# School of Engineering

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 was founded in April 2016 as a result of organizational reform by Tokyo Institute of Technology. The School consists of five undergraduate departments teaching the core fields of engineering: Mechanical Engineering, Systems and Control Engineering, Electrical and Electronic Engineering, Information and Communications Engineering, and Industrial Engineering and Economics, and also offers various graduate programs following those undergraduate programs. Through innovative curricula, students learn a diverse range of topics, including monotsukuri – advanced manufacturing as applications of the fundamental engineering and science. They engage in cutting-edge research in their laboratories, and interact with excellent students and researchers around the world through exchanges and international conferences, which cultivates in them the abilities they need to be creative engineers, researchers, and educators capable of working globally.

On the research front, we are promoting the reorganization of the research fields and groups across all schools in Tokyo Institute of Technology to better respond to the changing needs of the time. We have also established several interdisciplinary research groups that can be researching the global issues to realize our goal of building a sustainable society, including the Integrated IoT Technology Group, the Human Centric Group, and the Smart Power Grid Group.

These research structures contribute to the original, fundamental research conducted by faculties in our school, and promote collaboration research between industry and academia, with a particular emphasis on international research collaborations with some of the world's top universities and corporations.

The education and research at the School of Engineering is building a new future for human being.

**Nobuyuki IWATSUKI**
Dean, School of Engineering Professor

### Steering Committee

**Mitsuji SAMPEI**, Associate Dean for Education and International Affairs
**Kotaro INOUE**, Associate Dean for Finance and Safety
**Yasuyuki MIYAMOTO**, Associate Dean for Planning and Public Relations
**Syuichiro HIRAI**, Associate Dean for Research and Evaluation

# Departments and Research Groups in School of Engineering

| Department | Graduate Major | Group | Field |
|---|---|---|---|
| Mechanical Engineering | Mechanical Engineering<br>Energy Science and Engineering*<br>Engineering Sciences and Design*<br>Human Centered Science and Biomedical Engineering*<br>Nuclear Engineering * | Thermo-fluid | Energy Engineering, Power and Propulsion Engineering, Environmental Thermo-fluid Engineering |
| | | Materials and Processing | Advanced Production Engineering, Advanced Functional Materials, Structural Safety and Security Technology |
| | | Mechanical System | Dynamics, Robotics, Advanced Machine Elements |
| | | Frontier Technology | Aerospace Systems , Biomedical Engineering, Human Centric Design |
| Systems and Control Engineering | Systems and Control Engineering<br>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<br>Energy Science and Engineering*<br>Human Centered Science and Biomedical Engineering*<br>Nuclear Engineering* | Circuit | Integrated Circuit |
| | | Photonics, Ultrasonics, and Communications | Wireless Communications, Photonics, Ultrasonics |
| | | Device | Compound Semiconductor Device, Quantum Functional, 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<br>Human Centered Science and Biomedical Engineering* | 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, Communication Networks |
| | | 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<br>Engineering Sciences and Design* | Corporate System Creation | Corporate Governance System , Management Strategy /Marketing |
| | | Advanced Management and Paradigm Creation | Industrial System, Human Centered System, Operations management |
| | | Analysis Method Creation | Operations Research, Mathematical Sciences and Informatics, Econometrics, Cyber Physical System |
| | | Economic Science | Macroeconomics/Cliometrics, Microeconomics/Game Theory, Humanomics, Global Environmental Research |

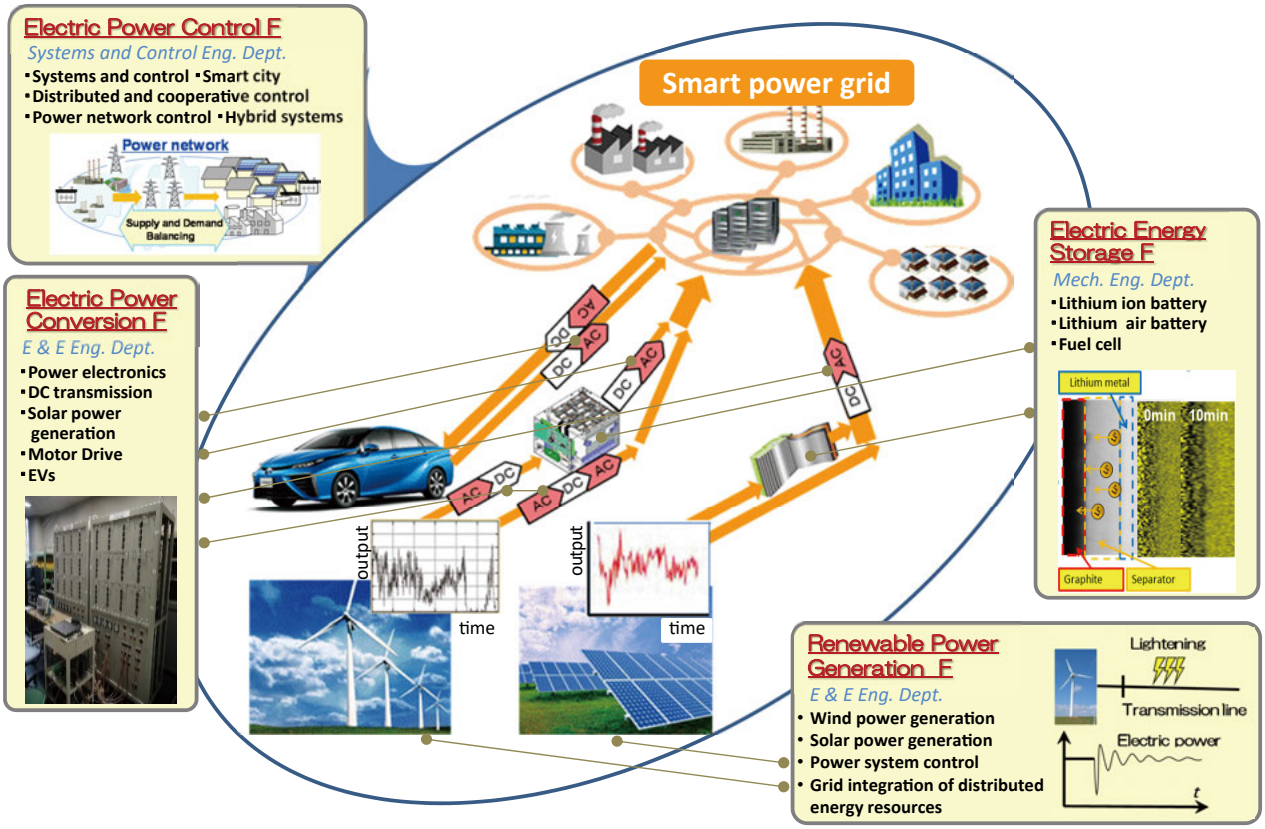
* interdisciplinary graduate majors that span multiple schools or departments

| | | |
|---|---|---|
| Interdisciplinary Research Groups | **Integrated IoT** | Wireless Communication |
| | | Integrated Circuit |
| | | Cyber Physical System |
| | | Integrated Robotics |
| | **Human Centric** | Humanomics |
| | | Human Centric Design |
| | | Sensory Information Processing |
| | | Cybernetics |
| | **Smart Power Grid** | Renewable Power Generation |
| | | Electric Power Conversion |
| | | Electric Power Control |
| | | Electric Energy Storage |

# 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 — Renewable Power Generation Field

**Toshiya Nanahara,** Professor
Power system engineering / Power engineering / Generation control / Wind power / Photovoltaic power / Energy storage / Time series analysis / Stochastic analysis

**Kenichi Kawabe,** Assistant 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

### 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,** 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 — 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.

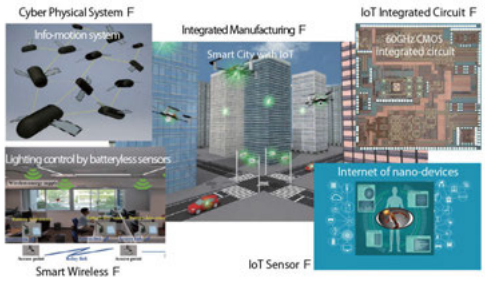
**Takashi Sasabe,** Associate Professor
Investigation into transport phenomena within electrochemical devices, like fuel cell and Li-ion battery by using nano/micro X-ray imaging and CFD modeling

**Manabu Kodama,** Assistant 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

## 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
### Cyber Physical System Field

**Masayuki Fujita,** Professor
Our Research lies in Cooperative Control and Distributed Learning in Human Robotic-Network Teaming with Visual Feedback.

**Takeshi Hatanaka,** Visiting Associate Professor
Distributed control/optimization/learning for Cyber-Physical Systems including buildings, data centers and microgrids

**Junya Yamauchi,** Assistant Professor
Cooperative control and shared autonomy in human-robotic network systems/visual feedback cooperative estimation and control/control based on machine learning

**Junichi Iijima,** Professor
Enterprise Engineering consisting of Enterprise Ontology, Enterprise Governance and Enterprise Architecture. Especially, DEMO for Enterprise Ontology and IT-CMF for Enterprise Governance of IT.

**Yoichiro Higuchi,** Professor
Econometrics, Spatial Econometrics, Development and Application of Spatial Interaction Data on Human Migration, Goods Distribution, Capital Circulation and Information Traffics

**Jaehyun Park,** Assistant Professor
My research highlights three genres – (1) ICT-enabled Innovations, (2) design thinking, and (3) smart cities & tourism in innovation, information systems, and design.

### Integrated IoT Group
### Integrated Manufacturing 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

**Tomohisa Tanaka,** Associate Professor
Development of new production technologies by using high-fre- quency 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
### IoT Sensor Field

**Mutsuko Hatano,** Professor
Quantum sensors and power devices using widegap semiconduc- tors, 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

### Integrated IoT Group
### IoT 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,** Assistant Professor
5G, IoT, Satellite Communication, Wireless Communication, Wireless Power Transfer, Machine Learning

### Integrated IoT Group
### Smart Wireless Field

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

**Takashi Tomura,** Assistant Professor
Research based on electromagnetic engineering: large-scale EM analysis, near-field communication system, satellite on-board & phased array antennas.

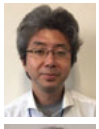
**Kazuhiko Fukawa,** Professor
Transmission and network techniques for wireless communications by developing digital signal processing, adaptive filters, and statistical based algorithms.

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

**Kei Sakaguchi,** Professor
Wireless communication engineering
5G/IoT/Millimeter-wave/Wireless energy transmission
Connected car/Automated driving

**Tran Gia Khanh,** Associate Professor
Next generation wireless communication networks/Next generation sensor networks

**Teruya Fujii,** Specially Appointed Professor
Wireless transmission, cell design and radio propagation technologies for the 5th mobile communication system. The 3D cell layout and network cooperation control technology for the next mobile communi-cation system. HAPS Cellular system in the next mobile communication



**Hideki Omote,** Specially Appointed Associate Professor
Radio propagation in mobile communication systems

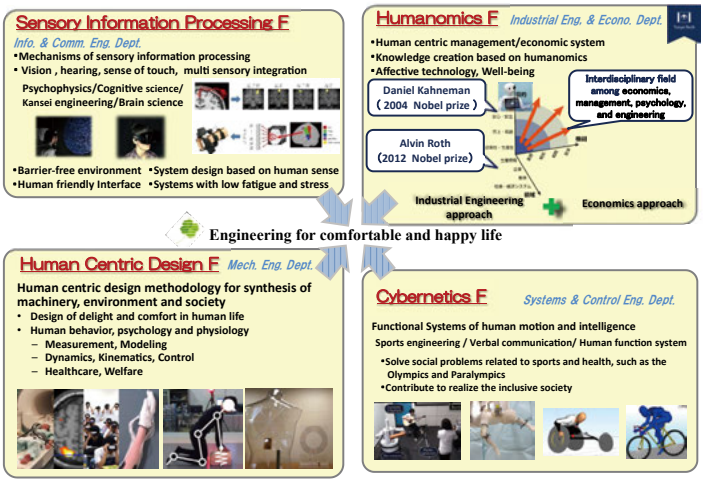
**Yukihiko Okumura,** Visiting Professor
Next generation mobile communication system/Radio access technologies/Radio Access Networks/Mobile Radio Applications

# 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.




## 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.

**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.

**Ken Masuya,** Assistant Professor
Study on the robots that coexist and cooperate with human beings in human environments.

**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.

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

**Yusuke Sugahara,** Associate Professor
Design and control of mechanical and robotic systems. Study on biped vehicle, stair-climbing wheelchair, working partner robot, aero-train, human-powered robotics.

**Daisuke Matsuura,** Assistant Professor
Development of devices for welfare and disaster response, precise noncontact 3D manipulation equipment utilizing magnetomotive levitation technology.

### Human Centric Group
### Sensory Information Processing Field

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

**Takehiro Nagai,** Assistant 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

**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,** Associate Professor (Biointerfaces Unit)
Brain activity information decoding (motor control, emotion, language, etc)/Brain-machine interfaces / Machine learning/EEG/fMRI

**Hiroyuki Kanbara,** Assistant Professor (Biointerfaces Unit)
Computational Neuroscience: We proposed computational model for neural motor learning of reaching movements.

### 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

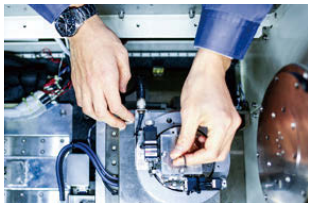
**Jacqueline Urakami,** Assistant Professor
Human Factors/culture and technology/cognitive ergonomics for interface design/technology for an aging society

### 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

**Kazuhiro Nakadai,** Specially Appointed 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.

# 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.

**Takayoshi Inoue**
Department Chief

## 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. From the perspective of societal collaboration, our department (as a member of the Industry-University Cooperation Office in the School of Engineering) serves as an intermediary and provides a forum to bring together faculty working on a wide variety of research projects, allowing us to contribute more to society through discoveries made in the field of mechanical engineering.

## 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.

Students of the 4th academic group go on to the Department of Mechanical Engineering. In addition to the undergraduate program, the department offers graduate programs in Mechanical Engineering, Energy Science and Engineering, Engineering Sciences and Design, Human Centered Science and Biomedical Engineering, and Nuclear Engineering.

## Research Groups and Fields of Research

### Thermo-fluid Group

Utilizing thermodynamics and fluid dynamics to blaze a trail in the fields of energy and environmental technology

Energy Engineering Field
Power and Propulsion Engineering Field
Environmental Thermo-fluid Engineering Field

### Mechanical System Group

Researching dynamic system theory and its application in everything from large-scale mechanical systems to robots and MEMS

Dynamics Field
Robotics Field
Advanced Machine Elements Field

### Materials and Processing Group

R & D into safe and secure technologies for mechanical structures, and advanced materials and processing technologies

Advanced Production Engineering Field
Advanced Functional Materials Field
Structural Safety and Security Technology Field

### Frontier Technology Group

Gathering new knowledge on the frontiers of mechanical engineering

Aerospace Systems Field
Biomedical Engineering Field
Human Centric Design Field

# Faculty

LANE: Laboratory for Advanced Nuclear Energy MSL: Laboratory for Materials and Structures
FIRST: Laboratory for Future Interdisciplinary Research of Science and Technology
GSIC: Global Scientific Information and Computing Center

## Thermo-fluid Group
## Energy Engineering Field

**Tetsuji Okamura,** Professor
The field is refrigeration and cooling engineering, e.g. a cryogenic thermo-syphon for superconducting magnet and a room-temperature magnetic refrigerator.

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

**Tomohiro Nozaki,** Professor
Our research group focus on clean energy technology via plasma-mediated catalysis for greenhouse gas (CH4, CO2) conversion and novel nanostructured materials for energy conversion devices.

**Seiji Okawa,** Associate Professor
Aiming for energy saving technology development, active control of freezing of supercooled liquid, cold insulator for transportation systems of refrigerated food, materials for equipment startup in cold area.

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

**Takao Nagasaki,** Associate Professor
Applications and fundamentals of thermo-fluid dynamics mainly focused on liquid-vapor phase change such as heat pipe, heat pump, cavitation and heat exchanger.

**Yoichi Murakami,** Associate Professor
Molecular energy engineering, thermal engineering, physical chemistry, molecular photophysics, engineering of triplet spins, development of energy conversion materials.

**Tetsuo Sawada,** Assistant Professor (LANE)
Study on safety of fast reactors, development of advanced nuclear energy systems, study on safety of fusion energy systems

**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.

**Hideharu Takahashi,** Assistatnt Professor (LANE)
Research themes are thermal hydraulics for safety and advancement of nuclear reactors, decommissioning, waste treatment and disposal, decontamination.

**Satoshi Momozono,** Assistant Professor
Fundamental researches of tribology and tribological applications for reduction of mechanical loss, wear and unexpected behavior caused by frictional characteristics.

**Hirotatsu Watanabe,** Assistant Professor
Chemical reaction and transport phenomena in energy conversion of carbon resources for low-carbon society.

## Thermo-fluid Group
## Power and Propulsion Engineering Field

**Takayoshi Inoue,** Professor
Heat transfer and its control under the extreme conditions, such as ultra low temp. to high temp., micro to macro, zero-gravitational to strong centrifugal field.

**Hidenori Kosaka,** Professor
High efficiency mobility systems, high efficiency, clean internal combustion engines, investigation of combustion via laser diagnostics, combustion control.

**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.

**Katsuyuki Kawamura,** Specially Appointed Professor
X-ray visualization of polymer electrolyte fuel cell

**Toshihiko Yoshida,** Specially Appointed Professor
Element research to vehicle application on polymer electrolyte fuel cell, element research of SOFC.

**Takashi Sasabe,** Associate Professor
Investigation into transport phenomena within electrochemical devices, like fuel cell and Li-ion battery by using nano/micro X-ray imaging and CFD modeling.

**Susumu Sato,** Associate Professor
Improvement of environment load in transportation system, high efficiency after-treatment system, alternative fuel engines

**Masayasu Shimura,** Associate Professor
Investigation of turbulent combustion using laser diagnostics such as LIF and PIV, and numerical simulations. Development of combustion control methods.

**Jun Hasegawa,** Associate Professor (LANE)
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.

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

**Suguru Uemura,** Specially Appointed Associate Professor
X-ray in-situ measurements of transport phenomena in porous media of fuel cell and lithium battery.

**Yu Ito,** Assistant Professor
Rocket and jet engines with a focus on compressible flows, cavitating flows, cryogenic flows, supercritical fluid flows, and heat transfer between these and solids.

**Manabu Kodama,** Assistant 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.

**Yuki Minamoto,** Assistant Professor
Investigation into fundamental physics of turbulent combustion using theoretical and computational approaches, and mathematical modelling for industry use.

**Hiroshi Naito,** Specially Appointed Assistant Professor
mass transport inside fuel cell/numerical simulation of heat and fluid flow/flow control

## Thermo-fluid Group

### Environmental Thermo-fluid 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.

**Isao Satoh,** Professor
Improvement of energy utilization in application fields such as production processes and air conditioning, and development of thermal storage and transport required for these applications.

**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.

**Katsunori Hanamura,** Professor
Near-field radiation transfer and its application to power generation, analysis of anode for high power density SOFC, and development of DPF for next generation.

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

**Takushi Saito,** Associate Professor
Research and development of the materials processing and physical properties control based on the heat transfer control and laser aided processing as well as the evaluation of thermal physical properties of composite materials.

**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.

**Masamichi Nakagawa,** Assistant Professor
(1) Boundary layer controls (+ separated flows and wakes), (2) Dynamic lift of wings, (3) Flow stability/instability, (4) Unsteady flows, (5) Multi-phase flows.

## Materials and Processing Group

### Advanced Production Engineering Field

**Hidenori Shinno,** Professor (FIRST)
Our research topics include ultra-precision machining, design methodology for machine tool, development of innovative mother machines, and machine tool engineering.

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

**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.

**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.

**Hayato Yoshioka,** Associate Professor (FIRST)
Research on Nano-machining and Nano-measurement technologies based on originally developed precision mechanical elements and controllers.

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

**Yuki Nakagawa,** Assistant Professor
Development of hot forming process of ultra-high strength steel and CFRP for reduction in weight of transportation, manufacturing of high performance parts having tailored property

## Materials and Processing Group

### Advanced Functional Materials Field

**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.

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

**Masao Kikuchi,** Specially Appointed Professor
Tribological technologies for hydraulic equipment of construction machinery, such as evaluation and characterization of sliding materials and lubricants.

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

**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.

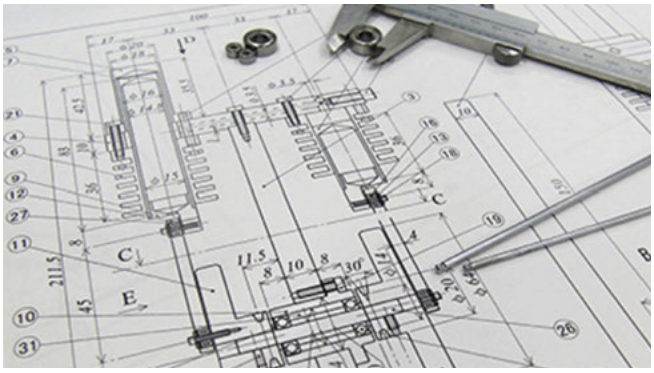
**Chiaki Sato,** Associate Professor (MSL)
Research on the mechanical aspects of carbon fiber reinforced composite material (CFRP) and adhesively bonded joints between CFRP and dissimilar materials frequently used for transportation such as automobiles and aircraft.

**Takatoki Yamamoto,** Associate Professor
Micro/nano technologies and its applications in medicine and healthcare.

**Shinji Tanaka,** Specially Appointed Associate Professor
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.

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

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



## Materials and Processing Group
### Structural Safety and Security Technology 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.

**Akira Todoroki,** Professor
Mechanics of materials and mechanics of composite materials; new fabrication process of composites and novel products of 3D printed composites.

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

**Masatoshi Kondo,** Associate professor (LANE)
Fusion reactor engineering, Fast reactor engineering, Liquid metal technology, Material compatibility

**Motoki Sakaguchi,** Associate Professor
Research in mechanics of materials, especially focusing on deformation and fracture of high temperature materials for jet engine application.

**Yoshihiro Mizutani,** Associate Professor
Main research topics are related to non-destructive testing (AE, UT, ET) and mechanical properties of materials for aerospace, construction machinery, and so on.

**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.

**Yoshiro Suzuki,** Assistant Professor
Multiscale numerical analysis, non-destructive inspection, and composite materials.

## Mechanical Systems Group
### Dynamics Field

**Masaaki Okuma,** Professor
Research of theoretical, experimental and hybrid CAE for analysis, design and utilization of machinery and structural dynamics.

**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.

**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).

**Ikuma Ikeda,** Assistant Professor
Active noise control with low sampling frequency, analysis and suppression of human tremor.

**Kensuke Hara,** Assistant Professor
Development of theory and numerical methods for multibody systems in multi-physics problems (e.g. Fluid-Structure Interaction, contact & friction).

## Mechanical Systems Group
### Robotics Field

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

**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.

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

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

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

## Mechanical Systems Group
### Advanced Machine Elements Field

**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.

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

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

**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.

**Shigeki Matsumura,** Associate Professor (FIRST)
Research on dynamics and energy saving of power transmitting system.

**Sang In Eom,** Assistant Professor (FIRST)
A study on microactuators using dielectric elastomer actuators.

**Takao Yasui,** Assistant Professor
A study on improvement of lesson content and the self-taught type e-learning system based on survey on comprehension degree of machine drawing standard.

## Frontier Technology Group
## Aerospace Systems Field

**Saburo Matunaga,** Professor
Concept creation, fundamental research, design, development, launch and operation of World first revolutionary space systems and robotic aerospacecraft.

**Hiroshi Furuya,** Associate Professor
Structural analysis and design of space structures, spacecraft systems, and deployable structures for space development.

**Hiraku Sakamoto,** Associate Professor
Thorough investigating dynamic structural analysis methods for lightweight and flexible structures, we aim at generating innovative space structure systems.

**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.

**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.

**Atsushi Noda,** Visiting Associate Professor
Planning & research for next space system, small satellite and space robot, and its technology roadmap development

**Satoru Ozawa,** Visiting Associate 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

## Frontier Technology Group
## Biomedical Engineering Field

**Toru Omata,** Professor
Grasping/manipulation with robot hands, surgical robots for manipulation in human body, and cell culture devices for cancer study, etc. using MEMS technology.

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

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

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

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

**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.

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

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

**Hitoshi Kimura,** Assistant Professor
Flexible robot system, biomechanics of sleep (Development of intelligent bedding system).

## Frontier Technology 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.

**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
Design and control of mechanical and robotic systems. Study on biped vehicle, stair-climbing wheelchair, working partner robot, aero-train, human-powered robotics.

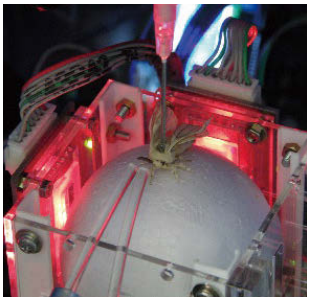
**Wataru Hijikata,** Associate Professor
Study on medical device and mechanical system based on mechatronics and biomedical engineering, development of implantable power generator, artificial heart, wireless power transfer, control of muscle contraction.

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

**Ken Masuya,** Assistant Professor
Study on the robots that coexist and cooperate with human beings in human environments.

**Daisuke Matsuura,** Assistant Professor
Development of devices for welfare and disaster response, precise noncontact 3D manipulation equipment utilizing magnetomotive levitation technology.

# Department of Systems and Control Engineering



**The mission of the Department of Systems and Control Engineering is to promote valuable innovations based on education and research in systems analysis, measurement, control theory, and system integration.**

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 interest includes not only artificial systems, e.g., robots, cars, planes, medical systems, and intelligent systems, but even life, society, and nature. The Department of Systems and Control Engineering prepares students to become creative and innovative individuals who can make beneficial contributions to our society.

Hiroyuki Hachiya
Department Chief

## Research

A wide variety of technologies and techniques are required to design a system. 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.

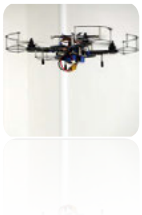
## Education

The Department of Systems and Control Engineering provides courses of control theory, instrumentation technology, system science, and engineering design for students to be specialists in systems and control engineering. Students at the department also study the necessary foundations of system analysis and development: mechanical engineering, electrical engineering, and information engineering. 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

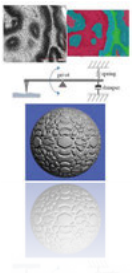
Researching cutting-edge systems theory targeting various systems, from next-generation robots to smart cities

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

# 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

**Tatsuya Ibuki,** Assistant Professor
Design of Cooperative Control Strategy for Mobile Robotic Networks, Development of Vision-based Estimation/Control Theory

## Control Theory Group
### Cyber Physical Systems Field

**Masayuki Fujita,** Professor
Distributed cooperative control of robotic networks/visual feedback estimation and control/energy management systems

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

**Takeshi Hatanaka,** Visiting Associate Professorr
Cyber-Physical & Human Systems, Cyber-Physical Campus Energy Management, Networked Mobility, Distributed Optimization/Learning/Games

**Junya Yamauchi,** Assistant Professor
Cooperative control and shared autonomy in human-robotic network systems/visual feedback cooperative estimation and control/control based on machine learning

## 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

**Hiroshi Deguchi,** Professor (Dept. Computer Science)
Agent Based Modeling & Simulation, IoT System as an Autonomous Distributed Cooperative System, Complex Systems with Decision Makers, Management Information System, Gaming Simulation, Social System, Data Analysis for Economic & Accounting System

**Tomohisa Hayakawa,** Associate Professor
Nonlinear control and dynamical systems theory, adaptive and learning systems, control applications to aerospace systems, mechanisms design for social systems

**Hideaki Ishii,** Associate Professor (Dept. Computer Science)
Large-scale networked control, Coordinated control of multi-agent systems, Distributed algorithms for PageRank computation, Cyber security for power systems

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

## 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

**Takashi Nakano,** Assistant Professor
Tribological Property of bacterial flagellar motor, Origin of solid friction, Mechanism of photocatalyst center by quantum chemical approach.

## Advanced Measurement Group
### Computer Vision and Image Processing Field

**Masatoshi Okutomi,** 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,** Visiting Associate Professor
Image Analysis, Multispectral Imaging, Multi-Modal Image Fusion, Image Processing Based on Generative Model, Optimization and Machine Learning.

**Akihiko Torii,** Assistant Professor
Computer Vision, 3D Reconstruction, Image-Based Localization, Structure from Motion, Image and Feature Matching.

## Advanced Measurement Group
### Applied Measurement Using Acoustic and Radio Waves Field

**Hiroyuki Hachiya,** Professor
Development of quantitative diagnosis method by ultrasound based on tissue structures and elastic property, and measurement methods in the ocean, air and ground.

**Shinji Ohyama,** Associate Professor
Measurement technology such as new localization system for sensor networks, CT system for visualization of temperature and wind speed distribution

**Shinnosuke Hirata,** Assistant Professor
An estimation method of physical properties of tissues or object' s position and motion by scattering or propagation properties of ultrasound

## System Analysis Group
### Nonlinear and Stochastic Dynamics 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

**Toru Aonishi,** Associate Professor (Dept. Computer Science)
Computational neuroscience, Mathematical theory of neural networks, Data-driven science

**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

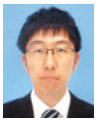
**Isao Ono,** Associate Professor (Dept. Computer Science)
Development of evolutionary computation algorithms for various optimization problems and reinforcement learning algorithms for various tasks

**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,** Assistant Professor
Thermal and fluid engineering／Energy conversion／Internal combustion engine ／ Exhaust after-treatment ／ Solid oxide fuel cell

## 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,** Associate 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,** Associate Professor (Dept. Computer Science)
Construction and understanding of self-assembled artificial cell-like systems and molecular robots based on DNA nanotechnology and microfluidic technology

**Yuya Hattori,** Assistant Professor
Analysis of radiation responses of cell population, Analysis of odor-source search behavior of C. elegans, Development of control method based on responses of micro-organisms population.

## System Integration Group
### AI-robotics Field

**Kazuhiro Nakadai,** Specially Appointed 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.

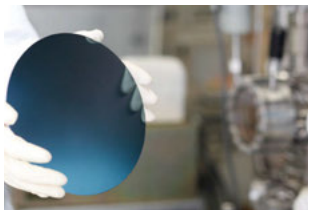
**Minoru Nakayama,** Professor (Dept. Information and Communications Engineering)
Human visual perception is analyzed using behavioral metrics such as EEG, eye movement, pupil responses and other responses

**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

**Kenji Nishida,** Specially Appointed Associate Professor
Statistical pattern recognition, Image processing, Computer vision, Machine learning, Facial expression detection for nursing and rehabilitaion

**Katsutoshi Itoyama,** Specially Appointed Associate Professor (Lecturer)
My research interests are focused on statistical audio signal processing and machine learning techniques for music information processing, audio-based scene analysis, and robotics.

# Department of Electrical and Electronic Engineering



**The Department of Electrical and Electronic Engineering provides an education and conducts research into the core fields of energy technology, electronics, ICT, and more – the foundations upon which modern society and its continuous diversification and advancement are built.**

Electrical and electronic engineering no longer concerns itself only with the study of electronic devices; it now serves as the foundation for all industries, including automobiles, robotics, and artificial intelligence. Students who learn electrical and electronic engineering as it is today are sought after not only by electronics manufacturers, but also by the automobile industry, societal infrastructure, and a wide variety of other fields. The Tokyo Institute of Technology has a long, proud tradition of successful research in the field, and the Department of Electrical and Electronic Engineering continues in that tradition, providing students with a solid academic foundation, a broad perspective, and creative thinking abilities they can harness to contribute to our society. We produce engineers and researchers of the highest level – individuals who can change the world.

Koichi Yasuoka
Department Chief

## 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.

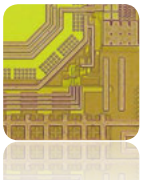
## Education

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 microprocessing 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

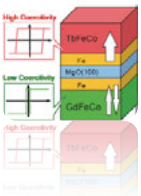
Studying the most sophisticated analog and digital circuit design technologies necessary for advanced electronic devices

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



### Electronic Materials Group

Developing cutting-edge devices and methods to control the physical properties of new functional materials

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

### Photonics, Ultrasonics, and Communications Group

Researching the hardware and software needed to build the next generation of communications networks

Photonics Field
Wireless communications Field
Ultrasonics Field

# Faculty

LANE: Laboratory for Advanced Nuclear Energy
FIRST: Laboratory for Future Interdisciplinary Research of Science and Technology

## 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

**Masaya Miyahara,** Assistant Professor
RF·Analog Digital Integrated Circuits/ Millimeter-wave Wireless Communication/ AD-DA Converter

**Hiroyuki Ito,** Associate Professor (FIRST)
Integrated Circuits, RF Circuits, Wireless Communication Circuits, Sensor Networks, Internet of Things, Cyber-Physical System

**Daisuke Yamane,** Assistant Professor (FIRST)
His research interests include integrated CMOS-MEMS technology, optical and RF MEMS technology, and highly-sensitive MEMS inertial sensor and its applications.

## 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,** Assistant Professor
Research based on electromagnetic engineering: large-scale EM analysis, near-field communication system, satellite on-board & phased array antennas.

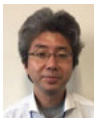
**Kei Sakaguchi,** Professor
Wireless communication engineering
5G / IoT / Millimeter-wave / Wireless energy transmission
Connected car/Automated driving

**Tran Gia Khanh,** Associate Professor
Next generation wireless communication networks/Next generation sensor networks

**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, cell design, radio propagation and network cooperation control technologies in mobile communication systems.



**Hideki Omote,** Specially Appointed Associate Professor
Radio propagation in mobile communication systems.

## Photonics, Ultrasonics, and Communications Group
### Photonics Field

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

**Tomohiro Amemiya,** Assistant Professor (FIRST)
Integrated optics, Metamaterials, Plasmonics, Semiconductor optical devices

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

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

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

**Takahiro Sakaguchi,** Assistant Professor (FIRST)
Opto-electronics / Distributed Bragg Reflector Vertical Cavity Surface Emitting Laser / Opto-photonic module / Semiconductor Devices

**Masanori Nakahama,** Assistant Professor (FIRST)
Opto-electronics / Semiconductor Wavelength Tunable Laser / High Power Laser / Tunable VCSEL employing Micro-Electro-Mechanical-System / High Power Semiconductor Laser with High Beam Quality for Laser Imaging.

**Hiroyuki Uenohara,** Professor (FIRST)
We have been pursuing the optical routing/node systems and related photonic functional devices using optical signal processing with high-speed, low power consumption.

**Tomoyuki Miyamoto,** Associate Professor (FIRST)
Optical wireless power transmission system / photonic module / high performance surface emitting laser / photonic device fabrication technologies

## 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

**Yosuke Mizuno,** Assistant Professor (FIRST)
Distributed sensing based on optics and ultrasonics, strain/temperature sensing using glass and plastic fibers, Brillouin scattering, nonlinear polymer optics

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

**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 / Power electronics IC / InP / GaN / 2-D semiconductor / Crystal growth / Ultrafine process

**Koichi Fukuda,** Visiting Professor
Semiconductor device modeling and simulation, especially device simulation, physical model and compact modeling for circuit simulation of tunnel FETs.

**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
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

**Kazuo Tsutsui,** Professor (FIRST)
Semiconductor devices / process technology / GaN and Si power devices / atomic level analyses of doped impurities

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

## Device Group
## Quantum Functional Device Field

**Yukio Kawano,** Associate Professor (FIRST)
Terahertz image sensors and their application to industrial and medical inspection, Terahertz and infrared plasmonic probes, Near-field terahertz and infrared spectroscopic imaging and material analysis

**Takamasa Kawanago,** Assistant Professor (FIRST)
Self-assembled molecule monolayer for gate dielectrics
Transfer printing for building functional devices
Organic/inorganic interfacial phenomena

**Koji Ishibashi,** Visiting Professor (RIKEN)
We fabricate nanoscale structures and study quantum effects. We try to manipulate the quantum states coherently towards quantum information technology.

## 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

**Masahiro Asada,** Professor (FIRST)
Semiconductor nano-devices/terahertz electronics, devices, and circuits/semiconductor terahertz sources/terahertz response of nanostructure/resonant tunneling devices

**Safumi Suzuki,** Associate Professor
Terahertz electronic devices, High electron mobility transistor, Terahertz applications (Wireless communication, Spectroscopy, etc.)

## 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.

**Dai Hisamoto,** Visiting Professor
Semiconductor Processes/Semiconductor Devices/Power Devices/Low Power Devices/ FinFET

**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
## Energy Electronics Field

**Akira Yamada,** Professor
Development of high-efficiency thin-film solar cells, Cu(In,Ga)$Se_2$ and $Cu_2ZnSn(SSe)_4$ absorber materials, Developing tandem solar cells using a perovskite top cell

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

**Kazuyoshi Nakada,** Assistant Professor
Solar cell, Semiconductor physics, Crystalline silicon solar cells, Cu(In,Ga)$Se_2$ solar cells, Cu(In,Ga)$Se_2$/perovskite tandem solar cells

## Electronic Materials Group
## Spintronics Field

**Shigeki Nakagawa,** Professor
Spintronics for perpendicular MRAM devices using Half-metallic films, Magnetic films with high magnetic anisotropy, Perpendicular magnetic recording technology

**Yota Takamura,** Assistant Professor
Spintronics (Half-metallic ferromagnets, Si-based devises, perpendicular magnetic anisotropy, Superconductors)

**Pham Nam Hai,** Associate 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 metamaterials and the related for novel optical devices.

**Mana Toma,** Assistant 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.

**Takayuki Okamoto,** Specially Appointed Professor
Nanophotonics / Plasmonics / Optical devices / Organic light emitting diode / Organic thin-film solar cell / Broadband light absorber / Radiative cooling

## Electronic Materials Group
### Organic Electronics Field

**Takaaki Manaka,** Professor
Organic electronics / Organic devices / Evaluation techniques for organic semiconductor / Organic dielectric materials / Nonlinear Optics / Liquid Crystals

**Dai Taguchi,** Assistant 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

**Takashi Kato,** Specially Appointed Professor
Opto-electronic devices / Organic electronics / Photo functional materials / Organic semiconductor / Molecular alignment / Display materials / Printed electronics

## 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

**Toshiya Nanahara,** Professor
Power system engineering / Power engineering / Generation control / Wind power / Photovoltaic power / Energy storage / Time-series analysis / Stochastic analysis

**Kenichi Kawabe,** Assistant 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.

**Masaki Kuzumoto,** Visiting Professor
Power Electronics / Power Device / Device Model / Si-SiC / MOSFET

**Takeshi Horiguchi,** Visiting Associate Professor
Power Electronics / Power Module / Power Device / Si-IGBT / SiC-MOSFET / Power Device Model / Electro-Thermal Simulation

## 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.

**Hiroya Sugimoto,** Assistant Professor
Electric Machines / Mechatronics / Control Engineerings / Bearingless Motors / Magnetic Bearings / Rare-Earth Free Motors / Traction Motors for Evs

## Electric Power and Energy Group
### Plasma and Environment Field

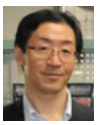
**Koichi Yasuoka,** Professor
High-voltage and Plasma Engineering, Arcless hybrid switch for AC/DC power distribution, Mineralization of persistent organic substances for water reclamation

**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

**Shungo Zen,** Assistant Professor
Atmospheric pressure plasma application / Plasma Engineering / High Voltage Engineering / Power Engineering / Energy Storage Material / Solar Cell / Hybrid DCCB

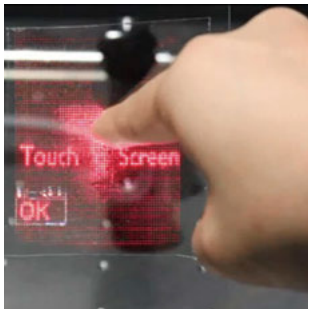
**Yoshiyuki Oguri,** Professor, (LANE)
Interaction between ion beams and hot plasmas related to inertial fusion / Accelerator-based trace-element analysis / Medical application of MeV ion beams

**Hiroshi Akatsuka,** Associate Professor (LANE)
Modeling of atomic-molecular processes in plasmas, spectroscopic measurement / Interaction with electromagnetic field / Astronautic or nuclear applications



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

# 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.

**Masahiro Yamaguchi**
Department Chief

## Research

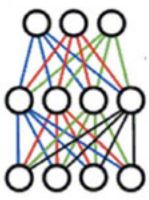
The aim of the Department of Information and Communications Engineering is to contribute to the academic fields that study both fundamental and applicable hardware and software technologies that will allow us to build a sustainable and user-friendly ICT- based society. In order to construct human-centric 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.

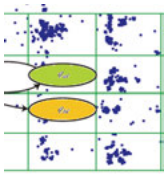
## Research Groups and Fields of Research



### 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

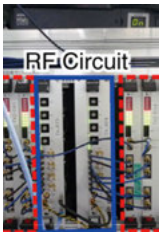
Sensory Information Processing Field
Intelligent Information Processing Field
Media Information Processing Field
Biological Information Processing Field



### Signal Processing Group

Researching fundamental mathematical technologies and effective algorithms for processing various types of signals

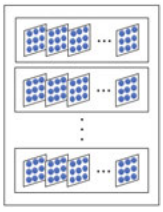
Media Signal Processing Field
Inverse Problems Field




### 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

FIRST: Laboratory for Future Interdisciplinary Research of Science and Technology
GSIC: Global Scientific Information and Computing Center
ASIST: Advanced Research Center for Social Information Science and Technology
WRHI: Tokyo Tech World Research Hub Initiative

## Human Information Systems Group
## Sensory Information Processing Field

**Makio Kashino,** Visiting Professor
Brain mechanisms of auditory perception, sensory characteristics in autism, decoding of mental states from biological signals, sports brain science

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

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

**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,** Associate Professor (Biointerfaces Unit)
Brain activity information decoding (motor control, emotion, language, etc) / Brain-machine interfaces / Machine learning / EEG / fMRI

**Hiroyuki Kambara,** Assistant Professor (Biointerfaces Unit)
Computational Neuroscience: We proposed computational model for neural motor learning of reaching movements.

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

**Petter Holme,** Specially Appointed Professor (Biointerfaces Unit)
Network theory, computational social science

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

## Human Information Systems Group
## Intelligent Information Processing Field

**Itsuo Kumazawa,** Professor (FIRST)
Image Processing, Image Recognition, User Interface, Tactile Display, Optical Sensor, Virtual Reality, Artificial Neural Network

**Shunsuke Ono,** Assistant Professor (FIRST)
Image Processing (restoration, regularization), Signal Processing (recovery, sparsity), Optimization (convex optimization, proximal splitting)

**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

**Nobuhiko SUGINO,** Associate Professor
Code Optimization Methods for GPGPU, Automatic Parallelizing Compilers, Implementation Techniques of Digital Signal Processing

**Yoshihiro Watanabe,** Associate Professor
Augmented Reality using projection technology, high-speed digital archiving, and human-computer interaction based on advanced computer vision.

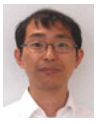
## Human Information Systems Group
## Media Information Processing Field

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

**Hiroya Takamura,** Professor (FIRST)
Computational Linguistics/Natural Language Processing/Machine Learning

**Hidetaka Kamigaito,** Assistant Professor (FIRST)
Natural Language Processing/Machine Translation/Syntactic Parsing/Automatic Summarization

**Takao Kobayashi,** Professor
Speech processing / Statistical parametric speech synthesis / Expressive speech synthesis / Spoken language interface / Signal processing / Machine learning



**Takahiro Shinozaki,** Associate Professor
Speech information processing putting the focus on automatic speech recognition and understanding, statistical pattern recognition, machine learning.

**Takamichi Nakamoto,** Professor (FIRST)
Human Olfactory Interface / Olfactory Display / Odor Sensing System / Sensory Information Processing / Embedded System / Biologically-inspired Sensing System

**Katsuhito Akahane,** Assistant Professor (FIRST)
Virtual reality / Human interface / Haptic display

**Shoichi Hasegawa,** Associate Professor (FIRST)
Virtual reality technologies, especially haptics and physics simulation and application to interactive embodied agents and entertainment

**Hironori Mitake,** Assistant Professor (FIRST)
Character Technology to Enrich Life : Conversational Agent with Social / Physical Presence, Touchable Virtual Creature, Motion Generation with Sensor / Motor Simulation etc.

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

**Tomoya Nakamura,** Assistant Professor
Computational optics, Optical design, Image processing, Coded imaging, Holography

## Human Information Systems Group
### Biological Information Processing Field

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

**Hiroyuki Suzuki,** Assistant Professor (FIRST)
Biometric authentication, Optical information processing, Medical history management systems, Medical information analysis

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

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

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

## 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.

**Izumi Ito,** Assistant Professor
Signal processing / Image processing / Transforms and spectral techniques

## Signal Processing Group
### Inverse Problems Field

**Isao Yamada,** Professor
Algorithms for Variety of Mathematical Problems in Signal Processing, Optimization, Inverse Problems and Data Science

**Masao Yamagishi,** Assistant Professor
Signal Processing / Optimization / Inverse Problems / Adaptive Filtering

## 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.

**Yuyuan CHANG,** Assistant Professor
Mobile communication, millimeter wave communication, multiple input multiple output (MIMO) systems, multi-user MIMO (MU-MIMO) systems, user scheduling, wireless sensor network

## 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

**Tetsunao Matsuta,** Assistant Professor
Multi-user information theory / Non-asymptotic analysis in information theory / Cache-aided communication / Non-asynchronous communication / Rumor source identification in networks

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

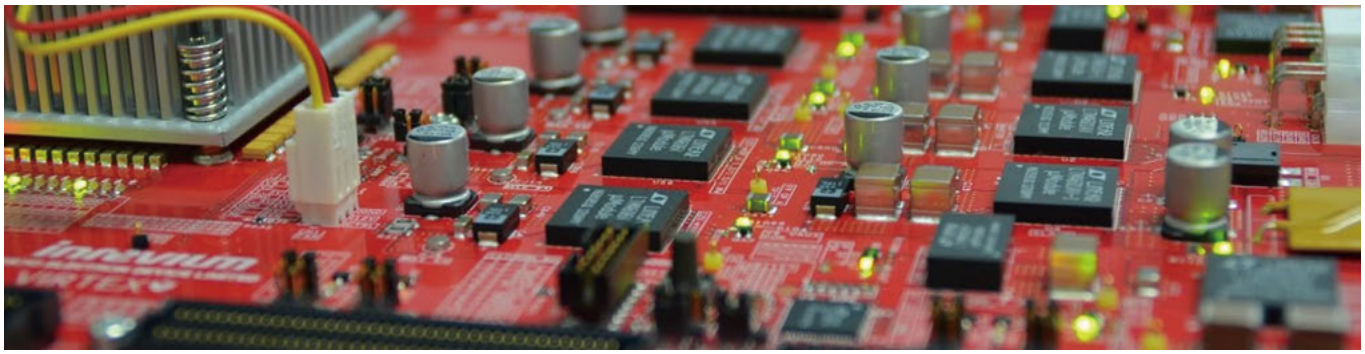
**Kenta Kasai,** Associate Professor
Coding Theory / LDPC Codes / Spatially-Coupled Codes / Graphical Models / Fountain Codes / Quantum Error Correcting Codes / Memory Channels

**Daniel Berrar,** Specially Appointed Associate Professor
Data science, machine learning, statistics, bioinformatics, systems biology

## Communication, Networks, and Security Group
### Communication Networks Field

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

**Yoshiaki Kitaguchi,** Associate Professor (GSIC)
Information and communication engineering / Next generation network operation and management / Network security / System dependability evaluation / Inter-cloud system



## 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

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

**Satoshi Tayu,** Assistant Professor
Graph algorithm / Combinatorial optimization

**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

**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

## Integrated Circuit and Computer Group
### Analog Integrated Circuits Field

**Shigetaka Takagi,** Professor
Our main research topics are analog integrated circuit designs for high linearity, high-speed operation, low supply voltage operation, reduction in power consumption, etc.

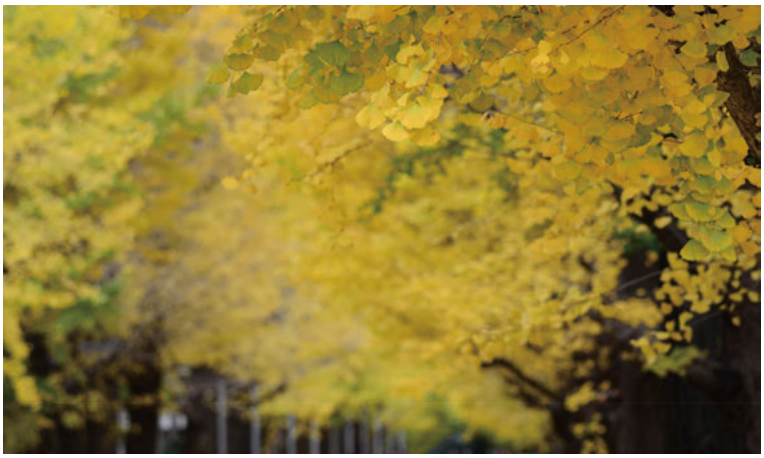
**Hiroki Sato,** Assistant Professor
CMOS Analog Integrated Circuit, Low-Voltage Circuit Technique, Signal Processing, IP Networking, Computer Security

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

**Masato Motomura,** Professor
Reconfigurable Hardware, Intelligent Computing, Deep Learning Processor, Annealing Machine

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

**Shimpei Sato,** Assistant Professor
Digital circuit design / Variable latency circuit / Computer architecture / Many-core processor / Network on Chip / Approximate computing



# 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.

Tomomi Matsui
Department Chief

## 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

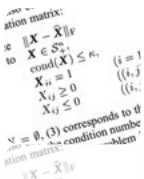
Developing optimization methods through engineering analysis focused on industrial processes including development, production, and sales, and on human behavior in those processes.

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.

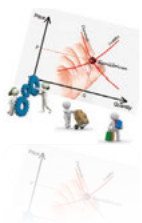
Corporate Governance System Field
Management Strategy / Marketing Field



### 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
Cyber Physical System 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

**Kenji Itoh,** Professor
Ergonomics / cognitive engineering / safety engineering / patient safety / Holistic Management System

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

## Advanced Management and Paradigm Creation Group
### Human Centered System Field

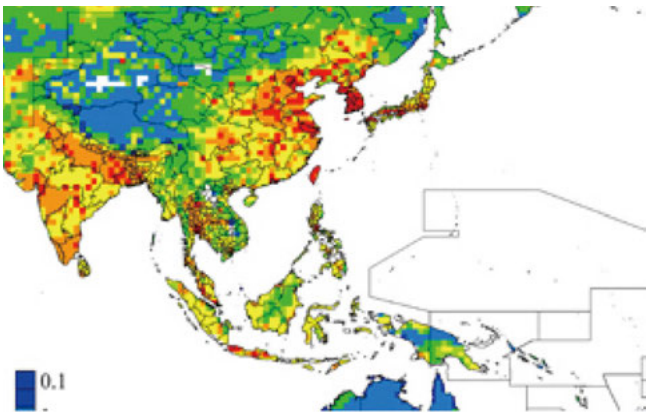
**Hiroyuki Umemuro,** Professor
Products or services that provide affective experiences / technology and aging / human-robot(agent)-interaction / management considering affective experiences of stakeholders

**Hirotaka Aoki,** Associate Professor
Cognitive ergonomics / cognitive task analysis applying eye tracking technique / usability and user experience evaluation / development of cognitive task analysis methods / industrial engineering

## Advanced Management and Paradigm Creation Group
### Operations Management Field

**Masami Miyakawa,** Professor
Applied statistics / Multivariate analysis / Statistical causal inference / Design of Experiment / Taguchi method

**Sadami Suzuki,** Associate Professor
Production management / operations management / logistics / supply chain management / customer satisfaction / customer value / service management




## Analysis Method Creation Group
### Operations Research Field

**Shinji Mizuno,** Professor
Modeling of problems in management science and engineering / approach by operations research / development and analysis of optimization algorithms / solution methods and evaluation

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

**Tomonari Kitahara,** Assistant Professor
Operations Research / Optimization algorithm / Simplex method / Mathematical Programming

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

**Yasushi Kawase,** Assistant Professor
Discrete optimization / Competitive analysis for online optimization / Algorithmic Game Theory / Robust optimization / Community detection in networks

## Analysis Method Creation Group
### Econometrics Field

selecting

## Analysis Method Creation Group
### Cyber Physical System Field

**Junichi Iijima,** Professor
Enterprise Engineering consisting of Enterprise Ontology, Enterprise Governance and Enterprise Architecture. Especially, DEMO for Enterprise Ontology and IT-CMF for Enterprise Governance of IT.

**Yoichiro Higuchi,** Professor
Econometrics, Spatial Econometrics, Development and Application of Spatial Interaction Data on Human Migration, Goods Distribution, Capital Circulation and Information Traffics

**Jaehyun Park,** Assistant Professor
My research highlights three genres – (1) ICT-enabled Innovations, (2) design thinking, and (3) smart cities & tourism in innovation, information systems, and design.

## Corporate System Creation Group
### Corporate Governance System Field

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

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

**Naoshi Ikeda,** Assistant Professor
Corporate finance / Investment policy / Financial policy / Payout policy / Initial public offering / Corporate governance / Capital market / Heterogeneous beliefs

## Corporate System Creation Group
### Management Strategy / Marketing Field

**Yoshitoshi Tanaka,** Professor
Intellectual property strategy / Integration of marketing and intellectual property rights / Patent portfolio with consumer needs / Basic patents and improvement patents / Patent information analysis

**Chung Sulin,** Associate Professor
Marketing / Distribution strategies / Retail internationalization (especially internationalization process and strategies of convenience store) / modernization of the distribution industry

## Economic Science Group
### Macroeconomics/Cliometrics Field

**Kyoko Yamamuro,** Professor
Economic History / Cliometrics / Quantitative History / Historical Data Analysis / Edo era

**Ryoji Ohdoi,** Associate Professor
Development of economic growth models based on agents' heterogeneity/analysis of international propagation of shocks /dynamic extension of trade models

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

**Daisuke Kurisu,** Assistant Professor
Mathematical statistics/Econometrics/Time series analysis/ Nonparametric statistics

## Economic Science Group
### Microeconomics / Game Theory Field

**Takehiko Yamato,** Professor
Economic mechanism design / Market and public goods provision 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

**Tomoya Kazumura,** Assistant Professor
Mechanism design/Game theory/Efficient auction design

## 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

**Jacqueline Urakami,** Assistant Professor
Human Factors / culture and technology / cognitive ergonomics for interface design / technology for an aging society

## Economic Science Group
### Global Environmental Research Field

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

**Yuko Kanamori,** Associate Professor
Developlment and analysis of environmental model of household sector / lifestyle / population and household structure analysis

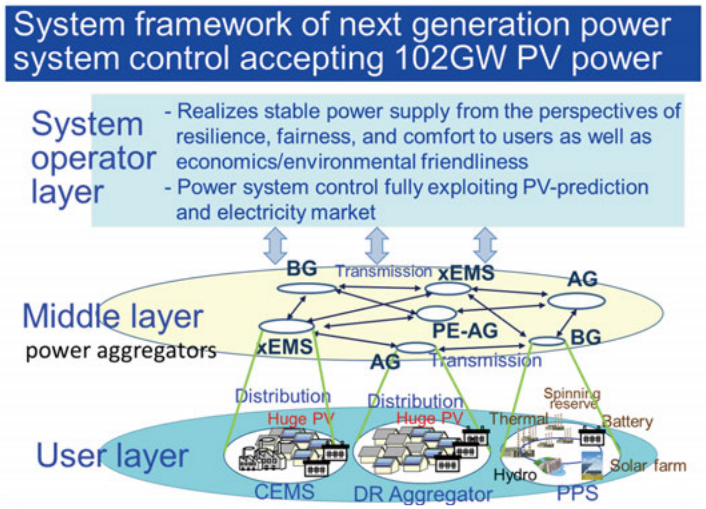
**Yosuke Munesue,** Assistant Professor
Impacts of food losses and waste on global food insecurity, natural resources, and greenhouse gas emissions / food loss reduction in the Sustainable Development Goals

# Typical Research Projects

## JAPAN SCIENCE AND TECHNOLOGY AGENCY (JST) CREST Program

PV Based Next Generation Smart Grid

### System Theory for Harmonized Power System Control Based on Photovoltaic Power Prediction




#### Research Overview

The main purpose of this research project is to develop a system theory of more advanced generation power system control in order to achieve a harmonized power supply under a large penetration of photovoltaic (PV) power systems. More specifically, this project aims to develop a power system control framework and methodology fully exploiting PV/demand power prediction as well as focusing on functions and properties of a middle layer consisting of various kinds of power aggregators in addition to a system operation layer and a user layer. This research can thus provide a fundamental framework of a future power control system that allows us to continuously introduce up to 102GW of PV, setting 64GW, which is the target proposed by the Japanese government, as a checkpoint, and that can be further developed towards a stable supply under introduction of more than 102GW.

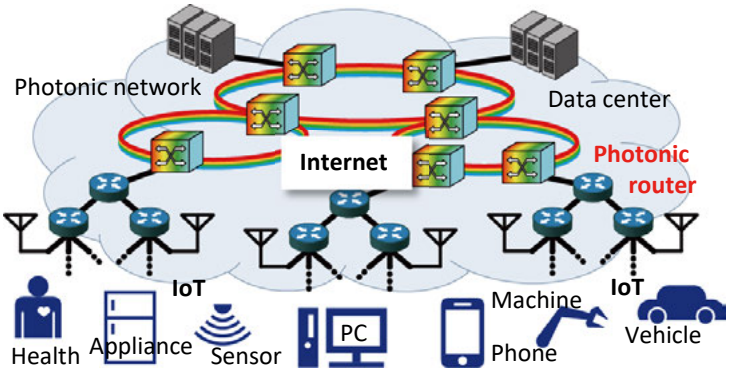
#### Members

**Jun-ichi Imura**, Prof. (Systems & Control Eng., p13)
**Takayuki Ishizaki**, Assis. Prof. (Systems & Control Eng., p13)

## JST-CREST

Advanced core technology for creation and practical utilization of innovative properties and functions based upon optics and photonics

### Development of zero standby power consumption photonic router by integrating heterogeneous materials of magnetic materials, metals and semiconductors




#### Research Overview

The research project aims to develop a novel photonic router characterized by no standby power consumption. The router is realized by integrating heterogeneous materials such as magnetic materials, metals and semiconductors on a single silicon photonic circuit chip. It has the great advantage of accommodating an increase in traffic transmitting large-capacity contents together with small-sized contents generated by IoT (Internet of Things) while preventing an increase in power consumption. The router brings about a breakthrough in infrastructural technologies for communication networks.

#### Members

**Tetsuya Mizumoto**, Executive Vice President
**Nobuhiko Nishiyama**, Assoc. Prof. (Electrical & Electronic Eng., p16)
**Yuya Shoji**, Assoc. Prof. (Electrical & Electronic Eng. (FIRST, IIR), p16)
**Tomohiro Amemiya**, Assis. Prof. (Electrical & Electronic Eng. (FIRST, IIR), p16)
**Kazuhiro Ikeda**, Dr. (National Institute of Advanced Industrial Science and Technology)【Collaborator】

## Grant-in-Aid for Scientific Research on Innovative Area

Science of Soft Robots

Soft robots with flexible bodies, motions, and intelligences

Research examples; from left, flight with soft wings, functional robot skin, soft artificial muscle

### Research Overview

Conventional robotics has been aiming for power, precision, and certainty. As a result, it achieved the excellent results in the industry, but it is not yet easy to realize some flexible and adaptable motions that living creatures can easily accomplish.

In this project, researchers conducting novel researches concerning "softness" gather from mechanical/electrical engineering, material science, computer science, medicine and biology. Through this interdisciplinary study, we are aiming to create a new discipline, "Science of Soft robots." Tokyo Tech conducts on researches, "flight and swimming with soft wings", "functional soft skin", and "soft artificial muscles" and promoting the project as a key member.

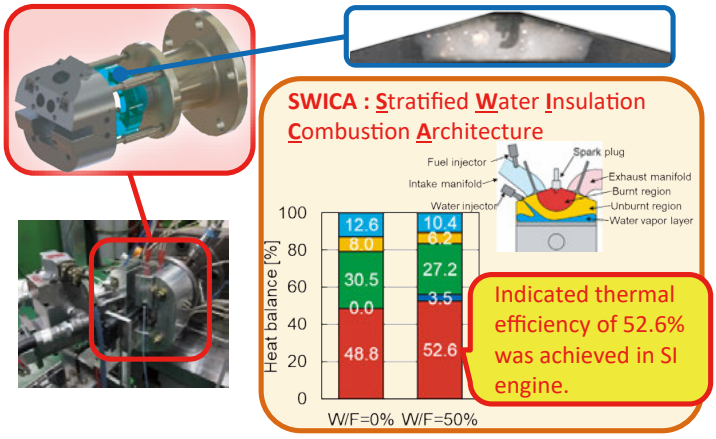
### Members

**Koichi Suzumori**, Prof. (Mech.Eng., p10)
**Hiroto Tanaka**, Assoc. Prof. (Mech.Eng., p10)
**Toshinori Fujie**, Assoc. Prof. (School of Life Science and Technology)
**Hiroyuki Nabae**, Assis. Prof. (Mech.Eng., p10)

## Cross-ministerial Strategic Innovation Promotion Program (SIP)

Innovative Combustion Technology

### Investigation of the interactions between heat transfer on the wall and knock in spark ignition engine



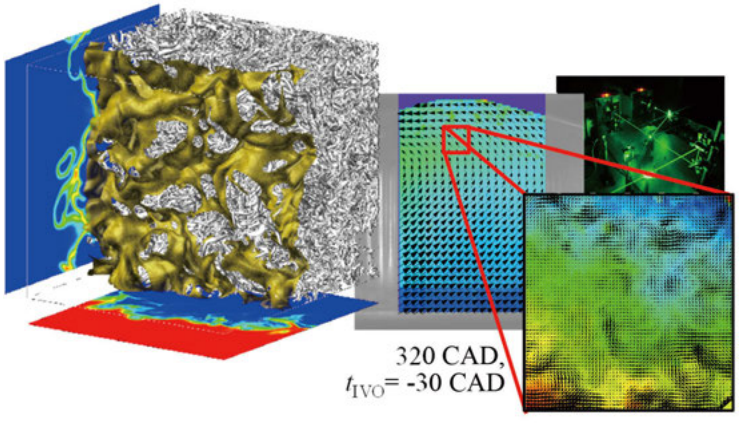

### Research Overview

Improvement of thermal efficiency of internal combustion engines (ICE) for automobiles is required strongly for the energy security and global environmental preservation in the future. Council for Science Technology and Innovation took "Innovative Combustion Technology" as a important research issue in SIP program in response to this requirement. We conduct the fundamental researches on the Improvement of thermal efficiency of ICE up to 50 % in SIP. Thermal efficiency of SI engine was improved up to 52.6 % by super lean combustion coupled with water direct injection technology (Stratified Water Insulation Combustion Architecture: SWICA).

### Members

**Hidenori Kosaka**, Prof. (Systems &Control Eng., p14)
**Susumu Sato**, Assoc. Prof. (Systems & Control Eng., p14)
**Tsuyoshi Nagasawa**, Assis. Prof. (Systems & Control Eng., p14)

### Clarification of Mechanism of Ignition, Flame Propagation and Wall Heat Transfer in Next Generation Gasoline Engine and Model Development




### Research Overview

Models of ignition, flame propagation and heat transfer used in computational fluid dynamics (CFD) for practical combustors have great influences on the accuracy of simulations, and are desired to be suitable for ultra-lean and high pressure conditions to be used in the next generation gasoline engines for more than 50% thermal efficiency. In this research project, highly accurate models have been being developed based on the combustion physics investigated by using massively paralleled direct numerical simulations (DNS) and combined laser diagnostics. The model is going to be integrated into HINOCA, which is the CFD software being developed in SIP and expected to be a platform for the industry.

### Members

**Mamoru Tanahashi**, Prof. (Mech. Eng., p8)
**Masayasu Shimura**, Assoc. Prof. (Mech. Eng., p8)
**Yuki Minamoto**, Assis. Prof. (Mech. Eng., p8)

## Cross-ministerial Strategic Innovation Promotion Program (SIP)

The Next-generation Power Electronics

### Research and Development of Power Electronic Systems Using the Next-Generation Power Semiconductor Modules

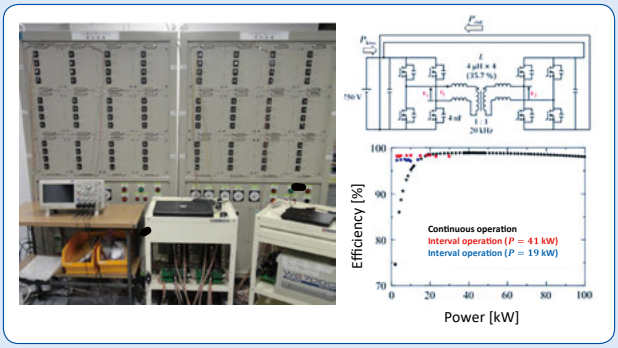
**High-power density and high-efficiency power converters**
**High-power and high-efficiency isolated dc-to-dc converters**
**The next-generation hybrid dc circuit breakers**
**SiC-based multilevel power converters for HVDC applications***
**Transformer-less converters for practical 6.6-kV distribution systems***

#### Research Overview

Power electronics is a key technology for further energy savings, being expected to make the competitiveness of the Japanese industry stronger in the world. The goal of this program is to expand and enhance the application of the next-generation power electronics technology based on power semiconductor modules using a new material of silicon carbide (SiC).

Nine universities and two manufacturers join this program to conduct 13 research themes. Tokyo Tech is responsible for five research themes. Two of them are collaborative research themes with the two manufacturers, as marked with "*" in the above list.

Tokyo Tech designed, constructed and tested a 750-Vdc, 100-kW isolated dc-to-dc converter using SiC-MOSFET modules. The converter recorded a power conversion efficiency as high as, or over, 98.3% in a wide range from 3% to 100%, which is the highest efficiency at present.

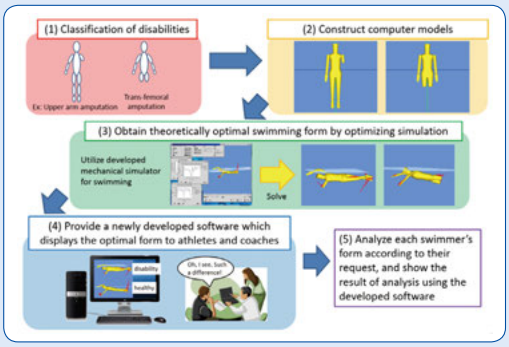



#### Members

**Hirofumi Akagi**, Spe.-Ap. Prof. (Electrical & Electronic Eng.)
**Hideaki Fujita**, Assoc. Prof. (Electrical & Electronic Eng., p.18)
**Makoto Hagiwara**, Assoc. Prof. (Electrical & Electronic Eng., p.18)
**Koichi Yasuoka**, Prof. (Electrical & Electronic Eng., p.18)
**Shungo Zen**, Assis. Professor (Electrical & Electronic Eng., p.18)
**Toshiya Nanahara**, Prof. (Electrical & Electronic Eng., p.18)
**Masaki Kuzumoto**, Visit. Prof. (Electrical & Electronic Eng., p.18)
**Tomoyuki Miyamoto**, Assoc. Prof. (Electrical & Electronic Eng., p.16, Inst. Innovative Res.)
**Shinsuke Miyajima**, Assoc, Prof, (Electrical & Electronic Eng., p.17)
**Kazuyoshi Nakada**, Assis. Prof. (Electrical & Electronic Eng., p.17)

## Japan Sports Agency High Performance Support Project

Research and Development Project (for Paralympics)




### Research and Development for Paralympic Top Athletes

#### Research Overview

This project aimed to support the sport events, in which medals in the Paralympics were expected, from advanced sports science and medicine as well as information technology. The researches and developments of equipment for competitions and training for top para-athletes were conducted for two years, by a special team which consisted of 20 or more researchers in 14 organizations. This team was lead by Prof. Motomu Nakashima. The targeted events were swimming, wheelchair tennis, athletics, wheelchair rugby and so on. The left figure shows an example of the project for swimming. The research was conducted in consideration of each para-swimmer.

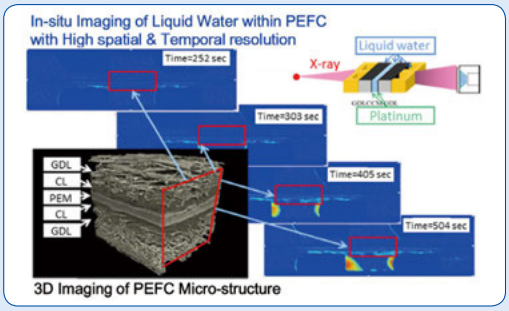
#### Members

**Motomu Nakashima**, Prof. (Systems & Control Eng., p14)
**Yusuke Miyazaki,** Assoc. Prof. (Systems & Control Eng., p14)
**Takeo Maruyama**, Assoc. Prof. (Inst. Liberal Arts)
**Yukio Takeda**, Prof. (Mech. Eng., p10)
**Daisuke Matsuura**, Assis. Porf. (Mech. Eng., p6, 11)
**Shoichi Hasegawa**, Assoc. Prof. (Inst. Innovative Res.)

## PEFC Research and Development Program (NEDO)

Liquid Water Visualization & Catalyst Layer Fabrication of PEFCs

### In-situ Visualization of Liquid Water within an Operating PEFC by using Wavelength-optimized X-ray Imaging Technique




Polymer Electrolyte Fuel Cells (PEFCs) are known as clean and high efficiency energy device. In PEFCs, water is generated by electrochemical reaction, and the water might impede transport of reactants to the catalyst site. Therefore, detailed understanding of the water transport phenomena within the PEFC is crucially important to reduce cost of the PEFC system.

In this project, laboratory-based in-situ X-ray imaging technique has been developed to visualize the micro-structure and the liquid water behavior within the PEFC. The figure clearly showed liquid water accumulation and discharge behavior within the PEFC, and the results has been used to understand the water behavior and design the high-performance component.

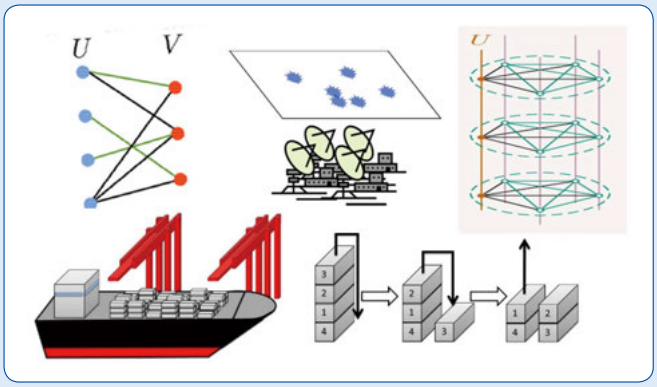
Research about catalyst layer fabrication process has been also promoted in the project. The obtained results has been used to realize better catalyst layer.

#### Members

**Shuichiro Hirai**, Prof. (Mech. Eng., p8)
**Hidetoshi Matsumoto**, Assoc. Prof. (Material Sci. & Eng.)
**Hiroshi Naito**, Spe.-Ap. Assis. Porf. (Mech. Eng., p8)
**Katsuyuki Kawamura**, Spe.-Ap. Prof. (Mech. Eng., p8)
**Takashi Sasabe**, Assoc. Prof. (Mech. Eng., p8)
**Masatoshi Tokita**, Assoc. Prof. (Material Sci. & Eng.)
**Kodama Manabu**, Assis. Porf. (Mech. Eng., p8)

## 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.

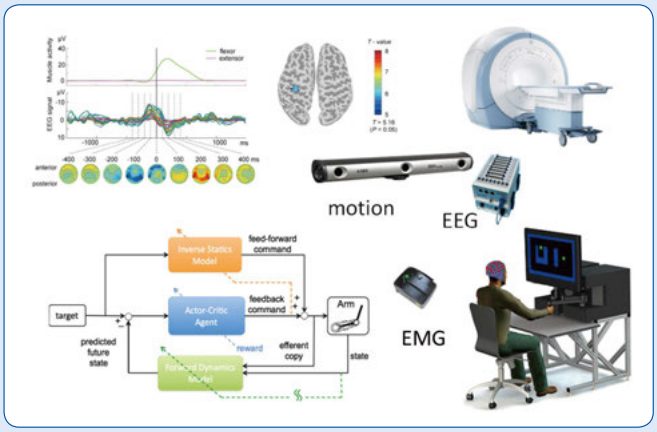
#### Members

**Tomomi Matsui**, Prof. (Industrial Eng. & Econo., p24)
**Akiyoshi Shioura**, Assoc. Prof. (Industrial Eng. & Econo., p24)
**Yasushi Kawase**, Assis. Prof. (Industrial Eng. & Econo., p24)
**Shinji Mizuno**, Prof. (Industrial Eng. & Econo., p24)
**Kazuhide Nakata**, Assoc. Prof. (Industrial Eng. & Econo., p24)

## Program for Advancing Strategic International Networks to Accelerate the Circulation of Talented Researchers (JSPS)

Human Interface

### Computational Neuroscience connecting behavior and brain activities




#### Research Overview

In this research, we aimed to elucidate "How does the brain represent the body motion and solve the control problem. The objective this research is to open up a new field of "Computational brain/body imaging method " which elucidate the brain' s theory of computation from EEG and body motion during motion task.

We are conducting research toward realization a society that ensures the quality of life and realizes a safe and secure life by using new rehabilitation techniques and developing prosthesis integrated with the body, even if the possibility of having some disability increases as the aging.

#### Members

**Yasuharu Koike**, Prof. (Info. & Communi. Eng., p20)
**Natsue Yoshimura**, Assoc. Prof. (Info. & Communi. Eng., p20)
**Hiroyuki Kambara**, Assis. Prof. (Info. & Communi. Eng., p20)

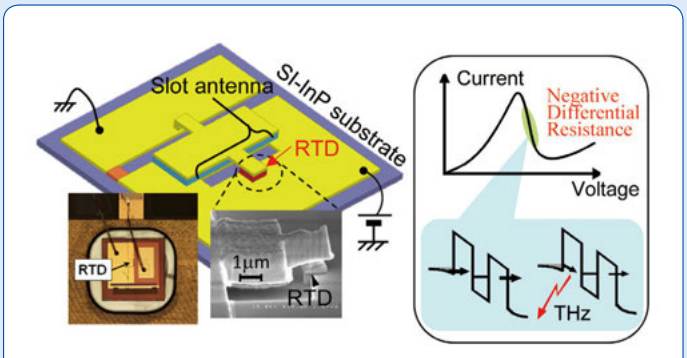
## Grant-in-Aid for Specially Promoted Research from Japan Society for the Promotion of Science

### Exploration of breakthrough in terahertz-device performance by understanding the radiation mechanism from view point of electron travelling and transition

#### Research Overview

The terahertz (THz) frequency range of approximately 0.1-10 THz remains unexplored, but various applications are expected, such as ultrahigh-speed wireless communications, imaging, and spectroscopy, etc. Compact semi-conductor sources with high power and room-temperature operation are essential for these applications. Up to now, we have succeeded a room-temperature oscillation of resonant tunneling diodes above 1 THz as the first-time achievement in electronic single devices. Because the THz range is located between light wave and millimeter wave, we have to establish comprehensive base of THz-device physics including the transport and transition of electrons in order to realize high-performance THz devices.

This project aims at establishment of THz-device physics and realization of high performance terahertz sources for various applications.




#### Members

**Masahiro Asada**, Prof. (Laboratory for Future Interdisciplinary Research of Sci. and Tech., Electrical & Electronic Eng., p17)
**Yasuyuki Miyamoto**, Prof. (Electrical & Electronic Eng., p17)
**Nobuhiko Nishiyama**, Assoc. Prof. (Electrical & Electronic Eng., p16)
**Safumi Suzuki**, Assoc. Prof. (Electrical & Electronic Eng., p17)

# Statistics

## Number of Staff

(As of May 1 2018)

| Course | Professor | Associate Professor | Associate Professor (Lecturer) | Assistant Professor | Total |
|---|---|---|---|---|---|
| Department of Mechanical Engineering | 24 | 29 | 0 | 20 | 73 |
| Department of Systems and Control Engineering | 10 | 8 | 0 | 10 | 28 |
| Department of Electrical and Electronic Engineering | 15 | 16 | 0 | 13 | 44 |
| Department of Information and Communications Engineering | 12 | 7 | 0 | 13 | 32 |
| Department of Industrial Engeneering and Economics | 13 | 10 | 0 | 10 | 33 |
| Total | 74 | 70 | 0 | 66 | 210 |

## Number of Students

(As of May 1 2018)

### Undergraduate Course

| Department | 2nd year | | | | 3rd year | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Men | | Women | | Men | | Women | | | |
| | | International Student | | International Student | | International Student | | International Student | | International Student |
| Department of Mechanical Engineering | 135 | 6 | 12 | 1 | 139 | 10 | 9 | 0 | 295 | 17 |
| Department of Systems and Control Engineering | 41 | 3 | 7 | 0 | 47 | 2 | 2 | 0 | 97 | 5 |
| Department of Electrical and Electronic Engineering | 70 | 1 | 6 | 1 | 86 | 4 | 2 | 0 | 164 | 6 |
| Department of Information and Communications Engineering | 46 | 2 | 6 | 0 | 49 | 4 | 4 | 0 | 105 | 6 |
| Department of Industrial Engeneering and Economics | 48 | 2 | 14 | 1 | 53 | 0 | 7 | 0 | 122 | 3 |
| Total | 340 | 14 | 45 | 3 | 374 | 20 | 24 | 0 | 783 | 37 |

(As of May 1 2018)

### Master's Course

| Department | 1st year | | | | 2nd year | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Men | | Women | | Men | | Women | | | |
| | | International Student | | International Student | | International Student | | International Student | | International Student |
| Department of Mechanical Engineering | | | | | | | | | | |
| Graduate Major in Mechanical Engineering | 144 | 22 | 16 | 7 | 139 | 16 | 4 | 0 | 303 | 45 |
| Graduate Major in Energy Science and Engineering | 15 | 3 | 1 | 1 | 17 | 1 | 2 | 1 | 35 | 6 |
| Graduate Major in Engineering Sciences and Design | 19 | 0 | 0 | 0 | 20 | 2 | 3 | 1 | 42 | 3 |
| Graduate Major in Human Centered Science and Biomedical Engineering | 17 | 7 | 1 | 0 | 11 | 2 | 1 | 0 | 30 | 9 |
| Graduate Major in Nuclear Engineering | 3 | 1 | 1 | 1 | 7 | 4 | 0 | 0 | 11 | 6 |
| Subtotal | 198 | 33 | 19 | 9 | 194 | 25 | 10 | 2 | 421 | 69 |
| Department of Systems and Control Engineering | | | | | | | | | | |
| Graduate Major in Mechanical Engineering | 60 | 7 | 4 | 2 | 66 | 11 | 1 | 0 | 131 | 20 |
| Graduate Major in Engineering Sciences and Design | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 1 |
| Subtotal | 61 | 8 | 4 | 2 | 67 | 11 | 1 | | 133 | 21 |
| Department of Electrical and Electronic Engineering | | | | | | | | | | |
| Graduate Major in Electrical and Electronic Engineering | 119 | 16 | 16 | 9 | 126 | 21 | 5 | 1 | 266 | 47 |
| Graduate Major in Energy Science and Engineering | 10 | 5 | 0 | 0 | 9 | 2 | 2 | 0 | 21 | 7 |
| Graduate Major in Engineering Sciences and Design | 10 | 1 | 2 | 0 | 7 | 0 | 1 | 0 | 20 | 1 |
| Graduate Major in Nuclear Engineering | 7 | 2 | 0 | 0 | 5 | 0 | 1 | 1 | 13 | 3 |
| Subtotal | 146 | 24 | 18 | 9 | 147 | 23 | 9 | 2 | 320 | 58 |
| Department of Information and Communications Engineering | | | | | | | | | | |
| Graduate Major in Information and Communications Engineering | 78 | 22 | 9 | 4 | 70 | 20 | 12 | 6 | 169 | 52 |
| Graduate Major in Human Centered Science and Biomedical Engineering | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 5 | 0 |
| Subtotal | 81 | 22 | 9 | 4 | 72 | 20 | 12 | 6 | 174 | 52 |
| Department of Industrial Engineering | | | | | | | | | | |
| Graduate Major in Industrial Engineering and Economics | 53 | 5 | 13 | 7 | 60 | 5 | 10 | 4 | 136 | 21 |
| Graduate Major in Engineering Sciences and Design | 5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 6 | 0 |
| Subtotal | 58 | 5 | 13 | 7 | 61 | 5 | 10 | 4 | 142 | 21 |
| Total | 544 | 92 | 63 | 31 | 541 | 84 | 42 | 14 | 1190 | 221 |

| Interdisciplinary Graduate Majors | 1st year | | | | 2nd year | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Men | | Women | | Men | | Women | | | |
| | | International Student | | International Student | | International Student | | International Student | | International Student |
| Graduate Major in Energy Science and Engineering | 70 | 14 | 8 | 1 | 72 | 4 | 16 | 3 | 166 | 22 |
| Graduate Major in Engineering Sciences and Design | 34 | 5 | 1 | 0 | 25 | 3 | 6 | 3 | 66 | 11 |
| Graduate Major in Human Centered Science and Biomedical Engineering | 64 | 13 | 16 | 5 | 47 | 5 | 13 | 1 | 140 | 24 |
| Graduate Major in Nuclear Engineering | 38 | 10 | 10 | 3 | 34 | 9 | 7 | 1 | 89 | 23 |
| Graduate Major in Artificial Intelligence | 65 | 17 | 13 | 7 | 62 | 14 | 6 | 3 | 146 | 41 |
| Graduate Major in Urban Design and Built Environment | 45 | 5 | 20 | 8 | 58 | 6 | 17 | 4 | 140 | 23 |

## Doctoral Course

(As of May 1 2018)

| Department | 1st year | | | | 2nd year | | | | 3rd year | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Men | | Women | | Men | | Women | | Men | | Women | | | |
| | | International Student | | International Student | | International Student | | International Student | | International Student | | International Student | | International Student |
| **Department of Mechanical Engineering** | | | | | | | | | | | | | | |
| Graduate Major in Mechanical Engineering | 25 | 13 | 0 | 0 | 16 | 7 | 2 | 0 | 14 | 3 | 1 | 1 | 58 | 24 |
| Graduate Major in Energy Science and Engineering | 2 | 1 | 0 | 0 | 3 | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 9 | 4 |
| Graduate Major in Engineering Sciences and Design | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 1 | 0 | 1 | 1 | 7 | 3 |
| Graduate Major in Human Centered Science and Biomedical Engineering | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 8 | 3 |
| Graduate Major in Nuclear Engineering | 2 | 2 | 1 | 1 | 2 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 7 | 5 |
| Subtotal | 32 | 16 | 2 | 2 | 24 | 13 | 6 | 1 | 21 | 5 | 4 | 2 | 89 | 39 |
| **Department of Systems and Control Engineering** | | | | | | | | | | | | | | |
| Graduate Major in Mechanical Engineering | 10 | 5 | 1 | 1 | 14 | 6 | 1 | 1 | 3 | 1 | 0 | 0 | 29 | 14 |
| Graduate Major in Engineering Sciences and Design | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subtotal | 10 | 5 | 1 | 1 | 14 | 6 | 1 | 1 | 3 | 1 | | | 29 | 14 |
| **Department of Electrical and Electronic Engineering** | | | | | | | | | | | | | | |
| Graduate Major in Electrical and Electronic Engineering | 24 | 12 | 1 | 1 | 14 | 11 | 2 | 2 | 12 | 1 | 1 | 1 | 54 | 28 |
| Graduate Major in Energy Science and Engineering | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 4 | 1 |
| Graduate Major in Engineering Sciences and Design | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| Graduate Major in Nuclear Engineering | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Subtotal | 26 | 13 | 1 | 1 | 14 | 11 | 3 | 3 | 14 | 1 | 1 | 1 | 59 | 30 |
| **Department of Information and Communications Engineering** | | | | | | | | | | | | | | |
| Graduate Major in Information and Communications Engineering | 19 | 9 | 4 | 3 | 16 | 4 | 5 | 5 | 5 | 0 | 1 | 0 | 50 | 21 |
| Graduate Major in Human Centered Science and Biomedical Engineering | 7 | 5 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 10 | 6 |
| Subtotal | 26 | 14 | 4 | 3 | 18 | 5 | 6 | 5 | 5 | 0 | 1 | 0 | 60 | 27 |
| **Department of Industrial Engineering** | | | | | | | | | | | | | | |
| Graduate Major in Industrial Engineering and Economics | 7 | 1 | 1 | 1 | 7 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 20 | 9 |
| Graduate Major in Engineering Sciences and Design | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Subtotal | 7 | 1 | 1 | 1 | 8 | 4 | 3 | 2 | 1 | 1 | 1 | 1 | 21 | 10 |
| Total | 101 | 49 | 9 | 8 | 78 | 39 | 19 | 12 | 44 | 8 | 7 | 4 | 258 | 120 |

| Interdisciplinary Graduate Majors | 1st year | | | | 2nd year | | | | 3rd year | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Men | | Women | | Men | | Women | | Men | | Women | | | |
| | | International Student | | International Student | | International Student | | International Student | | International Student | | International Student | | International Student |
| Graduate Major in Energy Science and Engineering | 14 | 5 | 2 | 1 | 16 | 8 | 3 | 2 | 15 | 1 | 3 | 0 | 53 | 17 |
| Graduate Major in Engineering Sciences and Design | 2 | 0 | 0 | 0 | 3 | 3 | 1 | 0 | 1 | 0 | 1 | 1 | 8 | 4 |
| Graduate Major in Human Centered Science and Biomedical Engineering | 15 | 8 | 3 | 2 | 12 | 3 | 5 | 2 | 5 | 2 | 3 | 1 | 43 | 18 |
| Graduate Major in Nuclear Engineering | 15 | 5 | 6 | 5 | 12 | 5 | 5 | 1 | 9 | 2 | 1 | 0 | 48 | 18 |
| Graduate Major in Artificial Intelligence | 12 | 6 | 4 | 2 | 17 | 6 | 2 | 1 | 10 | 1 | 3 | 0 | 48 | 16 |
| Graduate Major in Urban Design and Built Environment | 6 | 2 | 6 | 3 | 8 | 3 | 3 | 3 | 7 | 0 | 4 | 2 | 34 | 13 |

## Research Funds

| Year | Number of Projects | Research Fund (in thousand yen) |
|---|---|---|
| 2014 | 86 | 1,676,620 |
| 2015 | 31 | 1,510,299 |
| 2016 | 48 | 1,273,790 |
| 2017 | 51 | 910,291 |
| 2018 | 60 | 1,712,631 |
| Total | 276 | 7,083,631 |

(As of December 2018)

## Grant-in-Aid for Scientific Research 2018

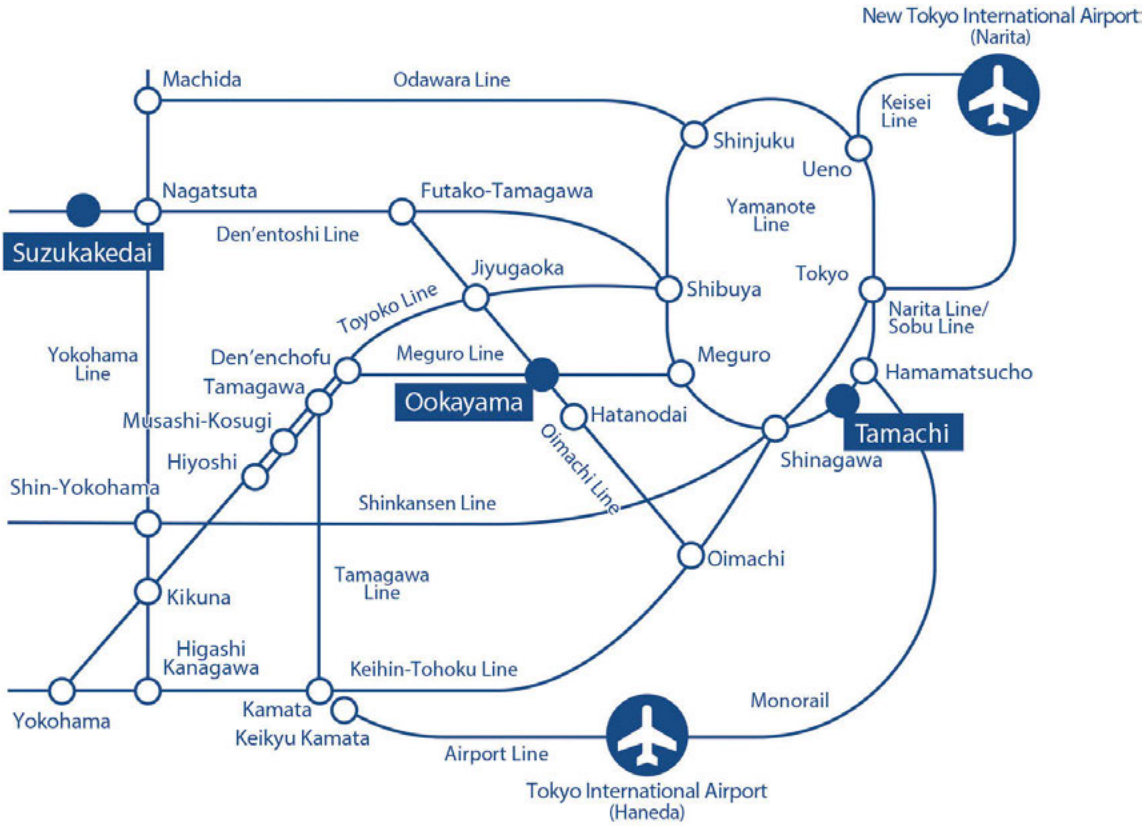
| Subject for Research | Number of Adoption | Amount (in thousand of yen) |
|---|---|---|
| Grant-in-Aid for Scientific Research (A) | 16 | 140,900 |
| Grant-in-Aid for Scientific Research (B) | 37 | 160,300 |
| Grant-in-Aid for Scientific Research (C) | 35 | 41,500 |
| Grant-in-Aid for Young Scientists (A) | 6 | 23,600 |
| Grant-in-Aid for Young Scientists (B)/ Grant-in-Aid for Early-Career Scientists | 26 | 28,300 |
| Grant-in-Aid for Scientific Research on Innovative Areas | 5 | 127,300 |
| Grant-in-Aid for challenging Exploratory Research/Grant-in-Aid for Challenging Research (Pioneering) or (Exploratory) | 15 | 43,800 |
| Grant-in-Aid for Research Activity start-up | 4 | 4,200 |
| Total | 144 | 569,900 |

(As of January 2019)


**For any inquiry regarding industry-university cooperation, contact us at:**

**Industry-University Cooperation Office in School of Engineering**
E-mail: icu-seng@e.titech.ac.jp

**Industrial Cooperation Contract Group 1, Industrial Cooperation Contract Group 2, Industrial Cooperation Division, Research Promotion Department**
URL: http://www.sangaku.titech.ac.jp E-mail: san.kyo@jim.titech.ac.jp




**Ookayama Campusls** a 1-minute walk from Ookayama Station
**Suzukakedai Campusls** a 5-minute walk from Suzukakedai Station
**Tamachi Campusls** 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