Department of Mechanical Systems Engineering
Department of Finemechanics
Department of Aerospace Engineering
Department of Quantum Science and Energy Engineering
Department of Robotics

Department of Mechanical Systems Engineering, Department of Finemechanics, Department of Aerospace Engineering, Department of Quantum Science and Energy Engineering, and Department of Robotics consist of following Core Laboratories, Cooperative Laboratories, and etc..

［The figure in parenthesis indicates the number of laboratories.］

Department of Mechanical Systems Engineering

① Core Laboratories
  Functional Systems Engineering （４）, Energy Systems Engineering （３）, Advanced Mechanical Systems Engineering （１）,

② Collaborative Chair (Graduate School of Biomedical Engineering)
  Biomechanical Engineering （１）

③ Cooperative Laboratories
 Fracture and Reliability Research Institute (FRRI) ［Division of Research:2]
  Strength and Reliability for Advanced Energy and Enviromental Materials (１), New Energy Systems Science (１)
 Institute of Fluid Science (IFS) [Division of Research:3, Research Center:1]
  Creative Flow Research Division (１), Complex Flow Research Division (２), Innovative Energy Research Center(２), Nanoscale Flow Research Division (１)
 Frontier Research Institute for Interdisciplinary Sciences (FRIS) ［Division of Research:1]
  Advanced Interdisciplinary Research Division(１)
 Institute of Multidisciplinary Research for Advanced Materials (IMRAM) [Research Center:1]
  Research center for sustainable science & engineering (１)

Department of Finemechanics

① Core Laboratories
  Materials Physics and Engineering (３), Nanomechanics(３), Biomechanics (２), Advanced Finemechanics （１）

② Cooperative Laboratories
 Fracture and Reliability Research Institute (FRRI) [Division of Research: 2]
  Division of Strength Reliability for Advanced Energy and Enviromental Materials(１), Division of Advanced Electric Power Technologies (１)
 Institute of Fluid Science (IFS) [Division of Research:2, Research Center:1]
  Nanoscale Flow Research Division (４), Innovative Energy Research Center(１), Creative Flow Research Division (２)
 Frontier Research Institute for Interdisciplinary Sciences (FRIS) ［Division of Research:1]
  Creative Interdisciplinary Research Division (１)
 Institute of Multidisciplinary Research for Advanced Materials (IMRAM) ［Research Center:1]
  Division of Measurements(１)

Department of Aerospace Engineering

① Core Laboratories
  Aeronautical Engineering(４), Astronautical Engineering (３), Advanced Aerospace Engineering(１)

② Cooperative Laboratories
 Institute of Fluid Science (IFS) [Division of Research:2]
  Creative Flow Research Division (２), Complex Flow Research Division (２)

③ Collaborative Laboratories [JAXA]
  Next Generation Space Transportation Systems （１）

Department of Quantum Science and Energy Engineering

① Core Laboratories
  Energy Physics Engineering (４), Safety Engineering of Nuclear Systems (４), Particle-Beam Engineering (５), Advanced Nuclear Engineering (１) , Others （１）

② Cooperative Laboratories

Institute for Materials Research (IMR)

Energy Materials Engineering (３), Quantum Theoretic Material Engineering (１)

Institute of Multidisciplinary Research for Advanced Materials (IMRAM)

Division of Process and System Engineering (１)

Cyclotron and Radioisotope Center (CYRIC)

Division of Radiation Protection & Safety Control(１)

Department of Robotics

① Core Laboratories

Robot Systems （４）, Nanosystems （３）, Advanced Robotics (１)

② Collaborative Chair (Graduate School of Biomedical Engineering)

Biomechanical Engineering （１）, Biomedical Engineering for Health and Welfare （１）

③ Cooperative Laboratories

New Industry Creation Hatchery Center (NICHe) (１)

Department of Mechanical Systems Engineering

Laboratory	Professor / Associate Professor	Theme of research
Functional Systems Engineering (Micro-Nanomechanical Architectonics)	Professor Takahito ONO Associate Professor Masaya TODA	Micro/nanomechanical systems are key technologies in the fields of information technology (IT), environmental engineering and biomedical engineering. Based on nanotechnology, nanomachining and advanced integration technology, our group is developing advanced precision mechanical systems consisted of nano/micro-mechanical elements and electrical elements. The examples of our research topics are following: 1. Biological 3D nano-imaging. 2. Ultimate sensing 3. Nano electromechanical systems
Functional Systems Engineering (Nano-Precision Mechanical Fabrication)	Professor Tsunemoto KURIYAGAWA （Department assigned：Graduate school of Biomedical Engineering） Associate Professor Masayoshi MIZUTANI	Our lab aims to promote innovations of nano-precision Micro/Meso Mechanical Manufacturing (M4 process) at the frontier of manufacturing technology, including ultra-precision mechanical manufacturing technologies for various shapes, nano-precision fabrication for 3D microstructures, atom/molecule manipulation for anostructures and so on. Our goal is not only to create high-precision shapes, but also to generate functional structures on the shape by controlling the micro textures. 1. Nano-precision Micro/Meso Mechanical Manufacturing (M4 process)(Kuriyagawa, Mizutani) 2. Creation of bio-medical interface utilizing various mechanical processes (Kuriyagawa, Mizutani) 3. Creation of functional interface by Powder Jet Deposition (Kuriyagawa,Mizutani)
Functional Systems Engineering (Tribology and Nanointerface Engineering)	Professor Koshi ADACHI Associate Professor Takanori TAKENO	The limit of performance and reliability of almost all machines are associated with friction and wear at the tribological contact interface. Therefore, we aim to understand and control them from nanoscale view points for creation of future highly-reliable and highly-functional mechanical systems. 1. Design and creation of highly-functional surface/ interface 2. Smart tribological systems by control of nanointerface 3. Friction drive systems for precision positioning
Energy Systems Engineering (Renewable Energy Conversion Engineering)	Professor Hiroo YUGAMI Associate Professor Fumitada IGUCHI	Our laboratories study two major research topics “high efficiency usage of thermal energy by thermal radiation control” and the other is “development of energy conversion devices for renewable energy resources base on solid state ionics and various mechanics” to solve global energy demand and global-scale environmental disruption to archive sustainable growth. 1. Study of thermal radiation control techniques 2. Development of solar thermal energy systems 3. Study to improve mechanical reliability and durability of Solid Oxide Fuel Cells.
Energy Systems Engineering (Fluid Mechanics)	Professor Yu FUKUNISHI Associate Professor: Seiichiro IZAWA	We are interested in a broad range of subjects related to fluid engineering. In addition to wind tunnel experiments, numerical and analytical approaches are also used trying to understand various fluid phenomena. We are also conducting flow control based on our accumulated knowledge using actuators such as a thin piezo-electric device. The main themes are as follows. 1. Turbulent and transition control (Fukunishi, Izawa) 2. Aeroacoustic noise control (Fukunishi) 3. Turbulent vortex motions (Izawa)

Laboratory	Professor / Associate Professor	Theme of research
Energy Systems Engineering (Control of Heat Transfer)	Professor Tetsushi BIWA	Our research forcuses on understanding of various thermoacoustic phenomena to design and build advanced energy conversion systems based on acoustic gas oscillations. 1. Understanding of thermal phenomena induced by oscillatory flow 2. Development of heat engines and heat transport devices using acoustic waves 3. Development of optical measurement techniques for oscillatory flow
<Collaborative Chair (Graduate School of Biomedical Engineering) > Biomechanical Engineering (Medical Nanosystem Engineering)	Professor Tetsu TANAKA （Department assigned：Graduate school of Biomedical Engineering） Associate Professor Takafumi FUKUSHIMA	Semiconductor neural engineering is a discipline that uses semiconductor process/device/circuit technologies to further understand properties of neural systems and to create novel fusion systems of living body and machine. One of the goals in this laboratory is to establish semiconductor neural engineering and develop biomedical micro/nano integrated systems. Another goal is to educate the next generation of leaders in biomedical engineering through research including: 1. Intelligent Si neural probe and brain-machine interface 2. Fully-implantable retinal prosthesis system 3. Bio/nano technology and novel Bio-FET sensor 4. 3-dimensional integration technology and analog/digital LSI design
<Cooperative Laboratories> Fracture and Reliability Research Institute [Division of Strength Reliability for Advanced Energy and Enviromental Materials, FRRI] (Laboratory for Surface Midification And Interfacial Control on Strength Reliability of Materials and Structures)	Professor Kazuhiro OGAWA	State-of-the-arts energy materials and components have been using at high temperatures, high pressure, or high-loading environments. Therefore, nano-level cracks or defects on surface or at the interface between crystal grains or materials can affect the lifetime of the materials and components. In this laboratory, the safety and reliability researches for energy materials and components based on surface modification and interface control have been studying. 1. Degradation mechanism analysis of energy materials and components 2. Development of thermal and environment barrier coatings for improvement of reliability for structural materials and components 3. Development of room-temperature bonding technique without heat affected zone 4. Study of high accuracy non-destructive evaluation for energy materials and components
<Cooperative Laboratories> Fracture and Reliability Research Institute [New Energy Systems Science, FRRI] (Laboratory for Earth Energy Systems Reserch)	Professor Toshiyuki HASHIDA Associate Professor Kazuhisa SATO	Establishment of environment-conscious energy systems is a prerequisite for the sustainable development of our society. Our research focuses on the development of next generation energy systems for subsurface energy extraction/cycling and energy conversion, and energy-substance systems based on nanomaterials. 1. Design and development of geothermal energy extraction systems based on complex mass/heat flow model 2. Supercritical CO_2/water/rock interactions for CO_2 geological storage and its reliability assessment 3. Mechanical reliability and durability of solid oxide fuel cells (SOFCs) and secondary battery systems such as lithium-ion batteries 4. Fabrication and functionalization of novel composites reinforced by carbon nanotubes for novel energy-substance systems

Laboratory	Professor / Associate Professor	Theme of research
<Cooperative Laboratories> Creative Flow Research Division, Institute of Fluid Science (Electromagnetic Functional Flow Dynamics, IFS)	Associate Professor Hidemasa TAKANA	Our group conducts researches on multiphase plasma flow and advanced electromagnetic fluids with focusing on the clarification of their complex thermofluid interactions in spatio-temporal multiscale, establishment and optimization of the intelligent fluid flow systems, as well as their advanced applicactions to environment, energy and material fields. 1. Characterization of particle, bubble and mist plasma flows for environmental treatment. 2. Development of electromagnetic energy conversion device for high utilization of wind energy. 3. Development of advanced micro thruster with ionic liquid. 4. Innovative cellulose fiber synthesis by electrostatic multiphase flow control.
<Cooperative Laboratories> Complex Flow Research Division, Institute of Fluid Science (Heat Transfer Control, IFS)	Professor Shigenao MARUYAMA Associate Professor Atsuki KOMIYA	Precise and active controls of heat and mass transfer under extreme conditions are important for future science and technology. This laboratory has been conducting research on the fundamentals and applications of heat and mass transfer controls using an advanced optical system under the conditions such as pressurized sea-floor, micro/nano scale and intra-vital environments. Energy transport phenomena and their control in complicated systems concerning the global warming are also investigated. 1. Low CO2 emission power generation system utilizing oceanic methane hydrate 2. Development of medical devices with highly precise heat transfer control technique 3. Evaluation of protein mass transfer and its active control 4. High heat flux cooling by phase change heat transfer in microscale
<Cooperative Laboratories> Complex Flow Research Division, Institute of Fluid Science (Advanced Fluid Machinery Systems, IFS)	Professor (Concurrent post) Shigenao MARUYAMA Associate Professor Yuka IGA	In our laboratory, we are studying complex phenomenon caused by high-speed gas-liquid mixture flow in an effort to acquire the high efficiency and reliability of next-generation fluidmachinery systems by using numerical and experimental analyses. 1. Clarification of mechanism of cavitation instabilities in liquid propellant rocked engine and development of the suppression techniequie. 2. Sophisfication of cavitation model for numerical simulation 3. Investigtion of cavitation thermodynamic effect by using high-temperature and high-pressure water tunnel
<Cooperative Laboratories> Innovative Energy Research Center, Institute of Fluid Science (Energy Dynamics, IFS)	Professor Kaoru MARUTA Associate Professor Hisashi NAKAMURA	For realizing combustion system with higher exergy efficiencies, various new concept combustion technologies are studied with domestic and international collaboration partners. 1. Analysis and construction of detailed combustion kinetics with a micro flow reactor with a controlled temperature profile for automobile engine and gas turbine combustor. 2. Fundamental and applied studies on microcombustion. 3. Microgravity combustion experiments for comprehensive combustion limit theory. 4. Research and development of high temperature oxygen combustion.

Laboratory	Professor / Associate Professor	Theme of research
<Cooperative Laboratories> Innovative Energy Research Center, Institute of Fluid Science (System Energy Maintenance, IFS)	Professor Toshiyuki TAKAGI Associate Professor Tetsuya UCHIMOTO	With sensing technique and material evaluation methods, we carry out studies of the optimization of maintenance of huge complex system as represented by energy plants and also the technology of saving energy. 1. Optimization of maintenance activities with inverse approaches and techniques for real-time sensing. 2. Development of functional coating techniques with diamond and diamond-like-carbon in terms of energy saving. 3. Development of nondestructive testing method and functional materials for structural health monitoring of carbon fiber reinforced composites.
<Cooperative Laboratories> Frontier Research Institute for Interdisciplinary Sciences (Advanced Interdisciplinary Research Division, FRIS)	Professor (Concurrent post) Toshiyuki TAKAGI (Department assigned：Institute of Fluid Science) Associate Professor Hiroyuki MIKI	For the design of the innovative machine which was superior in reliability and the durability, we try "the fusion of the function" in addition to the concept of the conventional "function and design of the shape". We promote a study on functional layer structure and functional composite material by interdisciplinary collaborative research. 1. Functional hard carbon film required for a design of conductivity and contact surface. 2. Magnetic shape memory alloy which has two electro-magnetic functionalities as sensing and actuating. 3. Technique which crystallizes powder dynamically by the simultaneous operation of compression and shearing force.
<Cooperative Laboratories> Nanoscale Flow Research Division, Institute of Fluid Science (Biological Nanoscale Reactive Flow，IFS)	Professor Takehiko SATO	We carry on creation and development of next-generation medical technologies such as plasma treatments and plasma sterilization by clarifying the interaction between the atmospheric-pressure plasma flow and the living organisms from the viewpoint of the biological reaction phenomena and the nanoscale flow phenomena. 1. Biological interaction mechanism by the atmospheric-pressure plasma flow 2. Reaction flow mechanism of the gas-liquid plasma 3. Discharge and the nanoscale flow phenomena of underwater plasma 4. Development of the method for sterilization and inactivation of pathogenic microorganisms by the plasma flow
<Cooperative Laboratories> Research Center for Sustainable Science & Engineering, Institute of Multidisciplinary Research for Advanced Materials (Solid State Ionic Devices, IMRAM)	Professor Koji AMEZAWA	Our laboratory contributes to solve environmental and energy problems throughout fundamental and application researches on environmental-friendly energy-conversion devices, such as solid oxide fuel cells and lithium ion secondary batteries. In particular, focusing on solid-state ion-conducting materials, we are challenging to establish an academic discipline on “solid-state ionics”, and applying this to develop novel materials and to improve performance/reliability of the energy conversion devices. We are also working for the development of advanced *in situ* analytical techniques for solid-state ionic devices.

Note: For more detailed information, please contact the director. (Professor Takahito ONO, TEL +81-22-795-5806)

Department of Finemechanics

Laboratory	Professor / Associate Professor	Theme of research
Materials Physics and Engineering (Intelligent Sensing of Materials)	Professor Hitoshi SOYAMA Associate Professor Yoshiteru AOYAGI	In order to realize sustainable society, researches on enhancement and evaluation of materials properties are conducting for light weighting of automobile and for extension and reliability of life time of power-and chemical-plants. 1. Research and development of mechanical surface treatments and evaluation of modified layer (Soyama) 2. Multiscale mechanics on properties of advanced materials (Aoyagi) 3. Production of novel materials by considering biomineralization (Soyama)
Materials Physics and Engineering (Intelligent Systems Engineering)	Professor Kazuo HOKKIRIGAWA Associate Professor Takeshi YAMAGUCHI	To realize the harmonized mature society of human and nature, it is necessary to establish intelligent systems engineering which enables development of green materials and their applications to advanced mechanical systems. Our group has been developing new plant-derived materials and their composites, and studying their applications to several mechanical systems. 1. Development and applications of hard porous carbon materials made from rice bran or rice husk 2. Development of friction/wear measurement systems 3. Gait analysis and development of evaluation system for slip resistance in shoe-floor interface
Nanomechanics (Optomechanics)	Professor Kazuhiro HANE Associate Professor Yoshiaki KANAMORI	Interaction between lightwave and micro/nano-scale mechanical structures and control of lightwave by micro/nano mechanical systems are studied. Applications are micro mirror display, tunable optical filter, optical switch, micro optical sensor etc. 1. Integrated optical systems with micro/nano actuators (optical switch, optical scanner, and micro interferometer) 2. Micro optical sensors for mechatronics (displacement and angular sensors) 3. Lightwave control by nano-scale mechanical structures (antireflection, waveglength selection, and polarization control) 3.
Nanomechanics (Precision Nanometrology)	Professor Wei GAO Associate Professor Yuki SHIMIZU	In Precision Nanometrology Laboratory, research activities are focused on nano-scale measurement and control of multi-degree-of-freedom surface forms and machine motions by combining unique precision nanometrology technologies with advanced machining technologies and control technologies in terms of nanometric metrology, control, fabrication and their applications. 1. Multi-dimensional ultra-precision optical sensors/actuators 2. Measurement and fabrication of multi-degree-of-freedom precision surface forms and machine motions 3. Measurement and control of micro/nanom-motions
Nanomechanics (Mechanics of Materials System)	Professor Masumi SAKA Associate Professor Hironori TOHMYOH	Based on interdisciplinary approach, we aim at comprehensively evaluating the strength and functionality of various advanced materials system, which varies from the plant in mega-scale to small materials in micro/nano scale. 1. Fabrication, Evaluation and Application of Metallic Nanomaterials (Saka,Tohmyoh) 2. Quantitative Nondestructive Evaluation by Potential Drop and Ultrasonic Techniques (Saka) 3. Highly Accurate Evaluation for Materials Using Acoustic Resonance and Electromagnetic Phenomenon (Tohmyoh)

Laboratory	Professor / Associate Professor	Theme of research
Biomechanics (Biodevice Engineering)	Professor Matsuhiko NISHIZAWA Associate Professor Hirokazu KAJI	Recent rapid progress in molecular cell biology generates a new field of biodevice engineering that utilizes functions of biomolecules and cells. We are developing enzymatic and cellular sensors and power devices with high sensitivity and efficiency by soft micromachining of biomaterials. Followings are our concrete research themes. 1. Enzymatic fuel cell devices 2. Medical and environmental sensors 3. Biolithography for controlling self-assembling of biomaterials 4. Molecular engineering of human / device interface 5. Hydrogel-based biohybrid machines
Biomechanics (Biological Flow Studies)	Professor Takuji ISHIKAWA	Biomechanics is a research field to understand biological, physiological and pathological phenomena in terms of physical principles. The methodology gives novel knowledge, which has not been accessible by conventional biological, medical and chemical tools. Our group focuses on biological flow related to microorganisms and a human body, and try to overcome environmental and health problems. 1. Prediction and control of microbial flora in the intestine 2. Physiological and pathological flow in the cardiovascular, respiratory and digestive systems 3. Large scale GPU computing of biological cells, such as micro algae and cancer cells 4. Transdermal absorption of medicine enhanced by mechanical stimulations
<Cooperative Laboratories> Fracture and Reliability Research Institute, [Division of Strength Reliability for Advanced Energy and Enviromental Materials, FRRI] (Laboratory for Prediction and Prevention of Fractures)	Professor Hideo MIURA Associate Professor Ken SUZUKI	New methods for predicting and preventing fractures of various devices, products, plants, and materials have been developed based on the explication of atomic-scale mechanism of characteristics and long-term reliability of materials. Main research topics are as follows. 1. Elucidation of the nature of advanced materials using quantum molecular dynamics 2. Development of highly sensitive sensors for detecting various external and internal loads in nano-scale 3. Evaluation of the damage of materials during the operation of various products by using electron microscope
<Cooperative Laboratories> Fracture and Reliability Research Institute, [Division of Advanced Electric Power Technologies, FRRI] (Joint Reserch with Tohoku Electric Power co., Inc.)	Professor (Concurrent post) Hideo MIURA Associate Professor Yoichi TAKEDA	With aiming to establish sustainable operation of the energy conversion systems, investigations related to improvement of efficiency in the turbine system and degradation mechanisms of structural materials in electric power generation plants are carried out. 1. Advanced technology for improving the efficiency of fossil fueled power generation 2. Advanced technology for distributed energy system using micro-gas turbine system 3. Improvement of efficiency and reliability of the turbine systems in fossil and nuclear power plants

Laboratory	Professor / Associate Professor	Theme of research
<Cooperative Laboratories> Nanoscale Flow Research Division, Institute of Fluid Science (Molecular Heat Transfer Laboratory, IFS)	Professor Taku OHARA	Molecular-scale thermophysical phenomena such as transport of thermal energy and mass, and interfacial phenomena among various phases play important roles in advanced technologies including biotechnology, design of thermal fluid and nanoscale fabrication process. Basic mechanism of the elementary process is being studied, which leads to the cutting-edge applications in mechanical engineering and thermal engineering. 1. Molecular-scale transport phenomena in liquids and solid-liquid/ liquid-gas interfaces 2. Analysis and control of molecular-scale transport phenomena of thermal energy and momentum aiming at the design of thermal fluids with required thermophysical properties 3. Study of advanced coating 4. Thermal and mass transport characteristics in molecular membranes such as cell membrane 5. Basic studies for biomimetic fluid machinery
<Cooperative Laboratories> Nanoscale Flow Research Division, Institute of Fluid Science (Molecular Composite Flow Laboratory, IFS)	Professor (Concurrent post) Taku OHARA Associate Professor Gota KIKUGAWA	From nanoscale to macroscale, various thermal and fluid phenomena, in which composite molecular-scale physics is integrated, are of critical importance in the wide range of engineering and industrial processes. In particular, an essential understanding of these phenomena is indispensable to improve the performance of next-generation semiconductor devices or to explore and develop novel polymeric substances. By using large-scale numerical simulations such as the molecular dynamics method, we investigate heat and mass transfer phenomena in the thermal and fluid engineering from the microscopic viewpoint. The underlying microscopic mechanisms governing macroscale thermofluid properties are examined as well. Moreover, industrial applications based on this knowledge are also explored. 1. Molecular-scale mechanisms governing macroscale thermofluid properties 2. Development of molecular dynamics analyses in the thermal and fluid engineering 3. Control of interfacial transport properties by surface modification techniques such as self-assembled monolayer (SAM) 4. Microscopic mechanism of interface affinity and wettability on the surface of organic molecular films 5. Multiscale analyses regarding design of transport properties for polymeric materials
<Cooperative Laboratories> Nanoscale Flow Research Division, Institute of Fluid Science (Non-Equilibrium Molecular Gas Flow Laboratory, IFS)	Professor (Concurrent post) Taku OHARA Associate Professor Shigeru YONEMURA	In rarefied gas flows around space vehicles, and in cold plasmas for semiconductor manufacturing or for an ion thruster, and in microscale gas flows in the neighborhood of MEMS/NEMS, the mean free path of gas molecules becomes as large as characteristic lengths of gas flows. Such gas flows are in strong nonequilibrium due to a lack of intermolecular collisions and cannot be treated as a continuum, but should be treated from the viewpoint of atoms, molecules, ions and electrons. Due to the developments of recent microfabrication technology, the industrial importance of such gas flows has increased year by year. We study physical phenomena in such flows and use the knowledge obtained here in industry. 1. Study on transport phenomena in nanoscale gas flows in porous media 2. Study on nanoscale gas lubrication by molecular gas dynamics approach 3. New numerical solution of the Boltzmann equation 4. Study on structure and behavior of cold plasmas

Laboratory	Professor / Associate Professor	Theme of research
<Cooperative Laboratories> Nanoscale Flow Research Division, Institute of Fluid Science (Quantum Nanoscale Flow Systems Laboratory, IFS)	Professor (Concurrent post) Seiji SAMUKAWA Associate Professor Takashi TOKUMASU	In the flow phenomena of fluid, it is often seen that the "chemical reaction" which occurs at the atomic/molecular scale affects much on the macroscopic "diffusion phenomena" of fluids. Moreover, very light atoms, such as hydrogen, cannot be regarded as a mass point and its effect sometimes appears at the phase diagram of this substance. When we analyze the mechanism by which the characteristics appears or behaviors of nanoscale flow systems which consists of such substances, it is necessary to analyze them by the method in which the "quantum effect" of the substances is considered because the conventional molecular dynamics method cannot treat such characteristics accurately. This laboratory treats the system in which the quantum effect of such fluid affects on the flow phenomena, and conducts research on clarification of its physical mechanism by various methods with considering the quantum effect and its application for engineering aspects. 1. Study for the transport phenomena of materials in polymer electrolyte fuel cell 2. Study for the effect of quantun characteristics of hydrogen atom/molecule on thermal properties of liquid hydrogen. 3. Modeling of proton transfer by quantum/molecular dynamics simulation.
<Cooperative Laboratories> Innovative Energy Research Center, Institute of Fluid Science (Green Nanotechnology, IFS)	Professor Seiji SAMUKAWA Associate Professor Tomohiro KUBOTA	Nano-process is getting more and more important to realize fabrication of ultrafine three-dimensional structures and novel functional films in the field of nanotechnology including semiconductor devices, MEMS/NEMS, optical devices, and biotechnology. We are studying on novel nanomaterials and nanofabrication processes by systematic investigation on physics and chemistry of interaction between particles such as atoms, molecules, electrons, ions, and photons and solid, liquid, and gas. 1. Novel devices fabricated by fusion of biotechnology and nanotechnology 2. Ultra-high-quality processes (etching, deposition) for leading-edge semiconductor devices 3. Precise plasma process system by fusion of plasma monitoring and computer simulation 4. Low environmental impact gas processes
<Cooperative Laboratories> Creative Flow Research Division, Institute of Fluid Science (Integrated Simulation Biomedical Engineering Laboratory, IFS)	Professor Toshiyuki HAYASE Associate Professor Atsushi SHIRAI	Understanding mechanisms of circulatory diseases is essential for establishment of prevention and treatment procedures of them. We are conducting research based on the integrated methodology of experimental measurement and numerical simulation aiming at precise elucidation of hemodynamics in vivo and development of a novel diagnostic methodology. 1. Understanding biofunctions by measurement-integrated simulations. (Hayase) 2. Development of novel medical instruments by measurement-integrated simulation. (Hayase) 3. Investigation of mechanical interaction between blood cells and blood vessels in microvasculature. (Shirai, Hayase) 4. Development of a theoretical model to elucidate mechanism of pulse diagnosis in traditional Chinese medicine. (Shirai)
<Cooperative Laboratories> Creative Flow Research Division, Institute of Fluid Science (Biomedical Flow Dynamics Laboratory , IFS)	Professor (Concurrent post) Toshiyuki HAYASE Associate Professor Makoto OHTA	We have a high motivation for leading researches for medical device with medical doctors. Our topics and topics are the followings. 1. Development of in-vitro model for supporting evaluation of new medical device and education. 2. Computational simulation for treatiment with medical devices 3. Optimization of medical devices 4. Analyses of cell responses with medical devices 5. Contribution to standardization for medical devices

<Cooperative Laboratories> Creative Interdisciplinary Research Division, Frontier Research Institute for Interdisciplinary Sciences (Creative Interdisciplinary Research Division, FRIS)	Professor (Concurrent post) Toshiyuki HAYASE (Department assigned：Institute of Fluid Science) Associate Professor Kenichi FUNAMOTO	Physiological and pathological mechanisms underlying diseases are investigated by interdisciplinary research, which combines engineering, medicine, informatics, and other disciplines. 1. Microfluidic device mimicking *in vivo* microenvironment 2. Cellular responses to hypoxic exposure 3. Hemodynamic analysis by integration of measurement and computation

Laboratory	Professor / Associate Professor	Theme of research
<Cooperative Laboratories> Division of Measurements, Institute of Multidisciplinary Research for Advanced Materials, (Surface Physics and Processing, IMRAM)	Professor Yuji TAKAKUWA Associate Professor Tadashi ABUKAWA	Solid surfaces are ideal templates, where exotic atoms are arranged or stacked artificially, to fabricate novel nano materials that exert unique functionality. In order to understand the surface processes, we study the fundamental properties of the solid surfaces and the reaction mechanism on the surfaces. We use a unique Photoemission-Assisted Plasma-Enhanced CVD method to grow thin films on the substrate. 1. Study of the formation mechanism of ultra-thin silicon dioxide 2. Synthesis of graphene, DLC and diamond films and understanding their growth processes. 3. Study of the surface and interface structures for nano devices. 4. Development of techniques for the direct visualization of surface and interface structures.

Note: For more detailed information, please contact the director. (Professor Hitoshi SOYAMA, TEL +81-22-795-6891)

Department of Aerospace Engineering

Laboratory	Professor / Associate Professor	Theme of research
Aeronautical Engineering (Computational Aerodynamics)	Professor Keisuke SAWADA Associate Professor Soshi KAWAI	We work in the fiedls of fluid mechanics, physical modeling, highly accurate, geometrically flexible and highly efficient CFD methods, high fidelity simulations, and their related topics in the aerospace engineering: ・Development of high-order-accurate unstructured mesh methods ・Study of transonic buffet and transonic flutter phenomena ・High-fidelity numerical simulation of high Reynolds number flows around an aircraft ・Numerical simulation of supercritical fluids in liquid rocket engine related problems ・Uncertainty quantification in CFD for predictive science ・Physical modeling for high temperature gas
Aeronautical Engineering (Smart Systems for Materials and Structures)	Professor Tomonaga OKABE Associate Professor Go YAMAMOTO	This research group is developing and implementing a variety of numerical failure modeling tools for the advanced composites as follows; 1. Numerical method for failure simulation of fiber-reinforced composites 2. Multi-objective design of composite aircraft structures 3. Virtual testing of composite aircraft structures 4. Multi-scale modeling of advanced composite structures 5. Atomistic simulation of advanced composite materials
Aeronautical Engineering (Experimental Aerodynamics)	Professor Keisuke ASAI Associate Professor Taku NONOMURA	In developing aircraft and spacecraft, it is indispensable to analyze and control the flow around the vehicle. In our laboratory, we study experimental techniques to simulate real flow conditions according to the similarity rule and to visualize the flow fields by optical means. Our current objective is “to create, measure, and control flows.” A particular emphasis has been placed on the development of various advanced wind-tunnel testing techniques and their applications to wind-tunnel tests in low-speed to hypersonic regimes. 1. Advanced measurement techniques (PSP/TSP, GLOF, etc) 2. Dynamic wind tunnel testing and nonlinear aerodynamic modelling 3. New-generation magnetic suspension and balance system (MSBS) 4. Aerodynamics for aerial locomotion in Martian atmosphere
Astronautical Engineering (Propulsion Engineering)	Professor Naofumi OHNISHI	New propulsion schemes by plasma, hypersonic flow dynamics, nonequilbrium gas dynamics, and numerical techniques for them are investigated by computer simulations for future aerospace engineering applications. 1. Feasibility study of beamed energy propulsion 2. Propulsion and flow control by unsteady plasma 3. Prediction of nonequilibrium radiation from hypersonic flow 4. Numerical simulations relevant to astrophysical flow
Astronautical Engineering (Space Exploration)	Professor Kazuya YOSHIDA Associate Professor Toshinori KUWAHARA	We are working on space robotics technology for application to various space exploration and space development missions. 1. Study on core technologies for space robotics and space flight systems, such as motion dynamics and control, sensing and navigation, teleoperation and autonomy 2. Dynamics and control of free-flying space robots for operation in orbital or micro-gravity environment 3. Research and development of exploration robots for the surface of Moon, planets and asteroids 4. Research and development of micro-satellites for scienctific observation, remote sensing and disaster monitoring missions

Laboratory	Professor / Associate Professor	Theme of research
Astronautical Engineering (Space Structures)	Associate Professor Kanjuro MAKIHARA	We are engaged in analytical and experimental research on structure, material, aeroelasticity and control for space structures and airplanes. 1. Integrated optimization of structure, aeroelasticity and control for aerospace vehicles 2. Shape and vibration controls for space smart structures 3. Energy harvesting for aerospace structures by using smart materials 4. Impact monitoring system based on piezoelectric sensors 5. Structural health monitoring for CFRP structures by using Lamb waves
<Cooperative Laboratories> Creative Flow Research Division, Institute of Fluid Science (Aerospace Fluid Engineering, IFS)	Professor Shigeru OBAYASHI Associate Professor Koji SHIMOYAMA	We are working on experimental fluid dynamics, computational fluid dynamics, and their integration for the innovation, safety, and creation of aerospace systems. 1. Multi-objective design exploration and knowledge discovery (OBAYASHI and SHIMOYAMA) 2. Ground experiments of sonic boom reduction techniques (OBAYASHI) 3. Measurement-integrated simulation of clear air turbulence and wake turbulence for aviation safety (OBAYASHI) 4. Next-generation computational fluid dynamics using the building-cube method (OBAYASHI) 5. Uncertainty quantification in computational fluid dynamics (SHIMOYAMA)
<Cooperative Laboratories> Complex Flow Research Division, Institute of Fluid Science (High Speed Reacting Flow, IFS)	Professor Hideaki KOBAYASHI	Combustion phenomena represented by gas turbine combustion of aircraft engines are highly complicated where turbulent flows interact with chemical reactions in extreme conditions. In this lab, researches on high-speed combustion phenomena and new combustion technologies with globally low environmental impact are performed using advanced laser diagnostics and numerical simulations. 1. Turbulent combustion in a high pressure and high temperature environment 2. High-pressure spray combustion in gas turbine combustor conditions 3. Supersonic combustion phenomenon and its control 4. Laser diagnostics for rocket engine combustion 5. Combustion technology of carbon-free and carbon neutral fuels
<Cooperative Laboratories> Complex Flow Research Division, Institute of Fluid Science (Complex Shock Wave, IFS)	Professor (Concurrent post) Shigeru OBAYASHI Associate Professor Mingyu SUN	We are interested in shock wave phenomena and teir interdisciplinary applications. Current research subjects include 1. The predication of far-field pressure induced by the atmospheric entry of a small asteroid 2. Fundental and applied study of shock waves and bubbles induced by underwater electric discharge 3. Toward the unification of interface tracking and capturing methods for gas-liquid two-phase phenomena
<Cooperative Laboratories> Creative Flow Research Division, Institute of Fluid Science (Spacecraft Thermal and Fluids Systems Laboratory, IFS)	Professor Hiroki NAGAI	We are working on study of thermal and fluids system for spacecraft, and development of their control technique. 1. Study on aerodynamic characteristics and heating when space vehicle enters into planet having atmosphere 2. Study on thermal control system and device for next-generation spacecraft 3. Study on airplane which flies in planet having atmosphere 4. Research and development of novel optical measurement technique for thermal and fluid dynamic phenomena

Laboratory	Professor / Associate Professor	Theme of research
<Collaborative Laboratories> Next Generation Space Transportation System, JAXA ※Note	Professor Sadatake TOMIOKA (Visiting member) Professor Hideyuki TANNO (Visiting member)	Collaborative laboratories with the Japan Aerospace Exploration Agency (JAXA). Research activities are at JAXA's Kakuda Space Center. Research on liquid rocket engine technologies, airbreathing engine technologies and hypersonic vehicles (includes entry and reentry vehicles) are underway in following fields; 1. Advanced rocket engine elements and aribreathing engine elements / systems (Tomioka Labo.) 2. Hypersonic vechicle elements and systems (Tanno Labo).

Note: For more detailed information, please contact the director. (Professor Keisuke SAWADA, TEL+81-22-795-6998)

※Note: This lab has receiving conditions for foreign students. So candidates should confirm that with the director of Aerospace Engineering before. (Professor Keisuke SAWADA, Tel +81-22-795-6998)

Department of Quantum Science and Energy Engineering

Laboratory	Professor / Associate Professor	Theme of research
Energy Physics Engineering (Advanced Fusion Reactor Engineering)	Professor Hidetoshi HASHIZUME Associate Professor Noritaka YUSA Associate Professor Satoshi ITO (Collaborative Chair: Fusion Reactor System Engineering) Professor (Visiting member) Nagato YANAGI	Nuclear fusion is an ultimate energy source that would solve most of enery-related problems the modern society faces and would realize a sustainable development. Our laboratory carries out researches indispensable for desining the fusion reactors such as 1. Development of re-mountable high temperature superconducting magnet system to produce strong magnetic fields necessary for plasma confinement, 2. Design of novel liquid-breeder blanket systems that convert high-energy neutrons into electricity, 3. Enhancement of non-destructive testing and evaluation methods for assuring the integrity of the components in the fusion reactors.
Energy Physics Engineering (Fusion Plasma Diagnostics and Advanced Plasma Confinement)	Professor (Concurrent post) Hidetoshi HASHIZUME Associate Professor Sumio KITAJIMA	To realize a nuclear fusion reactor, we focused on basic studies in divertor plasma physics, development of an advanced tool for researches on efficient confinement of alpha particles born in burning plasma and mechanism of transition to high confinement mode: 1. Interaction between recombining plasma and high energy particle flux (ELM-like burst) using the linear divertor plasma simulator DT-ALPHA, 2. Development of energetic ion production method to simulate alpha particle confinement in a small device, 3. Role of nonlinear ion viscosity in the transition to improved confinement mode.
Energy Physics Engineering (Neutron Device Engineering)	Professor Tomohiko IWASAKI	The research interest is the application of neutron reaction to energy production, nuclear transmutation and radiation application in various systems and devices such as fission reactor, fusion reactor and accelerator. The following are the main topics: 1. "Accelerator-driven system" -advanced safety reactor system 2. "Nuclear transmutation reactor system" for reduction of nuclear waste 3. "Space power supply device" for space exploration 4. "Neutron source device" for radiation application
Energy Physics Engineering (Reactor System Engineering)	Professor (Concurrent post) Tomohiko IWASAKI Professor (Concurrent post) Hidetoshi HASHIZUME Associate Professor Shinji EBARA	Our laboratory is tackling researches for advance in current nuclear fission energy system, realization of fast reactors as the next fission system and fusion reactors as the future system. We also set out to develop an integrated research field of fusion and fission reactors by using fluid engineering, heat transfer engineering, electromagnetics, and structural mechanics. Our research themes are mass transfer promotion from channel wall by turbulent flow appearing as pipe wall thinning in nuclear power plants, flow-induced vivration in piping of fast reactors, thermofluid phenomena in liquid blankets of fusion reactors, and so on. The researches are being conducted experimentally and numerically in terms of consistency as energy supply systems.

Laboratory	Professor / Associate Professor	Theme of research
Safety Engineering of Nuclear Systems (Nuclear Geotechnical Engineering)	Professor Yuichi NIIBORI	Based on geosphere transport phenomena, chemical reaction engineering and radiochemistry, the fundamental studies on the safety assessment of radioactive waste disposal system are conducted. The practical themes are: 1. Development of self-healing barrier of radioactive wastes by promoting interaction of radionuclides and cement-based materials, 2. Evaluation of transport phenomena of supersaturated silicic acid in alkali and thermal front, and its application to the design of geological disposal system, 3. Formation mechanism of high performance natural barrier by deposition of calcium silicate hydrate in a flow system through rock fracture, 4. Estimation of retardation effect of nuclide migration in unsaturated porous formation, and its application to performance assessment of the interim storage facility of contaminant soils, 5. Numerical simulation of sorption processes of actinide elements into natural clay minerals, and so on.
Safety Engineering of Nuclear Systems (Nuclear Energy Flow Environmental Engineering)	Professor Makoto TAHAHASHI （Department assigned：Department of Management Science and Technology） Associate Professor Youhei KIKUCHI Associate Professor Daisuke KARIKAWA （Department assigned：Department of Management Science and Technology）	In order to achieve higher level of safety in nuclear power plant, the interaction between human and machine should be carefully designed. In our laboratory, the problems of human factors are studied from variety of viewpoints. 1. Enhancement of organizational safety in nuclear power plant. 2. Evaluation of human-machine interface using human brain mapping method 3. Human factor study for air traffic control (ATC) system 4. Diagnosis system for early recognition of Cyber Attack
Safety Engineering of Nuclear Systems (Energy Physics and Engineering Education)	Professor Atsuki TERAKAWA	The division of Energy Physics and Engineering Education is committed to promote and expand social activities in harmony with human-beings and nuclear power beyond generations, and to develop creative and proactive methodology of education as well as practical leadership skills in nuclear engineering. With respect to medical applications of nuclear technology, we are conducting research on charged-particle therapy which takes physical and biological advantages of charged-particles to kill cancer cells. Particular attention is paid to development of a high-precision irradiation techniques and novel approaches to cancer treatment on the basis of therapeutic experiments using small animals. We also conduct human resource development in high-precision radiotherapy such as medical physicists.

Laboratory	Professor / Associate Professor	Theme of research
Particle-Beam Engineering (High Energy Materials Engineering)	Professor Akira HASEGAWA Associate Professor Shuhei NOGAMI (Collaborative Chairs: Materials Engineering for Fusion Reactors) Professor (Visiting member) Takeo MUROGA Associate Professor (Visiting member) Takuya NAGASAKA	Development of the reliable and high performance structural materials is essential for the advanced future power systems such as fusion reactor because they will be used in the harsh environment such as high energy particle beam exposure and high heat load. This division focuses on the following researches based on the material science, metallurgy, and mechanics of materials. 1. Development of high performance refractory metals for fusion reactor 2. Fundamental research on the interaction between high energy particle beam and materials 3. Development of life prediction method of energy systems 4. Development of low radio-activation structural materials for nuclear systems 5. Development of ceramics matrix composites for high temperature applications
Particle-Beam Engineering (System Engineering of Particle-Beams)	Professor (Concurrent post) Akira HASEGAWA Professor (Visiting member) Tomihiro KAMIYA Professor Shigeo MATSUYAMA (Collaborative Chairs: Molecular Imaging Engineering) Associate Professor (Visiting member) Taiga YAMAYA	Particle beams is applicable to fabrication of functional materials, analysis of specimen, RI production for medical imaging and radiation therapy. Their applications covers in various fields including engineering, environment, medicine and archeology. Our main research subject is system engineering of particle-beams which is systemize by combining the technologies of beam acceleration and optics, the particle irradiation, RI production and radiation measurements. Especially, we conduct research on beam focusing and are developing a micro- and nano-beam system. The system is combined with particle-induced X-ray emission (PIXE) method and micron-CT and applied for various fields. We also developing a positron emission tomography (PET) using RI produced by particle irradiation.
Particle-Beam Engineering (Advanced Radiation Application) [Branch in Rokkasho-mura]	Professor (Concurrent post) Akira HASEGAWA Professor Associate Professor Keitaro HITOMI	Our group focuses on development of compound semiconductor radiation detectors for advanced radiation applications including ultra-high resolution PET systems, ultra-high resolution SPECT systems, photon counting CT systems, and Compton cameras. The main research subject of our group is developing material purification methods, crystal growth methods and detector fabrication technologies for thallium bromide (TlBr) semiconductor radiation detectors.
Particle-Beam Engineering (Nuclear Fuel Science) [Branch in Rokkasho-mura]	Professor (Concurrent post) Yuichi NIIBORI Associate Professor Seong-Yun KIM	One of the most important problems needing to be solved in nuclear fuel cycle is the high-level liquid waste management. To minimize the waste and to reduce the radiotoxicity, our group is mainly engaged in the studies of chemical separation of fission produces such as 1. Nuclide separation processes of high level liquid waste using impregnated adsorbent and ionic liquids. 2. Separation between strontium and yttrium using impregnated adsorbent to reuse for radiotherapy. 3. Electrochemical of metal speciation in the solution of the reprocessing plant.

Laboratory	Professor / Associate Professor	Theme of research
(Degradation Science and Plant Life Management)	Professor Yutaka WATANABE (Collaborative Chairs: Fundamental Engineering for Nuclear Decommisioning) Professor (Visiting member) Masahiro YAMAMOTO	This lab does interdisciplinary studies based on mechanical engineering and materials science to understand materials degradation mechanisms and to improve plant life management methodologies for light water reactors and other nuclear systems. 1. Mechanistic studies in materials degradation of LWR components. 2. Matrials evaluation studies for supercritical water cooled reactors. 3. Development of monitoring methodologies of materials degradations in their initiation satages. 4. Development of anti-degradation alloys for nuclear systems. 5. Corrosion prediction and prevention studies for decommissioning Fukushima Daiichi Nuclear Power Plant.
Advanced Nuclear Engineering	Professor (Concurrent post) Atsuki TERAKAWA Professor (Concurrent post) Yuichi NIIBORI Professor (Visiting member) Eisuke MINEHARA Professor (Visiting member) Iwao KANNO Associate Professor (Concurrent post) Shigeo MATSUYAMA Associate Professor (Concurrent post) Nobuyuki KANEMATSU	On the basis of understanding and controlling the quantum-mechanical nature of light, electron, ion, etc., we develop the techniques which restore as soon as possible the living environments polluted with the radioactive materials emitted by the Fukushima Daiichi nuclear power plant accident and establish a field of radioactive decontamination engineering to respond to the nuclear hazard. Specifically, non-radioactive cesium cultivation, contamination monitoring of food, volume reduction of contaminated soil, and the technical development of effective use of contaminated materials are developed using quantum imaging technologies such as submilli-PIXE to monitor contamination of atmosphere and river, micro PIXE to image distributions of elements in a cell and PET to perform cerebral high order functional diagnosis and cancer diagnosis.
Energy Materials Engineering <Cooperative Laboratories> (Irradiation Effects in Nuclear and Their Related Materials, IMR)	Professor Yasuyoshi NAGAI Associate Professor Koji INOUE Associate Professor Kenji KONASHI Associate Professor Takeshi TOYAMA	We are studying defects, nano-scale precipitates and interface segregations of impurity/solute atoms in materials. Our target extends from nuclear materials such as reactor pressure vessel steels and shroud stainless steels to semiconductors such as silicon and silicon-germanium. We employ positron annihilation [two dimensional angular correlation of annihilation radiation (2D-ACAR), coincidence Doppler broadening and positron lifetime], 3D atom probe, electron spin resonance, optical absorption and transmission electron microscope. By combining fi rst-principles calculations and molecular dynamics simulations using the IMR super-computer with the above experiments we are clarifying the formation and microscopic structures of these defects, precipitates and interface segregations.

Laboratory	Professor / Associate Professor	Theme of research
Quantum Theoretic Material Engineering <Cooperative Laboratories> (Engineering for Actinide Materials, IMR)	Professor Dai AOKI Associate Professor Fuminori HONDA Associate Professor Tomoo YAMAMURA	The physics of f-electron systems, including both actinide and rare earth compounds, are an important aspect of strongly correlated electron systems. A large variety of fascinating phenomena, such as coexistence of magnetism and superconductivity, multipole order, quantum critical phenomena, are found. We grow high quality single crystals of actinide and rare earth compounds. By means of precise measurements under extreme conditions (low temperature, high field, high pressure), we aim to discover new phenomena and new physics. We also study actinide chemistry. Not only domestic collaborations but also international collaborations are strongly promoted.
Energy Chemical Engineering <Cooperative Laboratories> (Division of Process and System Engineering, IMRAM)	Professor Nobuaki SATO Associate Professor Akira KIRISHIMA	Development of rare metal chemistry for sustainable energy cycle Nuclear energy is one of the most important energy resource of our modern society, it is therefore strongly demanded to make nuclear fuel cycle more reliable. After the Fukushima NPP severe accident, countermeasure for the damegaed reactors and recovery activities of contaminated environment become very important issues in Japan. To respond these demands, our group researches on the fundamental chemistry of nuclear fuel debris, and develops novel and unique processes for the spent nuclear fuel based on the selective sulfurization of fission products. The radio chemistry of actinides and fisson products is also studied to perform more reliable safety assessment of radioactive waste ground disposal.

Notes; if you need more any details information, please tell the director. 〔Professor Yuichi NIIBORI, TEL+81-22-795-7901〕

Department of Robotics

Laboratory	Professor / Associate Professor	Theme of research
Robot Systems (System Robotics)	Professor Kazuhiro KOSUGE Associate Professor Shogo ARAI	A robot is a system, which consists of hardware, such as mechanical elements, actuators, sensors, and CPUs, and software, which generates intelligent behavior of the robot based on algorithms implemented in the CPUs. System robotics is a new field of robotics dealing with both hardware and software related to robotics in real environments. The research topics include but not limited to 1. Physical Human-robot Interaction 2. Assistive Robot Systems 3. Robotics Technology Applications to Real World
Robot Systems (Design of Intelligent Machines)	Professor Yasuhisa HIRATA	We expect to utilize robot systems not only the industrial fields but also the fields such as home, office, and hospital in cooperation with human. Our laboratory focuses on the passive robot system for supporting human being based on the physical interaction. The passive robot does not have active actuators, and its motion is controlled based on brakes and violation motors. The passive robots are intrinsically safe because they cannot move unintentionally with driving force. We also extend the passive robot concept for realizing the high-efficiency and wide-area surveillance system based on formation control of multiple passive vehicles. 1. Welfare Robot Systems 2. A Haptic Feedback Device for Guiding Human Motion 3. Formation Control of Multiple Mobile Robots
Nanosystems (Molecular Robotics)	Professor Satoshi MURATA Associate Professor Shinichiro NOMURA	Thanks to the progress of molecular biology and other life sciences, the mechanisms of biological molecular machineries have been elucidated in considerable detail. This knowledge is now ready to apply to various fields of engineering, such as fabrication of complicated nanostructures and functional molecular devices. In our laboratory, we are focusing on design and fabrication of nanostructures and molecular devices utilizing biomaterials such as DNA, lipid and proteins. Further, we seek for a systematic methodology called “molecular robotics”, to integrate them into a consistent system with desired autonomy. 1. Design and fabrication of nanostructures made of nucleic acids and lipids. 2. Design and fabrication of molecular devices for computation, sensing and actuation. 3. System integration of those structures and devices into a functional molecular robot or an artificial cell.
Nanosystems (Smart System Integration)	Professor Shuji TANAKA	Interface between “machines” and human is getting more important to consider the applications of advanced mechanical systems. Also, future “machines” will have advanced control, autonomy and functions as networked systems, as is the case with next-generation robots. This laboratory is studying “smart systems” enabling such advanced “machines” by integrating functional components in a small size. Our research interests include material development, process development, device fabrication and system demonstration (see examples below), all of which are necessary to implement “smart systems.” Through such a synthetic approach, high-level education and research in the field of Nanosystems are conducted. 1. Sensors for human-friendly robots 2. Wireless communication devices 3. Bio-sensors for medical diagnostics 4. System integration 5. Integration and packaging technology 6. Fundamental technology for sensors and actuators

Laboratory	Professor / Associate Professor	Theme of research
<Collaborative Chair (Graduate School of Biomedical Engineering) > Biomedical Engineering for Health and Welfare (Medical Welfare Engineering)	Professor Mami TANAKA （Department assigned：Graduate school of Biomedical Engineering） Associate Professor Takeshi OKUYAMA	With low birthrate and aging, staying healthy and the maintenance and improvement of the quality of life (QOL) are strongly desired. To stay healthy, early detection and treatment of diseases is important. In order to solve these, we treat the advanced mechatronics and signal processing technologies, and develop sensor/actuator systems for medical welfare apparatus. The topics are as follows: 1. Intelligent artificial finger 2. Development of a palpation sensor system 3. Elucidation of mechanism of human tactile and touch feeling 4. Measurement and analysis of human hand/finger motion
<Collaborative Chair (Graduate School of Biomedical Engineering) > Biomechanical Engineering (Nanodevice Engineering)	Professor Yoichi HAGA （Department assigned：Graduate school of Biomedical Engineering）	Minimally invasive medicine with less injury to the body, and healthcare devices which promote and maintain health are becoming more important in medical field. Using microfabrication technologies including MEMS (Micro Electro Mechanical Systems) technologies, research and education to develop novel and useful medical devices and healthcare devices are conducted. Our studies range from basic research and development of fabrication process to clinical application and practical research. 1. Minimally invasive medical diagnostic and therapeutic divices with high-performance and multi-function. 2. Novel healthcare devices using new structure or principle. 3. Development of nonplanar microfabrication technology which is suitable shape for insertion and use in the living body.
<Collaborative Laboratories> New Industry Creation Hatchery Center (Field Robotics, NICHe)	Professor (Concurrent post) Kazuhiro KOSUGE Associate Professor Keiji NAGATANI (Department assigned： New Industry Creation Hatchery Center）	We are working on research and development of unmanned field robots that have a capability to obtain information in the real world, such as natural fields and disaster environments. 1. Autonomous surveillance robots in indoor environments, such as plant facilities 2. Traversal and tele-operation technologies for unmanned ground vehicles (UGVs) on rough and weak terrains 3. Autonomous flight and observation for micro unmanned aerial vehicles (MUAVs) 4. Traversal and observation technologies for unmanned surface vessels on the water

Note: For more detailed information, please contact the director. (Professor Satoshi MURATA, TEL+81-22-795-4100)