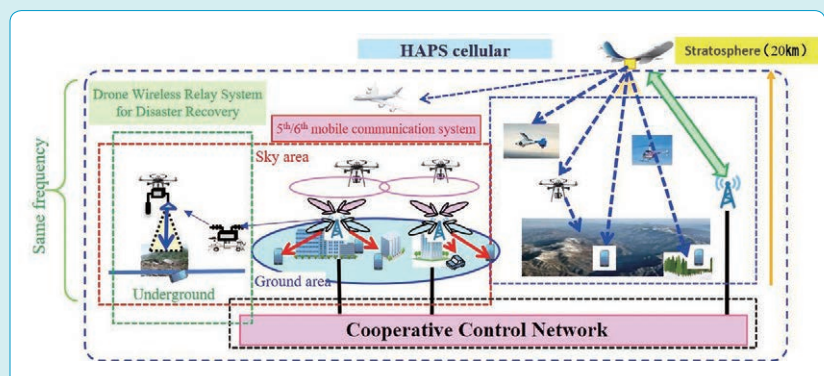
RICOH Collaborative Research Program on Advanced Digital Printing Technology

Increasing demand of digital printing technology (commercial and industrial)

Droplet deposition, coalescing, and image fixing

Inkjet printer (commercial and industrial)

Research Overview

The objective is to conduct basic research focusing on the elemental technologies that will become the core of next-generation digital printing technology and lead to high-speed, high-resolution imaging technology. In particular, research activities will focus on inkjet technology.

Members (*: Program Head)

Kazuyoshi Fushinobu, Prof. (ME P.9)*
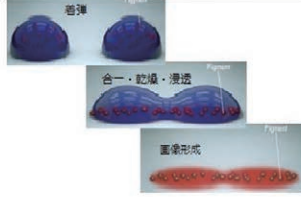**Shintaro Matsushita,** Asst. Prof. (ME, P.11)
Masami Kadonaga, S.A. Prof. (ME, P.9)

Tatsuya Kawaguchi, Asst. Prof. (ME, P.11)
Safumi Suzuki, Assoc. Prof. (EEE, P.18)
Koichi Kato, S.A. Assoc. Prof. (ME, P.9)

Manabu Kodama, Assoc. Prof. (ME, P.10)
Toshiaki Ougizawa, Prof. (MCT School)

## JTEKT Collaborative Research Laboratory for Innovative Core Technology

Research Overview

Mission of this collaborative research laboratory is to conduct researches of fundamental technology developments that are important for next-generation machine elements, their application for robotic systems and high-performance factory management systems. Most important core issues of the lab are machinery elements (gears, bearings and feed screws) and AI-based analysis of voice signals.
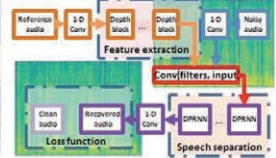

Development of fundamental technologies for analysis, design and manufacturing of gears

Intelligent mobilities based on innovative machinery elements
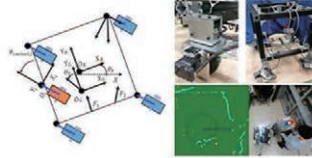
Development of noise-robust speech recognition techniques

Members (*: Program Head)

Nobuyuki Iwatsuki, Prof. (ME, P.12)*
Yukio Takeda, Prof. (ME, P.9)
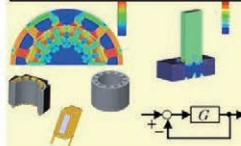**Takahiro Shinozaki,** Assoc. Prof. (ICE, P.21)

Tsune Kobayashi, S.A. Prof. (ME, P.12)
Daisuke Matsuura, S. A. Assoc. Prof. (ME, P.12)

YASKAWA-TokyoTech Collaborative Research Chair

Expanding need for collaborative robots

Ultra-lightweight motor and actuator

Exploration of new magnetic materials
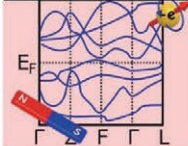
Synthesis and application of carbon materials
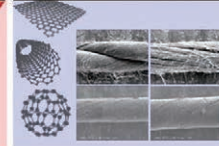
Research Overview

With the goal of realizing an ultralight collaborative robot in ten years, as a first step, we will bring together researchers in materials, motors, robotics, and other fields to study ultralight actuators to be used as a driving source.

Members (*: Program Head)

Akira Chiba, Prof. (EEE, P.19)*
Kyohei Kiyota, Assoc. Prof. (EEE, P.19)
Yusuke Sugahara, Assoc. Prof. (ME, P.9)

Yoshihiro Gohda, Assoc. Prof. (MCT School)
Shinsuke Mori, Assoc. Prof. (MCT School)
Tadahiko Shinshi, Prof. (IIR)

Yukio Tsutsui, S.A. Prof. (EEE, P.19)
Mitsuru Endo, S.A. Assoc. Prof. (ME, P.9)

Collaborative Research Program on Power Electronics Fundamental Technology with Mitsubishi Electric Corp.

Research Overview

To contribute to society through innovation in power electronics equipment, we aim to strengthen fundamental technologies in collaboration with power electronics-related laboratories.

Members (*: Program Head)

Hideaki Fujita, Prof. (EEE, P.19)*
Makoto Hagiwara, Assoc. Prof. (EEE, P.19)
Kenichi Kawabe, Assoc. Prof. (EEE, P.19)
Takahiro Urakabe, S.A. Prof. (EEE, P.19)
Shigeki Harada, S. A. Assoc. Prof. (EEE, P.19)

- ✓ Sophistication of control method
- ✓ Diagnosis of converter status (malfunction / abnormality)
- ✓ Construction and utilization of load / power supply model
- ✓ Circuit configuration exploration and optimization
- ✓ Sophistication of gate drive circuit
- ✓ Sophistication and utilization of power semiconductor models

$$I_d = f(V_{gs}, V_{ds}, T)$$
$$c_{gs} = f(V_{gs})$$
$$c_{gd} = f(V_{gs}, V_{ds})$$
$$c_{ds} = f(V_{gs}, V_{ds})$$
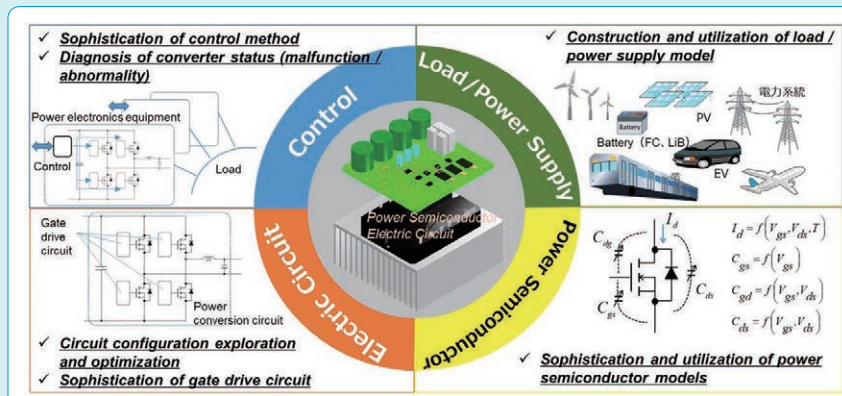
Other collaborative research laboratories and collaborative research clusters

- Collaborative Research Chair/Division Program founded by Sony Group Corporation
- DENSO Mobility Collaborative Research Cluster
- micware Future Navigation Collaborative Research Cluster

Abbreviations:
ME = Dept. of Mechanical Engineering
SCE = Dept. of Systems and Control Engineering
EEE = Dept. of Electrical and Electronic Engineering
ICE = Dept. of Information and Communications Engineering

IEE = Dept. of Industrial Engineering and Economics
MCT School = School of Materials and Chemical Technology
S.A. = Specially Appointed
(Ex.: S.A. Prof. = Specially Appointed Professor)

Industry Liaison

Large-scale Research Collaboration

	Collaborative Research Lectures — Collaborative research among company, faculty and specially-appointed faculty members	Collaborative Research Cluster — Part of the Collaborative Research Cluster is placed within Tokyo Tech to conduct collaborative research	Schemes for Co-Creation of Education and Research — Company supervises lectures at Tokyo Tech along with conducting collaborative research
Collaborative research expenses (indirect expenses included/ space fee excluded)	> 30 million JPY per year	> 20 million JPY per year	> 10 million JPY per year
Specially-appointed faculty member[※1]	Required (2 or more) Recommended by the company	Not required Can be recommended by the company	Not required
Contribution to education	Not required Student guidance by specially-appointed faculty members is possible	Not required	Required[※2] 2 subjects for 4 or more credits in a year by specially-appointed faculty members,
Indirect expenses, etc.	Amount equivalent to 30% of direct expenses	Amount equivalent to 25% of direct expenses Expenses for strategic industry cooperation (15% or more of direct expenses) are separately required"	Amount equivalent to 30% of direct expenses
Period	More than 2 years and not more than 5 years	More than 3 years and not more than 10 years	More than 2 years and not more than 5 years
Dedicate space in Tokyo Tech	Not required	Required	Not required
Person responsible for the establishment	Head of department, etc.	Research base head (research representative)	Dean
Other information	Before establishment, collaborative research conducted together with faculty members received is required Application submission 5 months prior to the establishment"	Research planning team between company and Tokyo Tech Support from Tokyo Tech's Open Innovation Organization Application submission 3 months prior to the establishment	Lectures and collaborative research are based on the same topics Application submission 3 months prior to the establishment"

※1 Specially-appointed faculty members are hired by collaborative research expenses
※2 Lectures will be incorporated into the special study programs set for the schools established at Tokyo Tech

"Technical Exchange"

We propose "Technical Exchange" to provide free-discussion opportunity for future full-collaborative research.

Send an inquiry to Industry-University Cooperation Office at School of Engineering

- Refinement of discussion points in advance
- Discussion between members from company and Tokyo Tech in School of Engineering
- Research introduction and discussion on the topics from faculty members
- Discussion place can be either company or Tokyo Tech

＊**We recommend to conclude an academic teaching agreement to join the "Technical Exchange"**

- Secure the confidentiality by NDA
- All the faculty members in School of Engineering will follow the agreement
- An expense of about 1M JPY per year for "Technical Exchange" on regular basis

Seminar of technical seeds

Introduction of research seeds of about 200 faculty members in School of Engineering

- Research topic from the standpoint of industry
- Topics related to many company, hot topics and theme

About 2 seminars per year

- Example: Heat transfer engineering, Integrated IoT, Management engineering, Acoustic engineering

Use the chance for personal connection to faculty members

- Collaborative research, Joint proposal for funding agency
- Technical advisor, in-company training, etc.

Inquiry for collaborative research with faculty members at School of Engineering

Tokyo Institute of Technology

Ookayama campus:　2-12-1 Ookayama, Meguro-ku, Tokyo 152-8550
Suzukakedai campus: 4259 Nagatsuta, Midori-ku, Yokohama, Kanagawa 226-8503

Industry-University Cooperation Office
(Ookayama campus, Ishikawadai 5 bld. 3F, room 304)

URL: https://www.e.titech.ac.jp/icuseng/

or

Office of Research and Innovation
URL: https://www.ori.titech.ac.jp/en/　　E-mail: sangaku@sangaku.titech.ac.jp

Statistics

Number of Staff

Course	Professor	Associate Professor	Associate Professor (Lecturer)	Assistant Professor	Total
Department of Mechanical Engineering	27	19	1	15	62
Department of Systems and Control Engineering	9	9		8	26
Department of Electrical and Electronic Engineering	13	20		9	42
Department of Information and Communications Engineering	13	10		9	32
Department of Industrial Engeneering and Economics	8	11		5	24
Total	70	69	1	46	186

Number of Students

Undergraduate Course

Department	1st year Men	Men Intl. Student	1st year Women	Women Intl. Student	2nd year Men	Men Intl. Student	2nd year Women	Women Intl. Student	3rd year Men	Men Intl. Student	3rd year Women	Women Intl. Student	4th year Men	Men Intl. Student	4th year Women	Women Intl. Student	Total	Total Intl. Student	Total
Department of Mechanical Engineering	353	7	25	1	119	5	14	0	126	3	5	1	157	10	8	1	429	20	
Department of Systems and Control Engineering					46	1	2	0	44	2	6	0	44	2	8	2	150	7	
Department of Electrical and Electronic Engineering					88	4	6	1	92	3	5	0	117	5	10	5	318	18	
Department of Information and Communications Engineering					45	2	4	0	50	3	3	1	48	4	5	1	155	11	
Department of Industrial Engeneering and Economics					54	0	8	1	54	0	7	0	60	1	15	1	198	3	
Total	353	7	25	1	352	12	34	2	366	11	26	2	426	22	46	10	1250	59	1628

(Note: the 1st year values 353, 7, 25, 1 span all departments.)

Master's Course

Department	1st year Men	Men Intl. Student	1st year Women	Women Intl. Student	2nd year Men	Men Intl. Student	2nd year Women	Women Intl. Student	Total	Total Intl. Student
Department of Mechanical Engineering										
Graduate Major in Mechanical Engineering	128	16	12	2	147	20	9	2	296	40
Graduate Major in Energy Science and Engineering	17	1	0	0	20	2	0	0	37	3
Graduate Major in Engineering Sciences and Design	16	0	3	0	11	2	3	0	33	2
Graduate Major in Human Centered Science and Biomedical Engineering	11	4	0	0	13	2	3	1	27	7
Graduate Major in Nuclear Engineering	5	0	0	0	2	0	0	0	7	0
Subtotal	177	21	15	2	193	26	15	3	400	52
Department of Systems and Control Engineering										
Graduate Major in Systems and Control Engineering	54	9	6	2	71	12	4	3	135	26
Graduate Major in Engineering Sciences and Design	0	0	0	0	1	0	0	0	1	0
Subtotal	54	9	6	2	72	12	4	3	136	26
Department of Electrical and Electronic Engineering										
Graduate Major in Electrical and Electronic Engineering	133	25	5	3	145	32	11	5	294	65
Graduate Major in Energy Science and Engineering	14	2	0	0	19	0	2	2	35	4
Graduate Major in Human Centered Science and Biomedical Engineering	6	1	1	1	13	2	2	1	22	5
Graduate Major in Nuclear Engineering	0	0	0	0	3	0	0	0	3	0
Subtotal	153	28	6	4	180	34	15	8	354	74
Department of Information and Communications Engineering										
Graduate Major in Information and Communications Engineering	89	34	5	2	100	42	20	11	214	89
Graduate Major in Engineering Sciences and Design	3	0	1	0	2	2	0	0	6	2
Graduate Major in Human Centered Science and Biomedical Engineering	5	3	4	3	1	0	3	2	13	8
Subtotal	97	37	10	5	103	44	23	13	233	99
Department of Industrial Engineering										
Graduate Major in Industrial Engineering and Economics	55	7	5	2	59	9	16	9	135	27
Graduate Major in Engineering Sciences and Design	3	0	0	0	1	0	0	0	4	0
Subtotal	58	7	5	2	60	9	16	9	139	27
Total	539	102	42	15	608	125	73	36	1262	278

Interdisciplinary Graduate Majors	1st year Men	Men Intl. Student	1st year Women	Women Intl. Student	2nd year Men	Men Intl. Student	2nd year Women	Women Intl. Student	Total	Total Intl. Student
Graduate Major in Energy Science and Engineering	80	14	3	0	88	13	15	8	186	35
Graduate Major in Engineering Sciences and Design	37	1	5	1	38	11	9	2	89	15
Graduate Major in Human Centered Science and Biomedical Engineering	55	13	26	14	64	10	36	13	181	50
Graduate Major in Nuclear Engineering	37	10	7	2	42	9	8	5	94	26
Graduate Major in Artificial Intelligence	70	18	8	4	77	25	8	4	163	51
Graduate Major in Urban Design and Built Environment	41	3	17	4	47	5	28	5	133	17

Doctoral Course

Department	1st year Men	Men Intl	Women	Women Intl	2nd year Men	Men Intl	Women	Women Intl	3rd year Men	Men Intl	Women	Women Intl	Total	Total Intl
Department of Mechanical Engineering														
Graduate Major in Mechanical Engineering	15	8	0	0	18	9	2	2	40	19	4	2	79	40
Graduate Major in Energy Science and Engineering	2	2	0	0	2	2	1	1	4	3	0	0	9	8
Graduate Major in Engineering Sciences and Design	4	2	0	0	2	1	0	0	2	0	0	0	8	3
Graduate Major in Human Centered Science and Biomedical Engineering	0	0	0	0	2	0	0	0	2	1	0	0	4	1
Graduate Major in Nuclear Engineering	1	0	0	0	0	0	0	0	1	1	0	0	2	1
Subtotal	22	12	0	0	24	12	3	3	49	24	4	2	102	53
Department of Systems and Control Engineering														
Graduate Major in Systems and Control Engineering	16	6	1	1	10	5	0	0	11	5	2	2	40	19
Graduate Major in Engineering Sciences and Design	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	16	6	1	1	10	5	0	0	11	5	2	2	40	19
Department of Electrical and Electronic Engineering														
Graduate Major in Electrical and Electronic Engineering	21	16	6	5	35	20	2	2	44	24	4	4	112	71
Graduate Major in Energy Science and Engineering	4	0	1	1	4	1	0	0	2	0	1	1	12	3
Graduate Major in Human Centered Science and Biomedical Engineering	5	1	0	0	1	0	0	0	4	2	0	0	10	3
Graduate Major in Nuclear Engineering	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	30	17	7	6	40	21	2	2	50	26	5	5	134	77
Department of Information and Communications Engineering														
Graduate Major in Information and Communications Engineering	17	10	2	2	24	14	2	2	29	14	8	6	82	48
Graduate Major in Engineering Sciences and Design	1	0	0	0	1	0	0	0	0	0	0	0	2	0
Graduate Major in Human Centered Science and Biomedical Engineering	4	2	2	2	3	3	0	0	5	3	2	1	16	11
Subtotal	22	12	4	4	28	17	2	2	34	17	10	7	100	59
Department of Industrial Engineering														
Graduate Major in Industrial Engineering and Economics	3	2	2	2	5	2	0	0	9	0	3	2	22	8
Graduate Major in Engineering Sciences and Design	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	3	2	2	2	5	2	0	0	9	0	3	2	22	8
Total	93	49	14	13	107	57	7	7	153	72	24	18	398	216

Interdisciplinary Graduate Majors	1st year Men	Men Intl	Women	Women Intl	2nd year Men	Men Intl	Women	Women Intl	3rd year Men	Men Intl	Women	Women Intl	Total	Total Intl
Graduate Major in Energy Science and Engineering	13	5	7	5	23	8	2	2	26	12	2	1	73	33
Graduate Major in Engineering Sciences and Design	8	3	0	0	3	1	1	1	5	1	0	0	17	6
Graduate Major in Human Centered Science and Biomedical Engineering	24	14	9	8	20	7	11	11	27	12	15	10	106	62
Graduate Major in Nuclear Engineering	7	3	1	1	13	9	0	0	13	2	3	2	37	17
Graduate Major in Artificial Intelligence	14	7	4	3	22	13	3	3	37	14	7	2	87	42
Graduate Major in Urban Design and Built Environment	7	6	6	4	10	3	10	9	15	6	10	5	58	33

Research Funds
(As of December 2023)

Year	Number of Projects	Research Fund (in thousand yen)
2018	72	1,712,631
2019	54	1,620,301
2020	49	1,628,405
2021	63	1,827,572
2022	63	3,494,624
2023	60	2,030,063
Total	361	12,313,596

Grant-in-Aid for Scientific Research 2023
(As of January 2024)

Subject for Research	Number of Adoption	Amount (in thousand of yen)
Grant-in-Aid for Scientific Research (A)	22	82,979
Grant-in-Aid for Scientific Research (B)	62	187,278
Grant-in-Aid for Scientific Research (C)	57	56,637
Grant-in-Aid for Scientific Research (S)	4	130,975
Grant-in-Aid for Early-Career Scientists	15	21,658
Grant-in-Aid for Challenging Research (Pioneering) / (Exploratory)	12	24,973
Grant-in-Aid for Research Activity start-up	4	6,602
Fund for the Promotion of Joint International Research (Fostering Joint International Research (A)・(B))	3	10,336
Grant-in-Aid for Transformative Research Areas(A)	2	19,110
Total	181	540,548
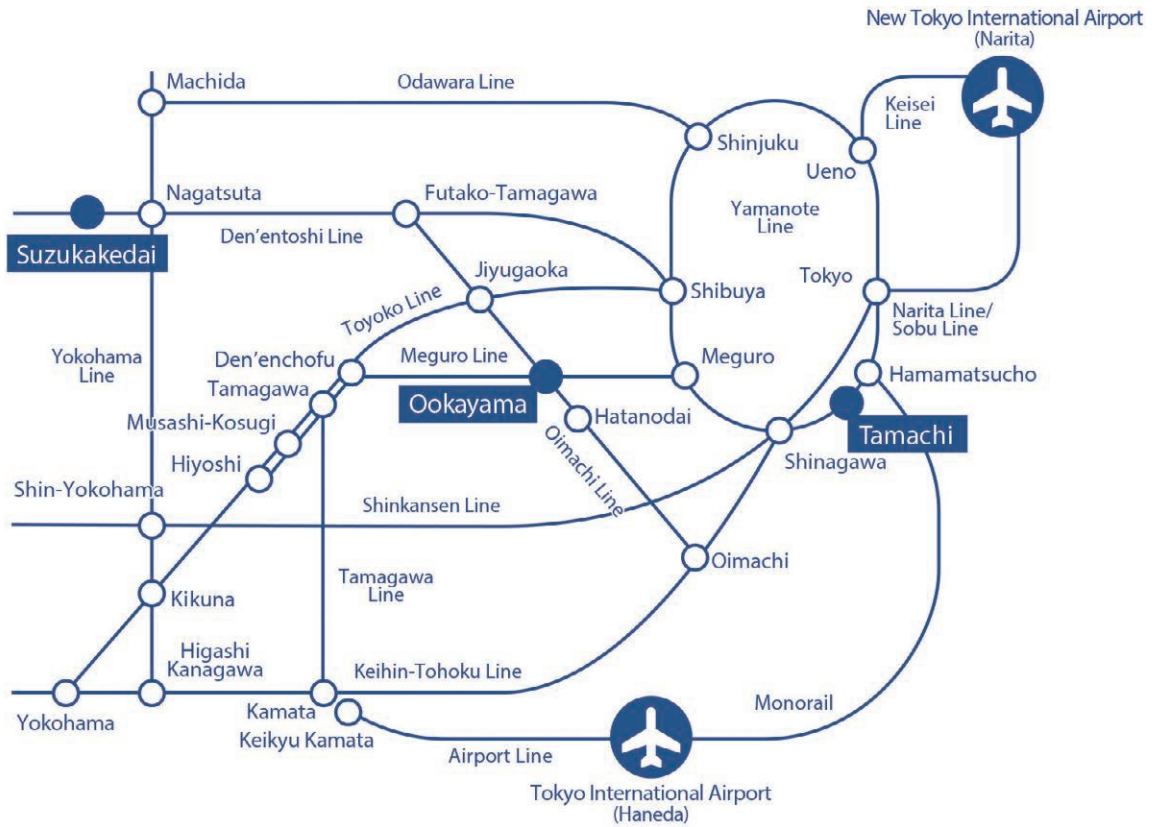
Ookayama Campus is   a 1-minute walk from Ookayama Station
Suzukakedai Campus is   a 5-minute walk from Suzukakedai Station
Tamachi Campus is   a 2-minute walk from Tamachi Station

Location

Ookayama Campus
2-12-1 Ookayama, Meguro-ku, Tokyo 152-8550, Japan

Suzukakedai Campus
4259 Nagatsuta-cho, Midori-ku, Yokohama, Kanagawa 226-8503, Japan