

# Mechanical Systems and Urban Innovation Sciences

Department of Intelligent Mechanical Systems

## Intelligent Systems Optimization



Our laboratory aims to develop basic theories and applications of intelligent systems optimization methodologies for supply chain management, scheduling, system science, and intelligent robotics. We are conducting research on new modeling, new optimization methods, artificial intelligence methods, efficient algorithms, modeling, analysis, and diagnosis for safe and optimized operations of large-scale industrial systems.

**Prof. NISHI Tatsushi**

■ **Research Themes**  
Systems optimization /artificial intelligence/ supply chain management/ scheduling/robotics



**Assoc. Prof. SATO Haruo**

■ **Research Themes**  
Radioactive waste disposal/environmental dynamics/radiation safety

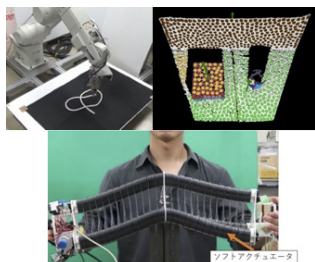


**Asst. Prof. LIU Ziing**

■ **Research Themes**  
Game theory/decision making/inventory management/computational intelligence/machine learning



## Intelligent Adaptive and Learning System



In our research field, our aim is to achieve robots capable of performing complex tasks, and we conduct fundamental research on advanced cognitive capabilities such as problem-solving, decision-making, and environment perception. Additionally, we strive for the social implementation of robots and engage in applied research in areas such as healthcare and rehabilitation.

**Prof. MATSUNO Takayuki**

■ **Research Themes**  
Surgical assistive robot/Manipulator robot



**Assoc. Prof. TODA Yuuichirou**

■ **Research Themes**  
Soft computing

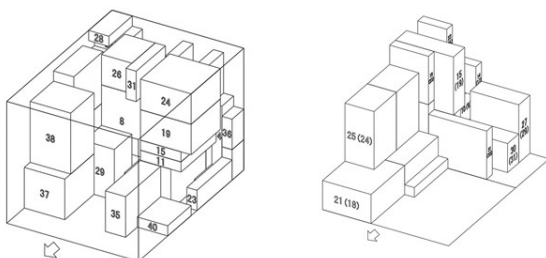


**Asst. Prof. SHIMOOKA So**

■ **Research Themes**  
Soft actuator



## Production Intelligence



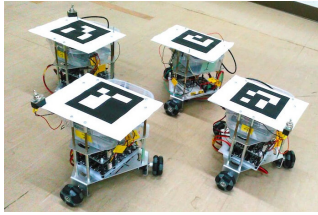
Research on problem modeling and model solution methods for appropriate decision making under various uncertainties associated with production activities, and research on designing human-machine systems based on human behavior, psychological states, and physiological measures. Specifically, research on the decision of loading and unloading positions in consideration of the order of unloading at the time of package delivery, research on mixed assembly lines, and so on.

Further, studies on interface design have been conducted for a better communication between road users and automated vehicles considering various levels of driving automation as well as types of road users – e.g., drivers or pedestrians.

**Assoc. Prof. YANAGAWA Yoshinari**

■ **Research Themes**  
Decision Modeling, Production Management

# Intelligent Mechanical Control



Control theory is one of the fundamental technologies supporting the current society. Its application field ranges widely from industrial apparatus to multi-agent systems. We focus on both theoretical and applied research on vast related topics including human-machine system like walking assistance device.

**Prof. HIRATA Kentaro**



■ **Research Themes**  
control theory/  
control engineering/  
machine learning/data science

**Senior Asst. Prof. NAKAMURA Yukinori**



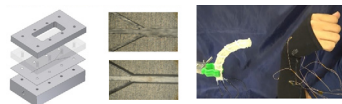
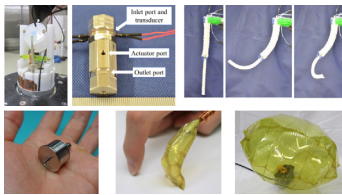
■ **Research Themes**  
control theory/  
control engineering/  
machine learning/data science

**Asst. Prof. Ikezaki Taichi**



■ **Research Themes**  
control theory/  
control engineering/  
machine learning/data science

# System Integration



Our research is about actuators and device for mechatronics and their system applications.

- Application of micro actuators and special environmental mechanisms
- Microreactors and microfluidic devices

- High-performance smart pneumatic artificial muscles, soft mechanisms, and medical and welfare equipment applications
- Research on actuators for extreme environments and devices for space probes using film processing technology

**Prof. KANDA Takefumi**



■ **Research Themes**  
actuator/sensor/mechatronics/  
softmechanism/welfare device/  
microsystem/microreactor/  
specific environment/ultrasonics/  
piezoelectricity/microchannel

**Assoc. Prof. WAKIMOTO Shuichi**



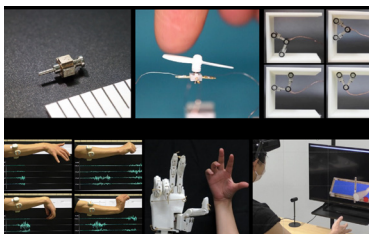
■ **Research Themes**  
actuator/sensor/  
mechatronics/softactuator/  
softmechanism/medical device/  
welfare device

**Asst. Prof. YAMAGUCHI Daisuke**



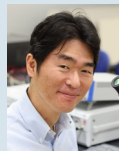
■ **Research Themes**  
actuator/sensor/mechatronics/  
softactuator/softmechanism/  
microsystem/specific environment/  
extreme environment/spacecraft/  
lunar exploration/pneumatics/  
ultrasonics/piezoelectricity

# Mechatronic Systems



The Mechatronics Systems Laboratory is engaged in creative and fundamental research and development of new sensors and actuators, applied research and development of robot hands and medical diagnosis and measurement devices using these technologies, and research and development of peripheral technologies. In particular, we focus on sensors and actuators based on the piezoelectric effect as a driving principle, and our research ranges from basic research such as driving theory to design, development, and evaluation of new devices, as well as applied research such as robot control using these devices.

**Prof. MASHIMO Tomoaki**



■ **Research Themes**  
Microrobotics/actuators/  
sensors/ultrasonic motors

**Assoc. Prof. SHIBANOKI Taro**

■ **Research Themes**  
Microrobotics/actuators/  
sensors/ultrasonic motors

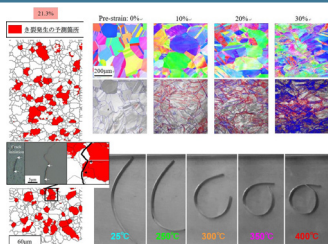
**Asst. Prof. NAGAI Isaku**

■ **Research Themes**  
Microrobotics/actuators/  
sensors/ultrasonic motors

# Mechanical Systems and Urban Innovation Sciences

Department of Advanced Mechanics

## Structural Materials Engineering



Our research focuses on metallic materials, composite materials, and functional materials to create the required material properties by controlling their microstructures. With the motto "Seeing is believing," we emphasize the importance of observing, thinking about, and modeling phenomena by ourselves. Laboratory students have access to a variety of state-of-the-art electron microscopy systems and are able to learn micro-sampling techniques, as well as observation and analysis techniques at the atomic level.

**Prof. OKAYASU Mitsuhiro**

■ Research Themes

Structural Materials/  
Composites/Functional  
Materials/Microstructures



**Assoc. Prof. TAKEMOTO Yoshito**

■ Research Themes

Structural Materials/  
Composites/Functional  
Materials/Microstructures



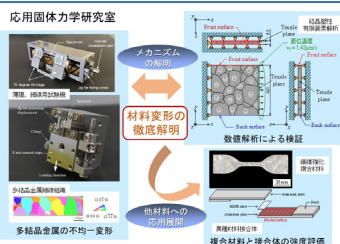
**Asst. Prof. ARAKAWA Junta**

■ Research Themes

Structural Materials/  
Composites/Functional  
Materials/Microstructures



## Applied Solid Mechanics



The target of our research is deformation, damage and fracture of various practical materials, including metallic and polymeric materials. We conduct experimental observations of nonuniform deformations for the materials and the corresponding numerical simulations in various levels.

**Prof. TADA Naoya**

■ Research Themes

mechanical engineering  
/high safety/high reliability/  
strength of materials



**Assoc. Prof. UEMORI Takeshi**

■ Research Themes

mechanical engineering  
/high safety/high reliability/  
strength of materials



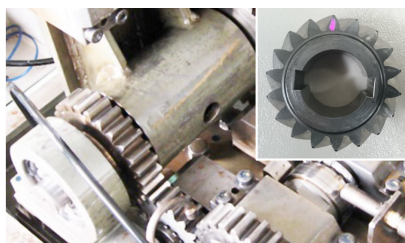
**Asst. Prof. SAKAMOTO Junji**

■ Research Themes

mechanical engineering  
/high safety/high reliability/  
strength of materials



## Machine Design and Tribology



In order to realize a carbon-neutral or decarbonized society, mechanical systems are required to be highly efficient, lightweight, and have a low environmental impact. At the mechanical design laboratory, we apply cutting-edge surface modification methods, coating methods and analysis methods to study technologies that dramatically improve the life, efficiency, and functionality of power transmission elements for EVs and various tribo-elements.



**Prof. FUJII Masahiro**

■ Research Themes

Mechanical element/Tribology/Gear/  
Fatigue strength/Low friction and  
wear/Surface modification/Coating

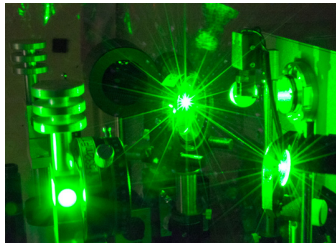


**Assoc. Prof. SHIOTA Tadashi**

■ Research Themes

Mechanical element/Tribology/Gear/  
Fatigue strength/Low friction and  
wear/Surface modification/Coating

# Nontraditional Machining



Along with the rapid progress of industrial technology, various new materials with excellent properties have been developed. Most of these materials are difficult to machine by the conventional mechanical methods, and the demand for machining of fine complicated shapes has been increased. Our laboratory is researching on high-performance and high-functional nontraditional machining methods, such as Electron Discharge Machining (EDM), Electron Beam Machining (EBM), and Laser Beam Machining (LBM) with using electric, electronic, optical energies. In addition, we are developing novel machining methods for the next generation.

**Prof. OKADA Akira**

■ Research Themes  
Nontraditional machining technology



**Assoc. Prof. OKAMOTO Yasuhiro**

■ Research Themes  
Laser beam machining/Electrical discharge machining

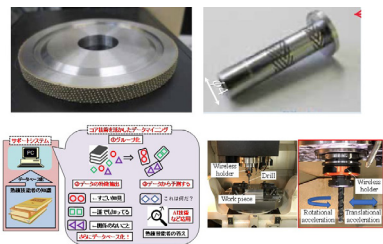


**Asst. Prof. SHINONAGA Togo**

■ Research Themes  
Electron beam machining/Laser beam machining



# Manufacturing Engineering



Studies on high efficiency, high precision, high quality, optimization, and intelligent automation of machining, which is the basic technology of manufacturing, and its peripheral technologies are carried out. In particular, advanced manufacturing technology for both machine tool users and builders is being developed through studies on not only grinding, cutting and abrasive finishing or their evaluation technology, but also further development of AI / IoT technology specialized in the field of manufacturing.



**Prof. OHASHI Kazuhito**

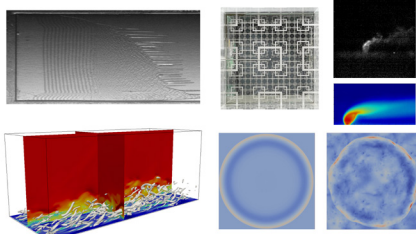
■ Research Themes  
Manufacturing Engineering/Grinding/Machining (Cutting)/Abrasive Machining



**Senior Asst. Prof. KODAMA Hiroyuki**

■ Research Themes  
Manufacturing Engineering/Machining (Cutting)/Grinding/Abrasive Machining/Data Mining

# Fluid Dynamics



Understanding and controlling the forces that an object receives from the air plays an important role in industrial products such as automobiles and airplanes. The Fluid Dynamics Laboratory conducts research on fluid dynamics with the aim of contributing to the improvement of the performance of current industrial products and the development of new products. The Fluid Dynamics Laboratory conducts research on relatively slow flows, such as those assumed for wind turbines and automobiles used in wind power generation, to fast flows that reproduce the flight environment of airplanes and rockets, based on experiments, numerical calculations, and AI techniques.

**Prof. KOUCHI Toshinori**

■ Research Themes  
Aerodynamics/Aerospace Engineering/Mechanical engineering



**Assoc. Prof. SUZUKI Hiroki**

■ Research Themes  
Aerodynamics/Aerospace Engineering/Mechanical engineering

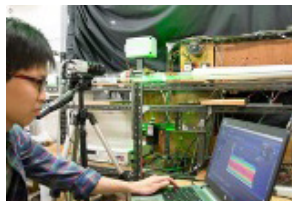


**Asst. Prof. TANAKA Kento**

■ Research Themes  
Aerodynamics/Aerospace Engineering/Mechanical engineering



## Heat Transfer Engineering



The Heat Transfer Engineering Laboratory conducts research on understanding the basic phenomena of heat and mass transfer for the effective use of thermal energy and developing products with industrial needs. Specifically, we are conducting a wide range of research such as thermal energy transport and storage using latent heat, development of a new desiccant air conditioning system, investigations of droplet condensation, evaporation and freezing behavior with controlling the surface properties of an object, microcapsules containing latent heat storage materials, and numerical analysis of absorption and reflection by generation and functional thermal radiation films.

Prof.  
HORIBE Akihiko

■ Research Themes  
latent heat storage/  
heat transport/polymer  
sorbent/microcapsule/droplet/  
surface properties/thermal radiation



Senior Asst. Prof.  
YAMADA Yutaka

■ Research Themes  
latent heat storage/  
heat transport/polymer  
sorbent/microcapsule/droplet/  
surface properties/thermal radiation

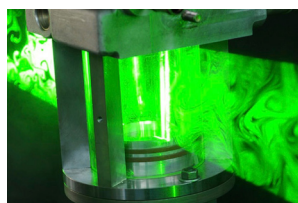


Asst. Prof.  
ISOBE Kazuma

■ Research Themes  
latent heat storage  
/heat transport/polymer  
sorbent/microcapsule/droplet/  
surface properties/thermal radiation



## Heat Power Engineering



Heat Power Engineering Laboratory focuses on combustion research for improving thermal efficiency and reducing harmful exhaust emissions. In-cylinder gas flow, spray and combustion processes are measured with ultra high-speed imaging, spectroscopy of emissions from chemical reactions, and lasers. Furthermore, CFD simulations are performed to predict and to elucidate those processes. Effective use of hydrogen, e-fuels and bio-fuels that contribute to carbon neutrality are also targeted.

Prof. KAWAHARA  
Nobuyuki

■ Research Themes  
Thermal Engineering  
/Internal Combustion  
Engine/Combustion/Laser  
Diagnostic/Numerical Simulation



Assoc. Prof.  
KOBASHI Yoshimitsu

■ Research Themes  
Thermal Engineering/  
Internal Combustion  
Engine/Combustion/Fuel/  
Compression Ignition

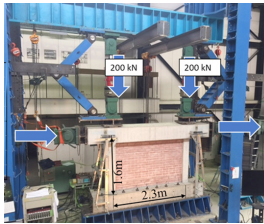


Asst. Prof.  
TSUBOI Kazuya

■ Research Themes  
Thermal Engineering/  
Combustion Engineering  
& Science/Computational Fluid  
Dynamics



## Aseismic Design of Structures



### Wind Resistance Group

Wind and tidal power generation are being developed by applying flow-induced oscillations in structures such as bridges caused by wind and water currents.

### Earthquake Resistance Group

Our research is a combination of analytical simulation, earthquake damage surveys, and structural experiments in order to evaluate and improve the seismic performance of buildings for disaster mitigation and earthquake-resistant cities. Focusing on sustainability, we explore innovative earthquake-resistant structural systems, such as hybrid designs featuring CLT timber walls and reinforced concrete.



**Prof. HIEJIMA Shinji**

#### ■ Research Themes

Wind engineering/Vibration engineering/  
Wind power generation/Tidal current  
power generation



**Assoc. Prof.**

**ALWASHALI Hamood**

#### ■ Research Themes

Seismic evaluation of buildings/seismic  
retrofit/performance assessment design/  
building structure/seismic disaster mitigation

## Design of Steel Structures



Research and education are conducted on the advanced methods of construction and maintenance of civil infrastructures. The types of infrastructures of our interest include railway, road, river, port, and soil structures such as tunnels, bridges, dams, banks. In terms of research topics, particular focuses are placed on the development of the state-of-the-art structural monitoring and nondestructive inspection techniques for the infrastructures under operation. To this end, we are developing physio-chemical models of structures, materials, and measurements, and validate the models and the monitoring/testing techniques built on them through computer simulations and experiments.



**Prof. NISHIYAMA Satoshi**

#### ■ Research Themes

infrastructure/construction/maintenance/  
steel structure/monitoring/nondestructive  
inspection



**Assoc. Prof. KIMOTO Kazushi**

#### ■ Research Themes

infrastructure/construction/maintenance/  
steel structure/monitoring/nondestructive  
inspection

## Design of Timber Structures



Research and development of timber technologies and structural design methods for middle and high-rise timber structures.

Structural design utilizing the latest wood materials such as CLT and fire-resistant timber.



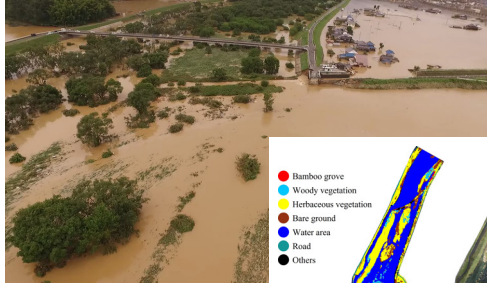
**Assoc. Prof.**

**FUKUMOTO Kouji**

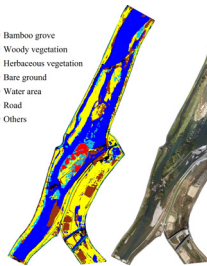
#### ■ Research Themes

Timber Structure/Timber  
Construction/Hybrid Structure/  
Structure Design

## Hydraulic Engineering



We have conducted education and research on water flow analysis and hydraulic design methods for various hydraulic structures in rivers and coastal areas, which are related to the creation of diverse aquatic environments that can coexist with nature.



Assoc. Prof.  
YOSHIDA Keisuke  
■ Research Themes  
Hydraulic Engineering

Assoc. Prof.  
AKOH Ryosuke

■ Research Themes  
Social Infrastructure(Civil  
Engineering/Architecture/  
Disaster Prevention)/  
Hydroengineering

## Geotechnical and Groundwater Engineering



Study on Prediction of Slope Failure during Heavy Rainfall

Development of Monitoring and Numerical Modeling Methods for Safety Assessment of River Levees against Seepage



Prof. KOMATSU Mitsuru  
■ Research Themes  
unsaturated soils/analysis of seepage flow/soil moisture



Assoc. Prof.  
FURUKAWA Zentarō  
■ Research Themes  
unsaturated soils

## Architectural Design and Theory



Development and Design Technical Practices of Design for Environmental Sustainability



Assoc. Prof.  
KAWANISHI Atsushi  
■ Research Themes  
Architectural Design/  
Architectural Theory/Design/  
Architectural Planning/Urban  
Planning

## Wood-Based Materials



Since wood, which is a natural material, fluctuates more than iron and concrete, I am developing the design of strength based on probability theory for high-reliability laminated lumber (Glulam), LVL and CLT and also developing simulation software for that purpose. In addition, based on the material of wood, I am developing a wood bonding method that has never been thought so far, and a wood joint with high rigidity and high yield strength. Furthermore, with the aim of decarbonizing, I am developing wood materials and structures that are easy to tear down, reuse, recycle, and use in cascade, and I am also developing a wood module construction method that is excellent in labor saving and energy saving.



Prof. (Special Appointment)  
NAKAMURA Noboru

■ Research Themes  
Wood-Based Materials/Timber  
Engineering/Timber Construction

## Urban and Building Environmental Engineering



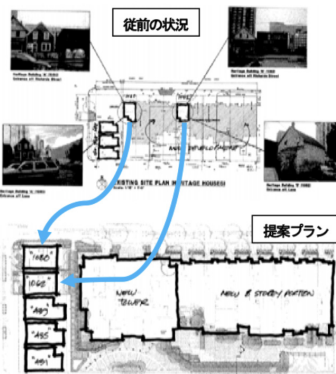
Energy is essential for maintaining human activity. However, consuming energy not only causes global environmental issues such as global warming and energy resource depletion, but also causes local (urban) environmental issues such as heat island phenomenon and air pollution. We have been researching in our laboratory to clarify the way urban structures and the related energy systems should be built in the near future in order to realize a comfortable urban environment while maintaining a sustainable earth.



Prof. NARUMI Daisuke

■ Research Themes  
Sustainable Urban and  
Architectural Design/Carbon  
Neutral/Energy System/Heat  
Island

## Architecture and Urban Spatial Planning



A mechanism for inheriting a housing as a good stock from a previous generation as a living housing for future generations, handing down the culture and the community or the characteristics in the district, and how to use them, how to control new development, We are proceeding with research, keeping in mind these ideas. So far, We are doing research on from the design control method of individual architecture to architectural planning / planning history and urban spatial planning, history related to architecture and planning / legal system and its implementation, in both Japan and overseas cities.



Assoc. Prof. HORI Hirofumi

■ Research Themes  
Architecture and urban spatial  
planning/Architecture and urban  
design policies/Architecture and urban  
landscape/Area based management/  
Business improvement district



Senior Asst. Prof.  
HASHIDA Ryohei

■ Research Themes  
architectural plan/  
housing theory/  
modern history



## Design of Concrete Structures



address the goals of a sustainable society from the concrete perspective.

Concrete is the foundation of social infrastructure that supports this substance civilization. However, the act of building a structure with concrete, or the act of building concrete itself is an act that destroys the natural environment. I want to own a car, I want to travel abroad, I want to live with a flush toilet, a TV, a cooler, but I also want to protect the natural environment. Developing a sustainable society may be the answer to this contradiction of humanity. In this laboratory, we



**Prof. AYANO Toshiki**  
 ■ Research Themes  
 Construction material/  
 Concrete engineering



**Assoc. Prof. FUJII Takashi**  
 ■ Research Themes  
 Construction material/  
 Concrete engineering

## Urban and Transport Planning



Realizing Sustainable Cities: In Japan, Sustainable cities are required in a declining birthrate and aging society. To realize safe, secure, and vibrant cities and transportation, we are researching efficient urban and transportation planning that takes into consideration the environment and people's lives.

Specifically, We are conducting research on the following topics.

- 1) traffic safety
- 2) public transportation planning
- 3) barrier-free transportation planning
- 4) clarification of the actual situation of the spongification phenomenon that occurs in the process of population decline
- 5) compact city planning
- 6) landscape-oriented city planning
- 7) measures for city planning in line with the history of historical and cultural civil engineering heritage that take advantage of the uniqueness of the region.

**Prof. HASHIMOTO Seiji**  
 ■ Research Themes  
 Urban Transportation  
 Planning/Community Development  
 by Transportation Policy/Traffic  
 Calming



**Assoc. Prof. HIGUCHI Teruhisa**  
 ■ Research Themes  
 Civil Engineering  
 History/Historical  
 Structures Preservation  
 and Utilization/Visual Town  
 Planning/Disaster Prevention



**Assoc. Prof. UJIHARA Takehito**  
 ■ Research Themes  
 Urban Planning/  
 Urban Environment  
 /Urban Transportation

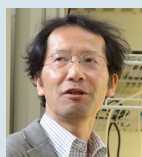


## Water Environment and Sanitation



material transport and aquatic ecosystems" to solve or prevent such issues for water resources. We hope to make our society safe, comfortable, and sustainable.

"Water" is essential for our lives and livelihoods, and also works as a medium of transporting substances on both local and global scales. Therefore, the sustainability of our life and ecosystem can be easily threatened by the excess usage and pollution of water resources. We are doing education and researches on "water quality control technology (water treatment)" and "relationship between



**Prof. NAGARE Hideaki**  
 ■ Research Themes  
 water environment/water treatment/  
 resource recovery/chemical substances



**Asst. Prof. HASHIGUCHI Ayumi**  
 ■ Research Themes  
 water environment/water treatment/  
 resource recovery/chemical substances

