Surface function
Predictive control
Welfare robot
Variable-pitch propeller ship control
Axonal elongation control
Assistance of sit-to-stand movement
Lubrication mechanism of synovial joints
Service blueprinting
Stem cells
Biomechanics
Visual feedback control
Tissue engineering
Nano-structural materials
Semiconductor quantum dot lasers
Environmentally conscious materials
Magnetocardiography
Wettability and fluidity
Biocompatibility
Finite-element human head model
Self-assembly of particles
Adaptive control
Service engineering
Sliding mode control
Multi-input multi-output plant
Functional spinal cord imaging
Multisensory informatics
Haptic display
Persona model
Traumatic brain injury
Spatial human interface
Psychophysiological information measurement and evaluation
Biologically inspired robots
Wearable interface
Robot therapy
Mechanical tolerance of neuronal cells
Design structure matrix
Augmented reality
Multiscale forming
Micro metal forming
Surface modification
Magnetoencephalography
Micro bio analysis
Environmentally conscious design
Mental health care
Human-robot interaction
Psychophysiological and social experiment
Bedroom type robot
Power assist
Micro medical devices
Design theory
Underwater robots
Neuroimaging
Haptic devices
Smart variable space
Fine particles
Ultra reality
Pedestrian/traffic flow model
Virtual reality
Source reconstruction

Tokyo Metropolitan University, Graduate School of System Design

Department of Intelligent Mechanical Systems

HUMAN MECHATRONICS SYSTEMS

Human resources development

At the Department of Intelligent Mechanical Systems, students enroll in lectures across multiple fields in addition to taking part in practical exercises and studies offered in the field of their specialty. This will allow them to acquire a comprehensive understanding of technology indispensable in contributing to society.

The introduction of the trans-disciplinary evaluation system has made it possible to develop human resources through cross-sectional and objective viewpoints. Students are asked to actively present the results of their exercises and research through presentations and articles in domestic and international academic societies, and to put together their achievements as a master's thesis or doctoral dissertation.

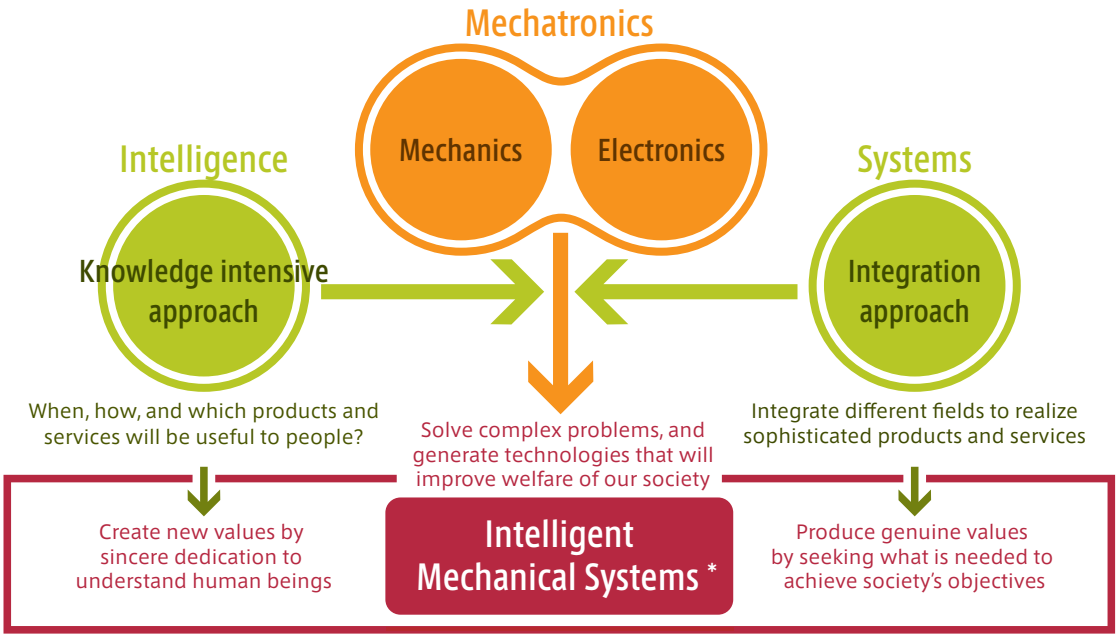
In the Master's program, we offer PBL (Project-Based Learning) type lectures that we call *Research Project Seminars*. Students will learn how to set tasks and to look for the relevant technology, in order to acquire the methods necessary for their studies – the process allowing them to effectively acquire practical abilities to solve problems.

We also offer a variety of economic support systems such as aid programs for participation in overseas academic meetings to facilitate international research activities, as well as overseas internship programs and various internal scholarship systems.

Admission policies

The Department of Intelligent Mechanical Systems aims to create new intelligent systems through cutting-edge research on mechatronics, with consideration for the security and comfort in urban life as well as the global environment and energy consumption. We seek candidates who:

1. hope to pursue the study of such disciplines as cutting-edge mechatronics control technology, sustainable systems, service engineering, medical, welfare and intelligent robot control technology.
2. hope to pursue the study of such disciplines as human dynamic analysis, brain activity analysis, virtual reality, micro-machining and production technology, and material, process and device technology.
3. have sufficient basic academic ability to study the above disciplines and a strong motivation to solve social problems.



* Beginning in fiscal year 2015 the name of our division/department was changed from "Human Mechatronics Systems" to "Intelligent Mechanical Systems."

Field of Control and Robotics

Professor

Kubota, Naoyuki

Intelligent robot

Smart robots and their practical application will open up the next generation

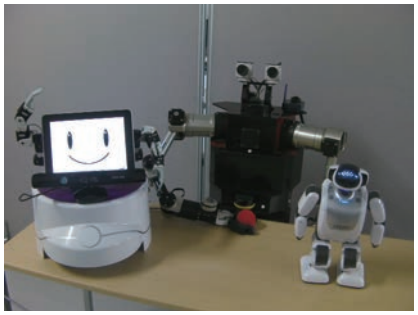
Our laboratory is undertaking constructive research using robots in order to shed light on the principles related to *knowledge*, including perception, recognition and intelligence.

In the field of applied research, we engage ourselves in the solution of various social and technological problems through research related to intelligence technology for the emerging synthesis of information, network and robot technologies. Moreover, we develop systems that will allow us to understand human abilities, respect human dignity and support people, based on the knowledge that we have obtained from such fields as ecological psychology and cognitive neuroscience.

More precisely, we are doing research and development on robot partners and carrying out research on support systems for elderly people and those affected by disasters as well as cognitive rehabilitation.

www.comp.sd.tmu.ac.jp/kubota-lab/
kubota@tmu.ac.jp

1. Human-type robot partners.
2. Robot partners for information support.



1

2

Professor

Kojima, Akira

Control theory
and applications
Robust control
Model predictive control

The future of control theory is for us to create

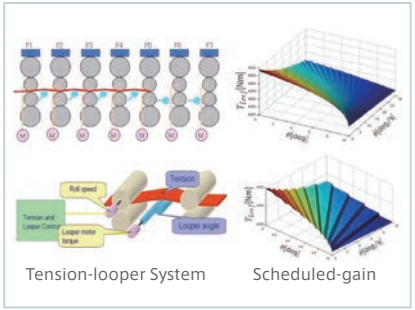
As is shown by such themes as 'various energy and distributed cooperation,' 'industrial system and environmental measures' and 'mechanical systems and humans,' the targets of *control* have changed considerably, and there are now various worldwide approaches in place. Our laboratory carries out research on the development of new control methods and their application to actual systems.

Simultaneously, with the publication of the cutting-edge achievements of robust control and predictive control methods, we undertake applied research that requires the true value of control theory to be put in place including 1) the smoothing of supply and demand of distributed energy, 2) the enhancement of the control systems of steel and engines and 3) robot control taking into account related mechanisms.

www.comp.sd.tmu.ac.jp/akojima-lab/
akojima@tmu.ac.jp

1. Control of mechanical systems.
2. Model predictive control for hot strip mill tension/looper systems.

1



2

Professor

Mori, Yasuchika

Control engineering
Control applications
Robot control

Control engineering, the technology of moving things in a safe and purpose-oriented way

As part of the theoretical research, we concentrate on the new development of the design theory of control systems in such fields as digital control, time delay control and sliding mode control as well as on the analysis of characteristics of predictive control using stochastic control theory.

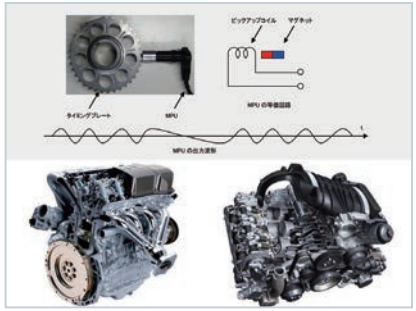
In addition, in the framework of our applied research, we engage ourselves in the guidance and control of airships of 3.5 meters in length, the improvement of the precise measurement of the crank position of automobile engines, the control for the stable motion of automobiles, the optimization of the action program for the realization of autonomous mobile robots and the development of welfare robots using CCD cameras and IC tags.

By applying the latest theories to concrete targets, we aim to help students develop various abilities so they can take an active part in the field of research and development.

www.comp.sd.tmu.ac.jp/mori-lab/
ymori@tmu.ac.jp

1. Flight control using multi-sensors.
2. Precise measurement of crank position.

1



2

Associate Professor
Takesue, Naoyuki
Robotics
Mechatronics
Intelligent mechanical systems

Challenge to global stages by developing and activating robots

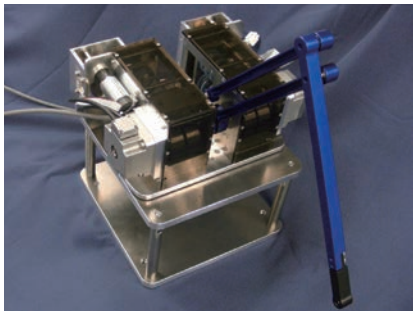
Our laboratory develops intelligent and innovative mechanical systems using the technology related to robotics and mechatronics, such as mechanical design, electric and electronic circuits, computer control and measurement and simulation.

As for specific themes, we carry out research and development into robot systems for human support that will help transport and assemble heavy items in factories, robots having mobility that equal that of living creatures, as well as underwater and aquatic robot systems.

We try to give impetus to such fields as high-level manufacturing and robotics and to create high added value, using technology and ideas.

www.comp.sd.tmu.ac.jp/ntlab/
ntakesue@tmu.ac.jp

1 Robot arm using gravity compensation mechanism.
2 Fish-like robot using impulse force generator.



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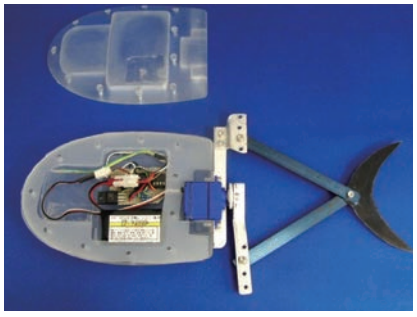


2

Associate Professor
Wada, Kazuyoshi
Robotics
Welfare robot
Psychophysiological and social experiment

Let's create a new world with innovative ideas!

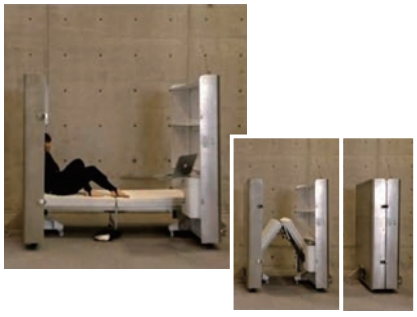
We carry out research and development into new robot technologies as well as their application in the field of welfare and experimentation and evaluation in the field.

More precisely, we study *robot therapy*, a method of mental care using animal-type robots, develop interfaces for robots to be used for preventive care, and we also study the *smart variable space*, which consists of compactly setting and dividing into modules such spaces as bedrooms, offices and kitchens, modifying the functions of the space by transferring and developing it automatically according to needs, and enhancing the efficiency of its utilization.

www.comp.sd.tmu.ac.jp/wada-lab/
k_wada@tmu.ac.jp

1 Robot therapy in nursing home.
2 Bedroom type robot.

1



2

Professor
Aomura, Shigeru
Computational mechanics
Biomechanics
Biomedical engineering

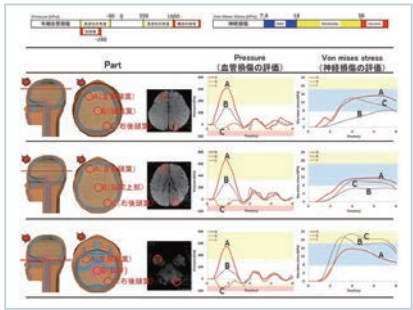
Discovering the secrets of the human body through engineering-medicine collaboration

We try to construct movement models, to clarify the mechanisms of disease apparition and to establish new methods of clinical diagnosis, by analyzing physical exercise, disease conditions and their clinical diagnosis from a dynamic viewpoint.

We also carry out research into how to reconcile humans with machines and how medical and welfare appliances should be designed in order to facilitate utilization by humans, by trying to understand the dynamic characteristics of humans.

www.comp.sd.tmu.ac.jp/suuchi/
aomura-shigeru@tmu.ac.jp

1. Reconstruction analysis of head injury caused by traffic accident.
2. Verification experiment and movement analysis of human sit-to-stand.



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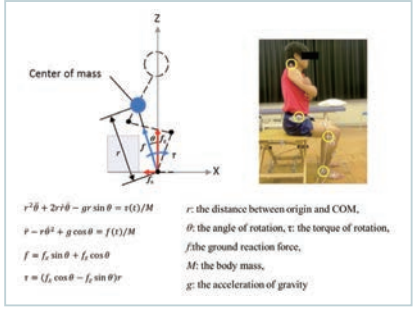


22

Professor

Ikei, Yasushi

Human interface
Virtual reality
Multisensory informatics
Instructional technology

Multi-sensory information technology will make the future ultra-reality world come true

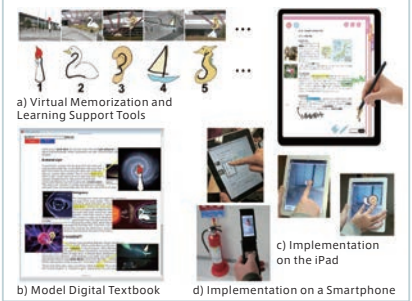
Our laboratory studies cutting-edge human interface based on multisensory information technology. We undertake research into systems that can be used in a multitude of ways from education, training and remote control to entertainment, by artificially creating real and interactive worlds through the transfer of information to the five senses of humans and allowing them to have various experiences.

In order to create new forms of interaction combining the senses of vision, hearing, touch, smell and vestibular sensation, we design various types of three-dimensional space display devices in virtual reality, and we also carry out research and development to create optimal ultra-reality spaces by trying to understand the characteristics of human senses.

http://mgikta.sd.tmu.ac.jp/
ikei@tmu.ac.jp

1. Multisensory information display and its application.
2. Memorization and learning support system using VR/AR.

1



2

Professor

Shimomura, Yoshiki

Design engineering
Service engineering
Intelligent machine
Knowledge engineering

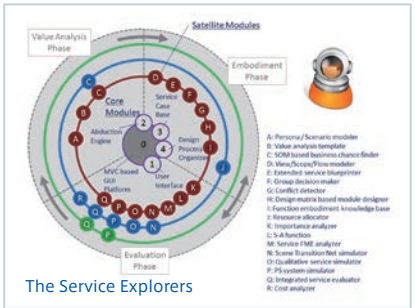
Your field is in the world. Let's seize the chance together!

In today's society, as suspension of superfluous production of artifacts is being required mainly from an environmental side, a means to economically compensate the decrease in production volume is also needed. This means increasing not only the value of artifacts as *things* but also the added value based on *service* and overall *knowledge* of the entire life cycle. With this context, service engineering aims at a basic understanding of services and the provision of specific engineering methods to design, produce, and develop services.

In our laboratory, two research groups currently drive service engineering researches. The first group is the design support group. This group aims at the development of a design support system that has 'intelligence.' The second group is the evaluation group. This group aims at the realization of high reliability services.

www.comp.tmu.ac.jp/smmlab/
yoshiki-shimomura@center.tmu.ac.jp

1. Function framework of Service CAD.
2. Co-creative Service CAD System.



1

2

Professor

Fujie, Hiromichi

Biomechanics
Biotribology
Tissue engineering

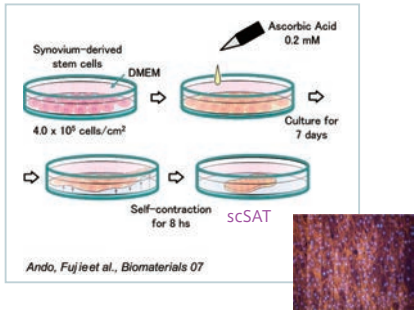
Learn from fascinating living organisms and open up a new engineering

TV programs and newspapers claim "Modern medicine is wonderful." Biomechanics is one of the driving forces making medicine 'magnificent.'

I (Fujie, the professor in charge) originally worked at the Mechanical Section of the Department of Engineering; in addition, I worked as a professor and researcher at medical schools inside and outside Japan for around 10 years. Our laboratory studies in a field near the forefront of medicine, and is engaged in advanced research into biomechanics together with clinicians. We are at the forefront of biological research including the new field that unites tissue regeneration engineering using stem cells and nanoforming and microforming engineering, the regeneration of soft biological issues and biotribology, and the dynamic functional analysis of joint functions with robot systems.

www.comp.sd.tmu.ac.jp/fujielab/
fujie@tmu.ac.jp

1. Synthesis and microscopic observation of small cell-based self-assembled tissues (scSAT).
2. 6-DOF robotic system for joint mechanical tests.



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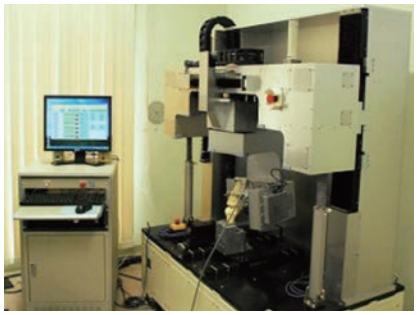


2

Field of Material, Process and Measurement

Associate Professor

Sakamoto, Naoya

Mechanobiology
Bioengineering
Biomechanics

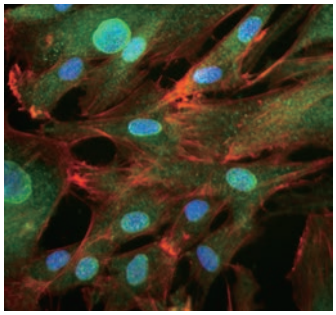
Reveal the *laws* in biology and physiology by mechanics and engineering

Morphology and functions of cells, fundamental units of our bodies, as well as tissues, built up by living cells, are controlled by not only biochemical but also internal and external mechanical signals. Elucidation of such controlling mechanisms would contribute to understand physiological systems and mechanisms of diseases and to develop medical devices and regenerative medicine.

Our laboratory is trying to reveal and understand novel mechanisms controlling biological systems with a combination of biological and mechanical engineering approaches.

1. Cell culture work in clean bench.
2. Fluorescence image of fibroblasts.

1



2

Professor

Moronuki, Nobuyuki

Precise and micro-machining
Surface function
Self-organizing processes

Surface functions expressed in a fine pellicle is deeper than meets the eye

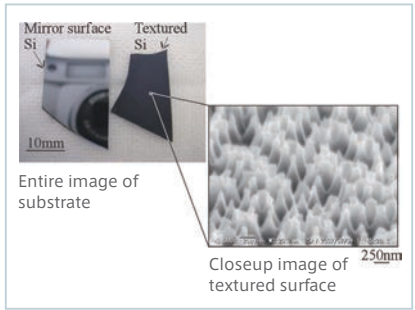
It is all thanks to the microstructures and nanostructures created on surfaces that allow lotus leaves to repel water, geckos to walk on walls and peacock feathers to produce fresh colors.

If we can create such surfaces artificially, our life will become even richer. However, traditional machining process are not sufficient to manufacture such microstructures over wide area at a low price. It is therefore necessary to develop processes that integrate such new ideas as self-organizing.

Our laboratory aims to propose such new machining processes and to realize the creation of various functional surfaces. These days, we engage in wide-ranging research also taking into account such elements as biocompatibility.

www.comp.tmu.ac.jp/seika/www/
moronuki@tmu.ac.jp

1. Antireflection surface produced by self-organizing process.
2. Self-assembled and transferred particles to resin layer.



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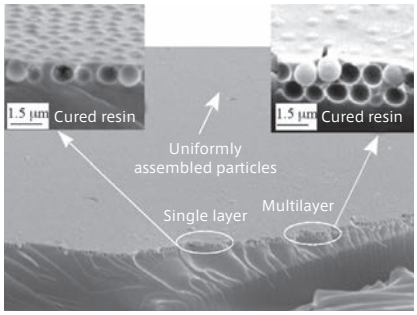


2

Professor

Yang, Ming

Microforming
Micro bio analysis

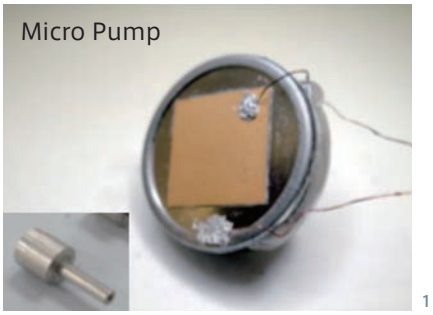
Manufacturing technology is a key to the happiness of mankind

Yang's laboratory is engaged in research into the creation of systems with micro-functions based on the principles of manufacturing. The aim is to realize production with high added value that will contribute to micromedicine and micro-biochemistry by uniting various nano-forming and microforming technologies.

The aim of our present research is to realize a safe and secure society through the creation of devices for micro-medicine and microanalysis systems for a rapid examination system into infectious diseases.

www.comp.sd.tmu.ac.jp/yanglab/
yang@tmu.ac.jp

1. Metallic micro pump systems.
2. Nanostructured CNTs reaction field for Bio-sensor.



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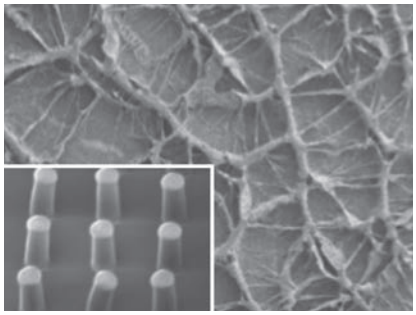


2

Cooperative graduate school

Associate Professor

Sugawara, Hiroharu

Photonics and electronic materials
Nanostructured semiconductors
Materials engineering

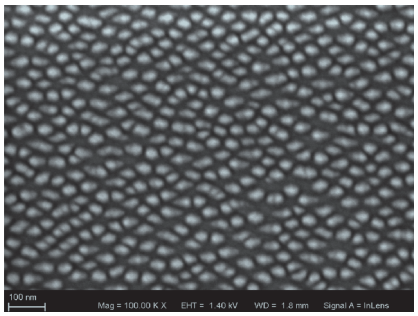
Let's look at our precognitions from a new point of view!

We are exploring the material technology in nanostructured semiconductors in order to produce semiconductor optoelectronic devices with higher efficiency and novel functions. Here students can learn about material synthesis, physical properties evaluation and material design.

1) We have largely improved the efficiency of the quantum dot laser by enhancing the density of self-assembled quantum dots of compound semiconductors. It may be applied to enhance bandwidth of the optical communication and achieve high repetitive light pulses. 2) We observed the low temperature crystallization of metal silicon compounds (silicides). Metal silicides are noticed as materials for green electronics, combining environmental compatibility and novel and/or better properties such as luminescence, high optical refractive index, magnetism and thermoelectric conversion.

http://ecswt1.sd.tmu.ac.jp
hsugawa@tmu.ac.jp

1. SEM image of high-surface-density semiconductor quantum dots (joint work with NICT).
2. TEM crosssection image of an iron silicide droplet crystallized at low temperature.



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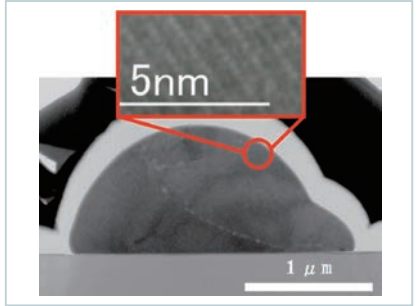


2

Associate Professor

Kaneko, Arata

Nano/micro-structure
Self-organization

Let's create technology that supports society and people 100 years from now!

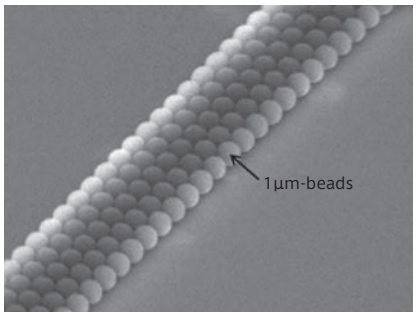
The application of MEMS (Micro Electro Mechanical Systems) such as microsensors is becoming more widespread every year, targeting such devices as automobiles, mobile tools and medical appliances.

The forming skills that support such MEMS production require bottom-up technology including self-organization in addition to top-down technology centering on lithography in order to pursue more microminiaturization, high-variety low-volume production, reduction of environmental impact and cost-cutting.

Our laboratory is carrying out research on the production techniques of new microstructures such as the self-alignment of surface modified particles, as well as on biodevices/microdevices including selective cell adhesion on microstructures.

www.comp.sd.tmu.ac.jp/kanekolab/
kaneko-arata@tmu.ac.jp

1. Self-assembled particles.
2. Cell-patterning on micro-structures.



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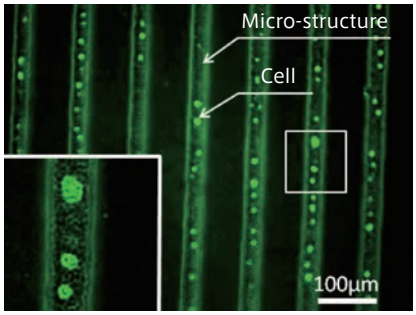


2

Field of Control and Robotics

Professor
Ando, Noriaki
Robot software

Professor
Tanikawa, Tamio
Micro hand

Associate Professor
Oozeki, Takashi
Photovoltaic system

Field of Human and System Engineering

Professor
Mochimaru, Masaaki
Service engineering

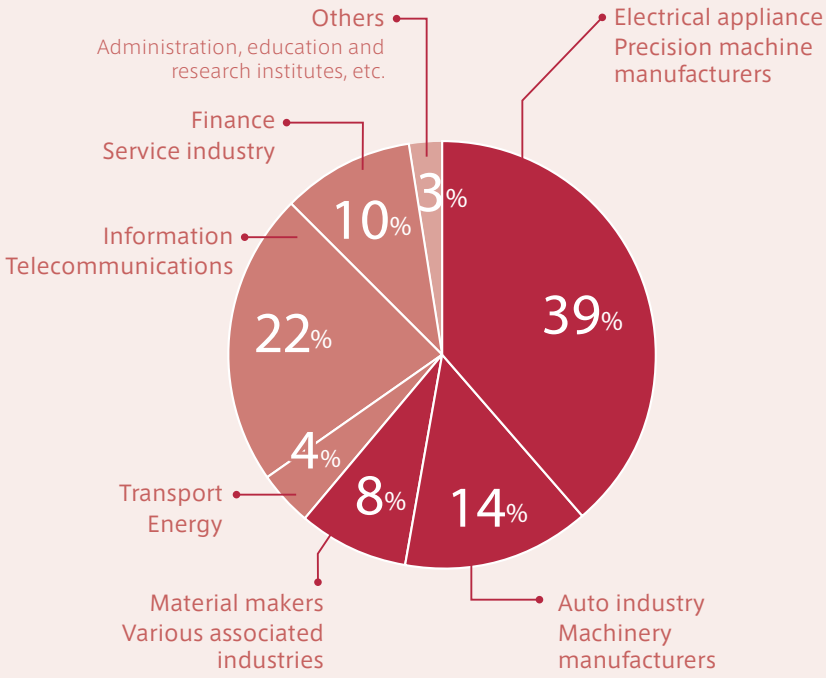
Associate Professor
Masui, Keijiro
Design for environment

Career opportunities after completing courses

Employment for alumni; breakdown by business type (2010-2014)

Results for
Division of Intelligent Mechanical Systems graduates and
Department of Intelligent Mechanical Systems degree holders

Including data of the division/department of Human Mechatronics Systems



Those who completed their courses at our Department have found jobs in a variety of fields including materials, processing, mechanics, electrical appliances, ICT systems, consulting and finance.

The need for human resources with a science and engineering background, who have acquired wide-ranging expertise and practical abilities, keeps increasing. All of our professors will support our students to the utmost so they can clearly draft their career plan and make a choice relevant to their aptitudes.

Tokyo Metropolitan University, Faculty of System Design
Division of Intelligent Mechanical Systems

Tokyo Metropolitan University, Graduate School of System Design
Department of Intelligent Mechanical Systems

◉ **Address**
6-6 Asahigaoka, Hino-shi, Tokyo 191-0065, Japan

◉ **Access**
from JR Toyoda Station (North Exit):
- 20 minutes on foot
- 5 minutes by bus and a 5-minute walk (take Keio bus at the *Hirayama Kogyo-Danchi Junkan* bus stop and get off at *Asahigaoka Chuo-Koen*)

from JR Hachioji Station (North Exit) or Keio-Line Keio Hachioji Station (West Exit):
- 15-30 minutes by bus and a 10-minute walk (take Keio bus for Hino Station or Toyoda Station and get off the bus at *Oowada Sakaue*)

◉ **Inquiries about the entrance examination**
Secretariat of the Graduate School of System Design: Tel. 042-585-8611

◉ **Inquiries about the department**
Prof. Yoshiki SHIMOMURA, Head of Faculty and Department:
yoshiki-shimomura@center.tmu.ac.jp

http://www.comp.sd.tmu.ac.jp/ims/index_e.html

首都大学東京
TOKYO METROPOLITAN UNIVERSITY

2015.04