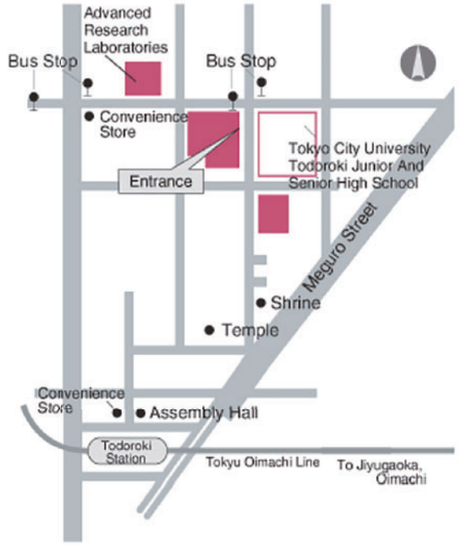
ACCESS MAP

Todoroki Campus

Todoroki Campus

- Faculty of Urban Life Studies
- Faculty of Human Life Studies
- Graduate School of Environmental and Information Studies : Urban Life Studies
- Advanced Research Laboratories

10min. walk from Todoroki Station

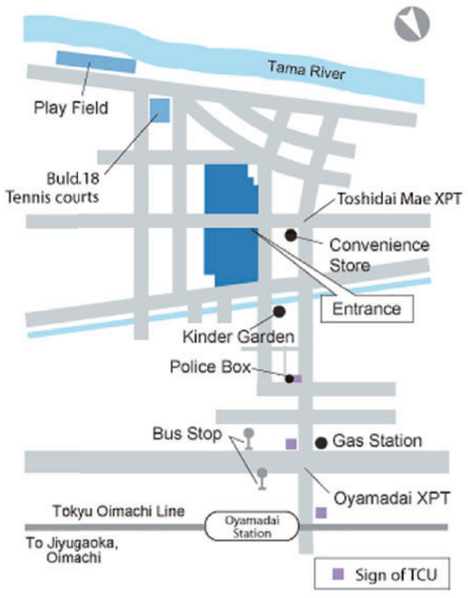


Setagaya Campus

Setagaya Campus

- Faculty of Engineering
- Faculty of Knowledge Engineering
- Graduate School of Engineering

12min. walk from Oyamadai Station



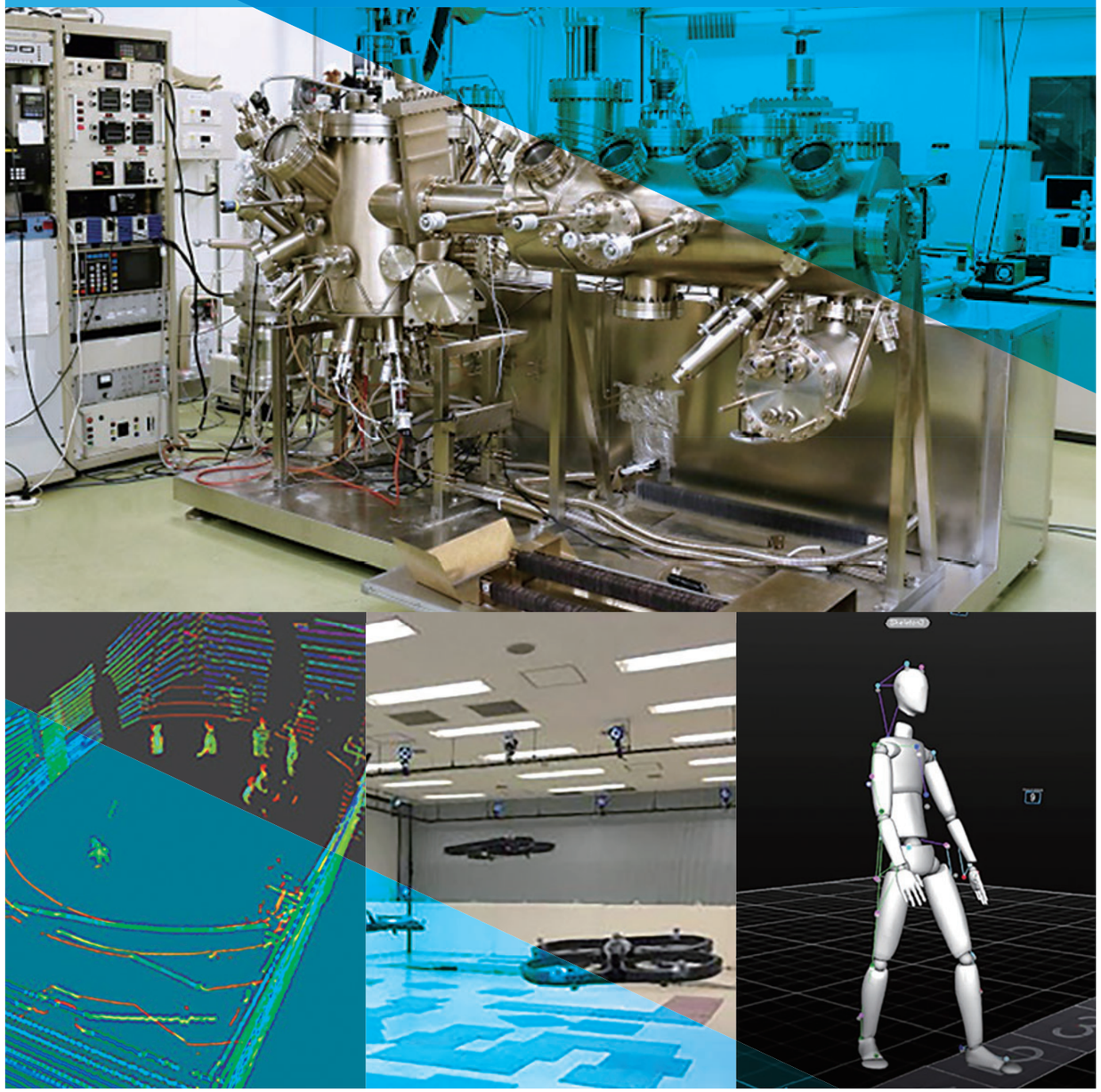
ADVANCED RESEARCH LABORATORIES

Overview

ARL (Advanced Research Laboratories) was established in April 2004 to realize the philosophy of TCU, "Human resource developments and academic researches for sustainable social developments". ARL's main purpose is to offer advanced education for students, and ARL is expected to enhance research activities of TCU, to promote collaborations among industry, government and academia and to return those research outputs to society.
ARL consists of "Institute of Innovation Researches" in which each research center conducts innovative researches, "Institute for Future City Studies" in which each research unit conducts sustainable city-related researches, "Laboratories of Leading Professors", "Units of Prioritized Studies" and "Incubation Laboratory". ARL plays a central role in TCU as an university-wide organization in promoting technical innovations for various problems and interdisciplinary challenges that today's society faces.

www.arl.tcu.ac.jp

TOKYO CITY UNIVERSITY



Human resource development and academic research for sustainable social development.

Message from the Director

Established in April 2004, Advanced Research Laboratories (ARL) take advantage of their cutting-edge equipment to promote research themes consistent with social needs and advanced education for graduate and undergraduate students so that they can serve as pioneers embodying the philosophy of Tokyo City University (TCU), which is "human resource development and academic research for sustainable social development."

Currently, the ARL has two institute and ten centers as its core organizations, including the Institute of Innovation Researches and the Institute for Future City Studies, which addresses a wide variety of issues related to aging urban hardware and software; the Research Center for Nano-Electronics, which pursues research on optoelectronic devices enabling energy savings in information and communication technology (ICT); and the Advanced Retrofit Technology International Center, which facilitates the development of reconstruction techniques for social infrastructure, such as expressways and railroads. Other ARL laboratories are challenging advanced academic research topics like microelectromechanical systems (MEMS), novel solar photovoltaic generation, smart grid systems, and robotics, among others.

Research projects have been promoted under the framework of the Program for the Strategic Research Foundation at Private Universities supported by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Program for Creation of Future Society sponsored by the Japan Science and Technology Agency (JST), project research backed by science research grants and other funds, research based on programs that invite the public to make proposals – including the Strategic Information and Communications Research and Development Promotion Program sponsored by the Ministry of Internal Affairs and Communications (MIC) – and joint research with business entities. All of these projects have been pursued to advance leading-edge research and development activities, as well as to disseminate their findings back to society.

In addition to internal projects, ARL proactively promotes collaborative research projects with business entities, other academic institutions, and overseas research organizations as part of efforts to disseminate information to diverse recipients, and to promote the common good by sharing its findings with the world. The Research Center for Nano-Electronics, among others, is highly regarded for its development of a Si-based light-emitting device, which is regarded as the most advanced in the world, and the center is also aggressively promoting the research and development of laser applications. Individual research centers work on their own research activities to promote further developments through the distribution of findings and exchanges, and by holding periodic seminars to present discoveries and report progress.

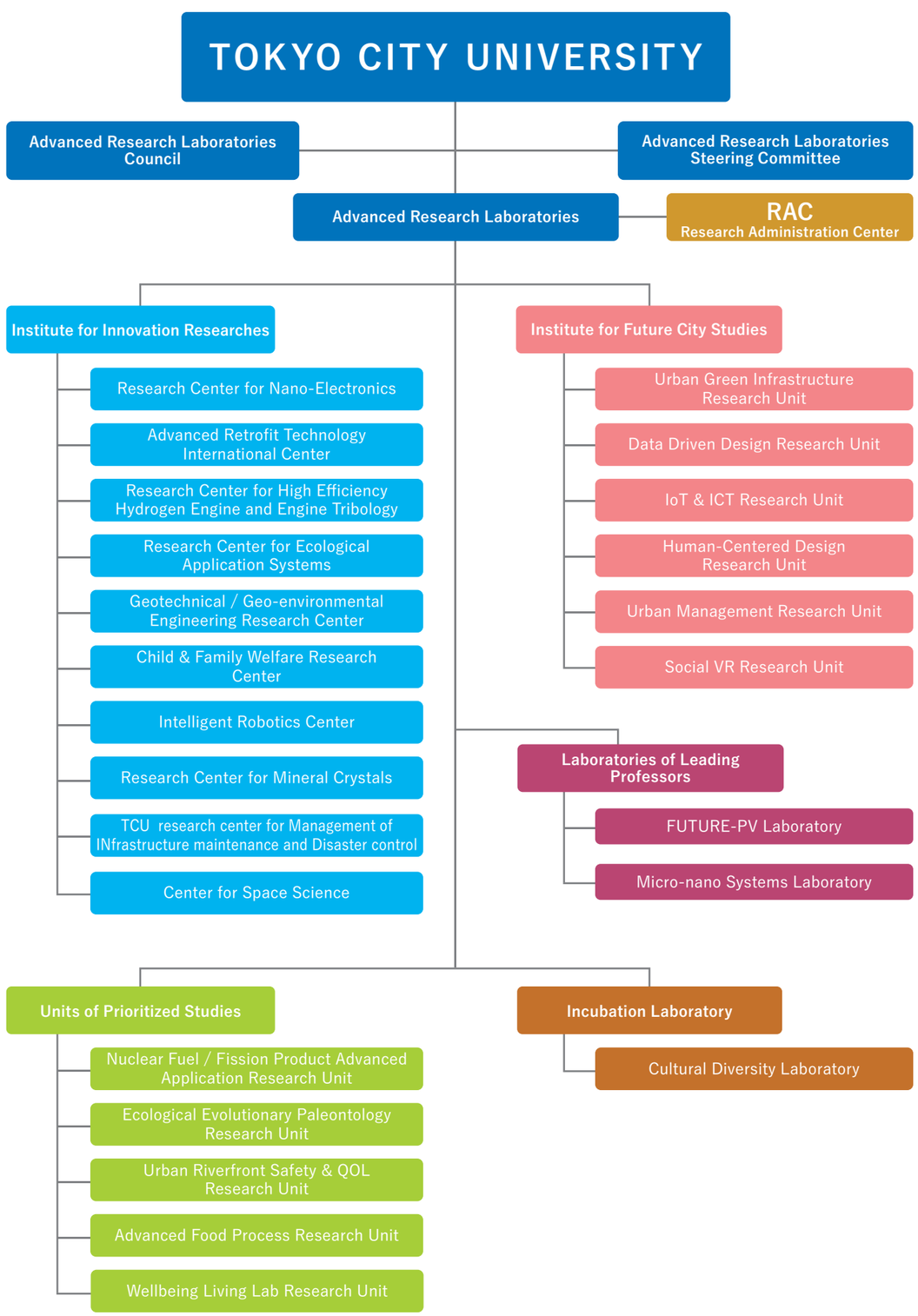
Looking to the future, ARL will make even more efforts for its development as the research base of TCU. Your continued support would be greatly appreciated.

Advanced Research Laboratories, TCU
Kenichiro Nonaka, Director

Todoroki Campus

Setagaya Campus (Bulding No.6)

Organizational Chart (2021.3.1)



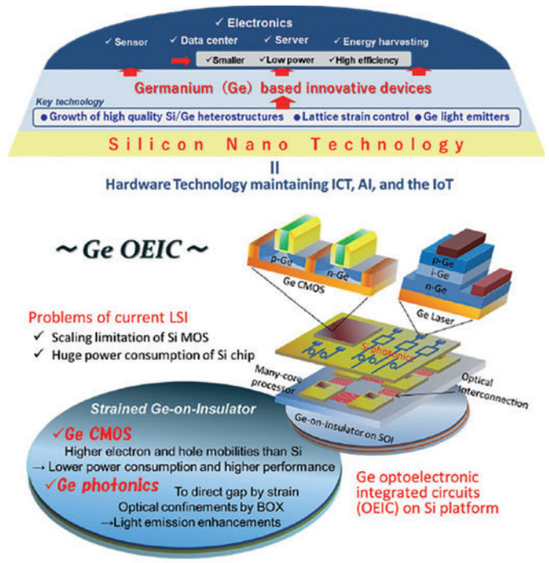
Research Center for Nano-Electronics

keyword | ◆Semiconductor materials ◆Optoelectronic devices

High-performance and low-power-consumption electronic devices
Highly efficient light emitting devices for optical interconnections
Group-IV semiconductor epitaxial growth and lattice strain control

Today's highly advanced information communication technology (ICT) is based on semiconductor nanoelectronics, but difficulties in achieving further performance improvements and their huge power consumption are worldwide critical issues. To overcome them, we are developing next-generation low-power consumption optoelectronic devices by employing "Germanium (Ge)" as a novel semiconductor material, where we make full use of various equipments in our clean room for high-quality crystal growth and semiconductor device processing.

Toward realization of Ge OEICs (Optoelectronic Integrated Circuits) on the Si platform (Si substrate), we succeeded in fabrication of strained Ge-on-Insulator (GOI) substrates by means of Ge epitaxial growth and wafer direct bonding techniques. This allows us to create large size Ge/Si wafers, enabling mass production of Ge OEIC chips where both high-performance Ge CMOS and Ge high-efficiency light emitters are integrated on the identical wafer. Moreover, we have been focusing on lattice strain engineering, and succeeded in the growth of strained SiGe high quality films, fabrication of highly strained Ge microbridge devices and room-temperature strong light emission by current injection from strained Ge LED devices. Furthermore, we are developing circularly polarized light emitters from atomic layer materials and Ge spin LED toward next-generation optical cryptography communication technology.



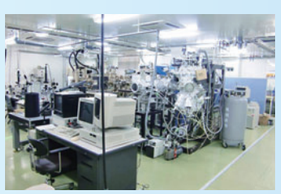
Research themes

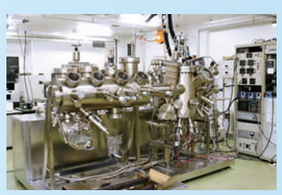
- Strained Ge-on-Insulator
- Strained Ge channel devices
- Ge photonic devices
- Ge microdevices
- Novel atomic layer material based devices

Research staff

Head/Professor	Kentarou Sawano
Professor	Hiroshi Nohira
Professor	Yuichiro Mitani
Associate Professor	Yusuke Hoshi
Emeritus Professor	Takuya Maruizumi


Clean room


Semi-clean room


Si/Ge Molecular Beam Epitaxy (MBE)


Electron Beam (EB) Lithography

Advanced Retrofit Technology International Center (ARTIC)

keyword | ◆Infrastructure maintenance ◆measurement ◆data science ◆risk

Advance the technical fields related to infrastructure maintenance

In the past few decades, the deterioration of urban infrastructures constructed after the war has become apparent, resulting in calls for action and investment to maintain them in a healthy condition. The lack of proper infrastructure maintenance and management can lead to significant social and economic losses, such as accidents occurring with increasing frequency and severity that result in traffic jams/shutdowns, third party damage, and civic liabilities. To promote a sustainable and resilient society, it is necessary to leverage the latest advances in science and technology towards providing comprehensive maintenance of aging infrastructures under live load conditions while simultaneously considering the possibilities of natural disasters such as earthquakes, typhoons, and heavy rain.

With the overall goal of promoting a sustainable and resilient society, we aim at developing practical and sustainable technology for rational infrastructure maintenance and risk management by leveraging modern advances in the science and technology fields of sensing, communications, and data analytics. Our specific efforts include: Promoting advances in sensing, data acquisition, communication, and storage, which have provided tremendous opportunities for scientists and engineers to unleash the power of established domain knowledge, thus making it possible to understand and design systems that align with reality at unprecedented levels of precision. Taking advantage of current possibilities to produce physical models of natural or engineered systems and thus be better and more quantitatively informed by the measured data in terms of their parameters, uncertainties, and variabilities. This includes 'data-driven' models (e.g., artificial neural networks) capable of prediction or operation capabilities that would normally be difficult to formulate when based solely on domain knowledge. Acknowledging that there is substantial room for improvement in the fields of infrastructure maintenance and risk management, we aggressively seek developments in theory, computational algorithms, and hardware technology in order to significantly improve capabilities for diagnosis, prognosis, and planning.

The Advanced Retrofit Technology International Center (formerly the Advanced Retrofit Technology Center) was established in 2013 within the Advanced Research Laboratories of Tokyo City University. Its main purpose is to advance the technical fields related to infrastructure maintenance. Our main research themes include inspection, diagnosis, repair, and reinforcement technology for infrastructure such as bridges, tunnels, and port facilities. Our research and development (R&D) efforts promote the use of advanced sensor and data analysis technologies. We are also conducting R&D on infrastructure deterioration predictions and natural disaster risk assessments.

Research themes

- External force measurement using the latest sensing technologies
- Determination of infrastructure deformation using the latest sensing technologies
- Fatigue damage detection using sensor technology
- Advanced bridge weigh-in-motion technology
- Estimation of the spatial distribution of physical properties
- Sophisticated natural risk assessment methodsa
- Deterioration of transportation infrastructure facilities and asset management
- Advanced of fatigue damage using phased-array ultrasonic testing
- Axial force evaluation of corroded high-strength bolts

Research staff

Director/Professor	Ikumasa Yoshida
Professor	Osamu Maruyama
Professor	Hiromi Shirahata
Associate Professor	Hidehiko Sekiya
Research assistant professor	Jingwen Song
Postdoctoral fellow	Samim Mustafa
Visiting Professor	Siu-Kui Au
Visiting Associate Professor	Stephen Wu
Visiting Researcher	Masayuki Tai
Visiting Researcher	Yusuke Koto
Executive Advisor, Founder, President	Chitoshi Miki

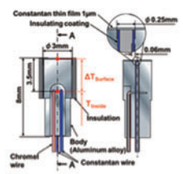
Research Center for High Efficiency Hydrogen Engine and Engine Tribology (HEET)

keyword ◆Heat engine ◆Fuel ◆Lubricant/Oil ◆Lubrication/Tribology ◆Engine cooling ◆Hydrogen engine

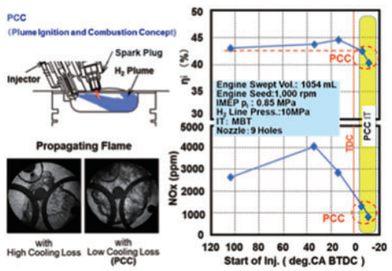
Study on Ultra-High-Efficiency and Zero Emission Power Source (Next Generation Engine)

The HEET Research Center contributes to preventing global warming and mitigating energy resource depletion by conducting research aimed at reducing friction generation in various internal combustion engine components. It also aims at reducing cooling losses occurring primarily in combustion chamber, and to utilizing hydrogen as a fuel that can be created primarily from renewable energy sources without also producing CO2 emissions.

Multi-Cylinder Gasoline Engine for Tribology Research



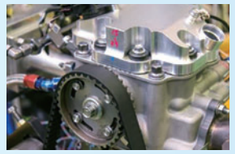
Three-Wire Thin-Film Thermocouple



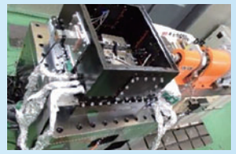
Research themes

- Study on the Reduction of Friction Losses
- Direct Measurement of Piston Friction Force using Floating Liner Method
- Mesurement of Lubricating Oil Consumption while using Low Friction Componets
- Measurement of oil film pressure on piston skirt using thin-film pressure sensor
- Development and Application of Highly Precise and Responsive Heat Flux Sensor
- New Combustion Method of Hydrogen-Fuel Engine, (PCC)
  *Plume Ignition and Combustion Concept
- Measurement of Heat Flux Characteristics of in Hydrogen Fuel Engines

Thin Film Sensing Technology (Pressure / Distance Sensor)



Friction force measurement system based on floating liner method



Friction force measurement and seizure evaluation unit system for plain bearings

Research staff

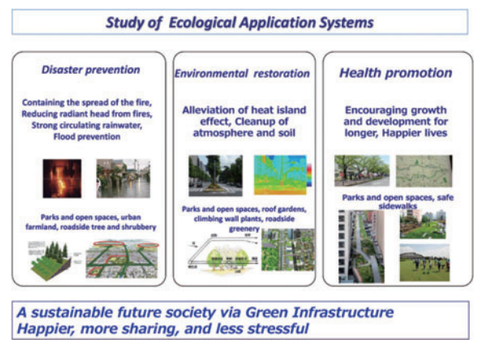
Director/Professor	Yuji Mihara
Professor	Shuzo Sanda
Associate Professor	Akemi Ito
Lecturer	Masakuni Oikawa
Research lecturer	Daijiro Ishii
Researcher (AF)	Masayuki Yamauchi
Researcher (AF)	Mitsuaki Yamamoto
Researcher (AF)	Mikio Nakamura
Researcher (AF)	Makoto Kano
Researcher (AF)	Toshihiro Oikawa
Researcher (VR)	Mitsuru Urabe
Researcher (VR)	Motohiko Koushima

Research Center for Ecological Application Systems

keyword ◆Ecological Systems ◆Green infrastructure management

Developing phytoremediation-based measures for treating heavy metal soil pollution
Advancing hybrid soil types for use in various artificial revegetation applications
Advancing hot environment relaxation effects via urban greening
Improving urban storm water retention and circulation via planting bases
Enhancing environmental real estate values by cultivating greenery

Our laboratory promotes the study, planning sciences, and technical developments needed for the formation of urban environments within which human society and ecological systems can exist in harmony. To achieve these goals, our work and study methods aim at the creation of disciplines that combine sciences related to landscape and architectural planning, environmental greenery, and the preservation and promotion of health and hygiene in various ways. Our vision calls for the integration of the natural environment into all aspects of urban land use, including disaster prevention areas such flood and fire prevention, rainwater storage and circulation, and alleviation of the heat island phenomenon and the promotion of public health issues such as environmental cleanliness and recreation. Through study and experimental investigations, we will continue to advance the public interest in the functions use of natural environments.



Research themes

- Heavy metal soil pollution countermeasure utilizing phytoremediation
- Study on hot environment relaxation effect brought about by railway track greening

Hybrid turf

Rail track greening

Phytoremediation experimental field

Research staff

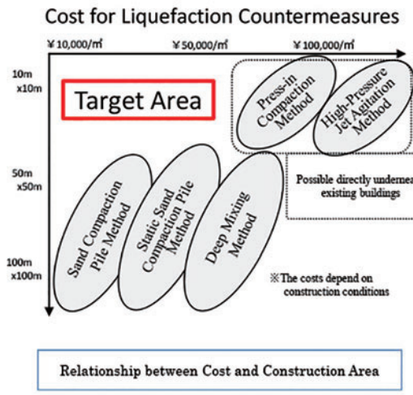
Director/Professor	Shiro Wakui
Professor	Kentaro Iijima
Associate Professor	Shigehiro Yokota
Guest Researcher	Akihiko Horikawa
Guest Researcher	Masayo Yamasaki
Guest Researcher	Ritsumasa Yamashita

Geotechnical / Geo-environmental Engineering Research Center

keyword ◆Soil Investigation ◆Liquefaction Countermeasures ◆Soil Structure

Development of technology to reduce geohazards

In order to moderate the increasing threat of natural hazards, and with a particular aim at preventing geohazards such as soil liquefaction and slope failures, the latest developments in fields including soil research, liquefaction countermeasures, and the construction of soil structures are being studied Although our research themes have evolved in tandem with changing social requirements, our center remains committed to addressing these and other issues through collaborative efforts.



Relationship between Cost and Construction Area

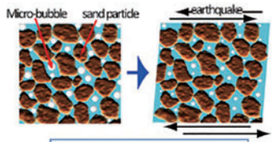


Image of Improvement

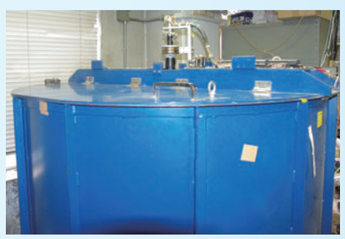
Micro-bubble Water

Research themes

- Liquefaction Countermeasure using micro-bubbles and particles injectedinto the ground
- New soil investigation technique using Screw Drive Sounding
- Development of reinforcingand repairing methods for soft ground and soil structures

Research staff

Director/Professor	Naoaki Suemasa
Professor	Kazuya Itoh
Engineer	Tsuyoshi Tanaka
Collaborative researcher	Kouichi Nagao
Collaborative researcher	Takamitsu Sasaki



Centrifuge Apparatus

Model Ground Improvement Machine

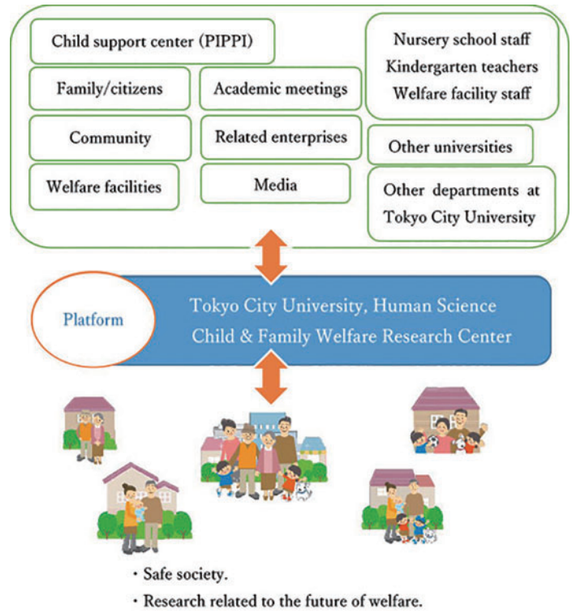
Screw Drive Sounding

Child & Family Welfare Research Center

keyword ◆Children ◆Welfare ◆Family ◆Safety ◆Health ◆Collaboration

Research about “PIPPI” Child Raising Support Center users
Cooperation related to Shibuya Welfare Center
Labor savings at nursery schools

Until now, there has not been a local community platform connecting child-raising parents, nursery school childminders, university researchers, and companies producing childcare products. This means there has not been effective research on how to raise children. However, our Faculty of the Human Life Sciences has already achieved results through its “PIPPI” Child Raising Support Center.
PIPPI operates under this Faculty and the "Child Family Welfare Research Center," which was created to act as a hub connecting various childcare-related bodies and organizations. Through the center, questions regarding childcare problems and issues occurring at various locations are explored and answered, and items relating to child welfare are presented as research questions to be holistically and comprehensively researched. The goal is produce useful results that can be returned to society.



- Safe society.
- Research related to the future of welfare.

Research themes

- Research about Child Raising Support Center (PIPPI) users
- Cooperation with Shibuya welfare
- Labor savings at nursery schools

Research staff

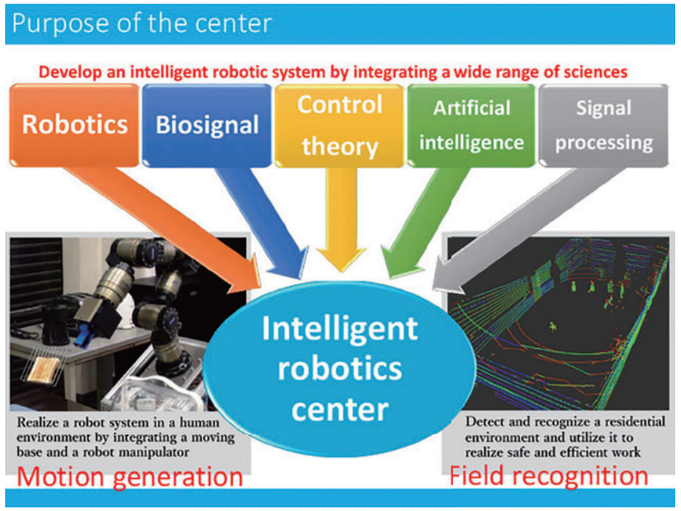
Center Director	Shinya Hayasaka
Researcher	Sachiko Kameda

Intelligent Robotics Center

keyword ◆Robotics ◆Control ◆Artificial Intelligence ◆Image Processing ◆Signal Processing ◆Bio-telemetry

The construction of intelligent robot systems that can coexist with people

Robot services and autonomous vehicle driving techniques have been rapidly developed in recent years, but further improvement in performance and safety must be established in order to put them to use in actual human working environments. Therefore, the Intelligent Robotics Center aims at the construction of intelligent robot systems that can coexist with people. To accomplish this, we integrate a wide range of fields such as robotics, artificial intelligence, signal and image processing, control engineering and biosignal measurements to facilitate cutting-edge robotic research.



Research themes

- Development of a vision system using image recognition
- Biosignal measurements and signal processing for establishing good relationships between machines and people
- Intelligent robot systems through control theory and signal processing

Testbed for developing mobile robots

Electric wheelchair equipped with LiDAR (Right),
motion capture system to measure the position of UAVs (Center),
force plates to estimate both floor reaction force and joint torque (Left).

Research staff

Head/Professor	Kenichiro Nonaka
Professor	Hidetoshi Oya
Professor	Akira Taguchi
Professor	Nobuhiko Mukai
Professor	Hidehiro Nakano
Professor	Yue Bao
Professor	Hideo Miyachi
Professor	Masaki Kyoso
Professor	Hideaki Takayanagi
Associate Professor	Daisuke Sato
Associate Professor	Kazuma Sekiguchi
Associate Professor	Toshiyuki Sugimachi
Associate Professor	Koichi Nishibe
Associate Professor	Shota Yabui
Lecturer	Yoshikatsu Hoshi

Research Center for Mineral Crystals

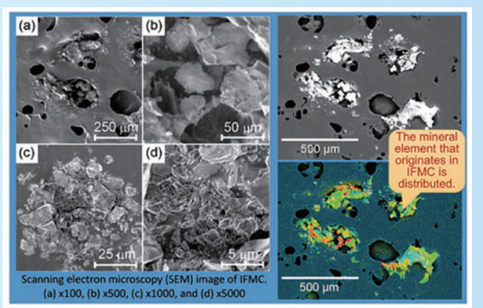
keyword ◆Mineral Crystals ◆Functional sportswear ◆Adaptive clothing for elderly

Current status and issues of nursing care in a super-aging society
Importance of health care for different types of elderly
Realization of a healthy and active society through physical exercise

In recent years, Japan has entered the stage of a super-aging society. As a result, the number of elderly people who need a variety of nursing care services has increased significantly. In addition, healthy seniors also need healthcare services. Our research center aims to elucidate the mechanisms of solutions formed by the combination of minerals and hot-spring water, which we called Integrated Functional Mineral Crystals (IFMCs). An increasing quantity of experimental evidence suggests that IFMCs are beneficial for improving the health status and exercise capacity of users. Our center has also been working on the development of functional sportswear and adaptive clothing for elderly persons.

Research themes

- Current status and issues of nursing care in a super-aging society
- Importance of health care for different types of elderly
- Realization of a healthy and active society through physical exercise



Research staff

Research Center Director	Takamichi Hirata
Visiting Associate Professor	Tomohiro Akiyama
Collaborative Business Partner	Kenichiro Hatakeyama
Collaborative researcher	Tomohiro Nomura

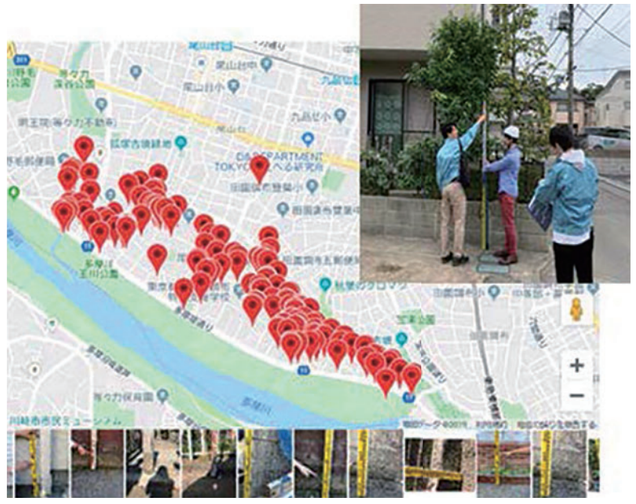
TCU research center for Management of INfrastructure maintenance and Disaster control

keyword
- Management of infrastructure construction and maintenance
- Natural disaster prevention / mitigation
- Sharing of scientific knowledge between academic and civilian communities

SUSTAINABLE DEVELOPMENT GOALS

Smart management of infrastructure construction and maintenance
Controlling effects of intensifying natural disasters (disaster prevention / mitigation)
Research center for disaster countermeasures that contributes to the community by utilizing big data including information obtained from citizens

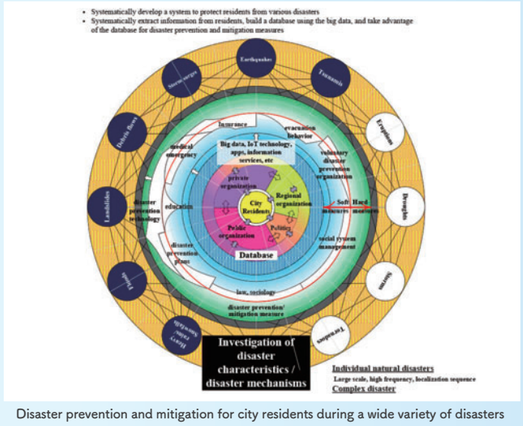
There are growing concerns among citizens over recent intensifying natural disasters that have caused tremendous damage to aging facilities and infrastructure. As a disaster countermeasure research base, we are working to build a framework to connect civic groups with the university and thus support the community by delivering academic information to the civilian world.



Inundation damage survey in Tamazutsumi / Denenchofu area due to the Typhoon Hagibis (Typhoon No. 19)

Research themes

■ Disaster prevention and mitigation for city residents during a wide variety of disasters



Disaster prevention and mitigation for city residents during a wide variety of disasters

Research staff

Director/Professor	Kazuya Itoh
Professor	Naoaki Suemasa
Associate professor	Takahito Mikami
Engineer	Tsuyoshi Tanaka
Associate professor	Takashi Goso
Associate professor	Hidehiko Sekiya
Associate professor	Yuki Akiyama

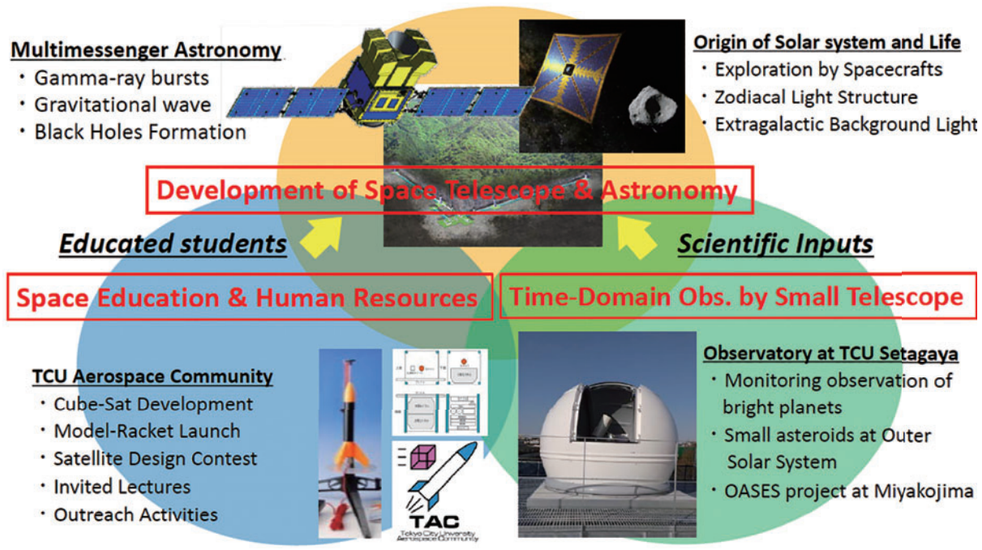
Center for Space Science

keyword
- Astrophysics
- Space engineering
- Space utilization

SUSTAINABLE DEVELOPMENT GOALS

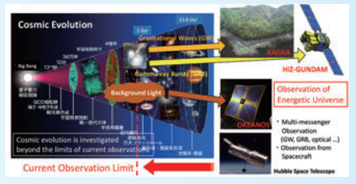
Space science and education in collaboration with natural/ social science & technology based on multidisciplinary methods

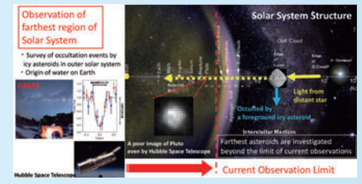
Advanced Research Laboratories, Center for Space Science

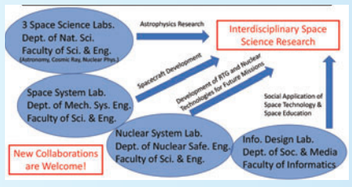


Research themes

■ Comic Evolution and life in the Universe are studied by Interdisciplinary Space Science Approach







Research staff

Head/Associate Professor	TSUMURA Kohji
Professor	MIYASAKA Akihiro
Associate Professor	WATANABE Rikio
Professor	KOIKE Seita
Lecturer	KADOTA Kenichi
Associate Professor	NISHIMURA Daiki
Professor	TAKAKI Naoyuki
Professor	TAKAHASHI Hirotaka

Institute for Future City Studies

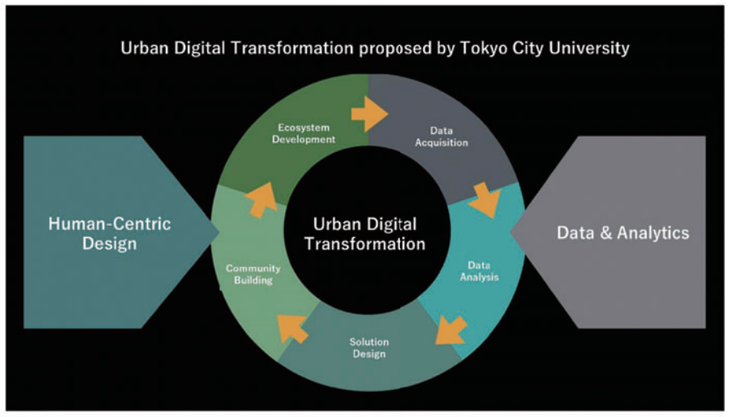
keyword ◆Future City ◆Urban Research ◆Digital Transformation

Urban Digital Transformation

Cross-academic research on the application of digital technology and human-centered design for future city

Outline of the Institute for Future City Studies

The Institute for Future City Studies aims to strengthen its identity as the "urban research university" and to contribute to the realization of internationally competitive, highly functional cities. The theme of our research is "How can digital technology transform cities? Specifically, we advocate "Urban Digital Transformation" that combines technologies such as AI (Artificial Intelligence), IoT, 5G, and Big Data with human-centered approaches such as solution design, community, and green infrastructure. We have organized six research units, where researchers from different fields such as science, engineering, and social sciences discuss and proresearch in a cross-academic manner.



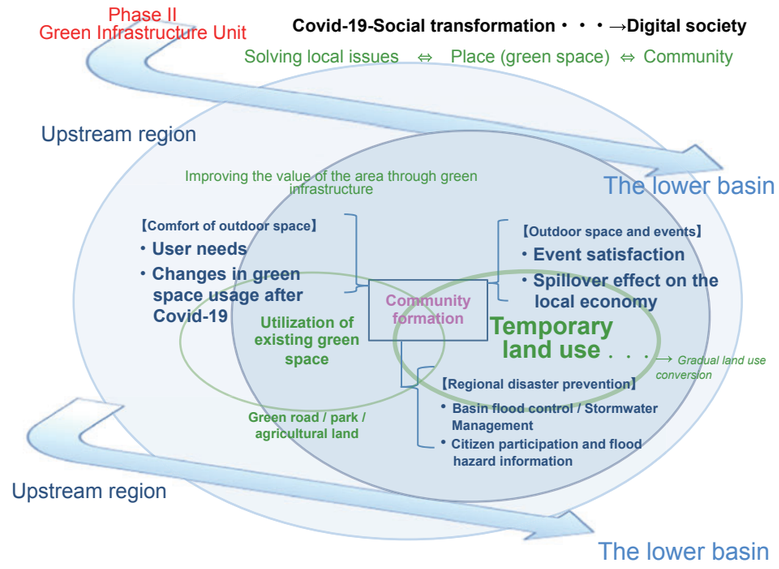
Research Unit	Research staff
	Director/Professor Masaki Hamura　Deputy Director/Professor Osamu Maruyama
■ Urban Green Infrastructure Research Unit	Unit Leader/Professor Kentaro Iijima
■ Data Driven Design Research Unit	Unit Leader/Professor Hideaki Takayanagi
■ IoT & ICT Research Unit	Unit Leader/Professor Kohei Shiomoto
■ Human-Centered Design Research Unit	Unit Leader/Associate Professor Toshiki Nishiyama
■ Urban Management Research Unit	Unit Leader/Associate Professor Koichi Kitami
■ Social VR Research Unit	Unit Leader/Professor Junko Ichino

Urban Green Infrastructure Research Unit

Institute for Future City Studies

keyword ◆Green infrastructure ◆Basin ◆Environmental restoration ◆Disaster prevention ◆Community ◆Health / Stress management

It is expected that green infrastructure measures and business development will complement existing infrastructure developments by incorporating various functions of the natural environment in urban land use. These will include urban disaster prevention efforts such as preventing the spread of fire and preventing urban floods due to rainwater infiltration, along with other environmental issues such as mitigating the heat island effect, promoting environmental purification, conserving local natural resources, and facilitating recreation to achieve a combination of social benefits and public interest functions. Our research unit will proceed with research aimed at (1) improvement of the exposure and vulnerability of urban environmental pressures and reductions to development damage by incorporating green infrastructure, (2) the creation of comfortable living spaces and improvements to environmental real estate values, and (3) the promotion of local resident healthcare and community information.



Research themes

- ■ Comfort evaluation of outdoor green space / Research on health and stress management for urban residents and workers
- ■ Examples of outdoor space utilization and city center area management
- ■ Evaluation of rainwater runoff control function and soil / vegetation environments in basin green space
- ■ Evaluation of ecosystem services in terms of mixed farming and housing / regional resource recycling

Research staff

Unit Leader/Professor Kentaro Iijima
Associate Professor Shigehiro Yokota
Associate Professor Yukari Niwa

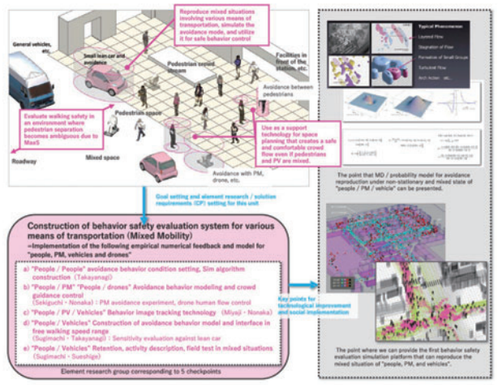
Data Driven Design Research Unit

Institute for Future City Studies

keyword ◆Smart City ◆Pedestrian ITS ◆Crowd Flow Simulation ◆Personal Vehicle ◆Drone Technology

Human behavior analysis research for smart city
Automatic tracking technology for pedestrian behavior
Safety evaluation for urban space with mixed movility
Affinity between stagnant space and micromobility

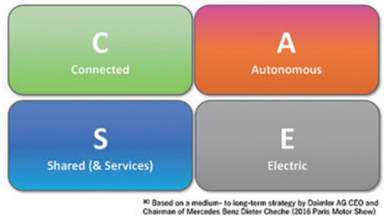
The research purpose of this research unit is to develop a simulation system that evaluates mutual behavioral safety in a “Mixed Mobility Urban Space.” As currently envisioned, smart city development plans will be steadily promoted by Mobility as a Service (MaaS) and vehicle artificial intelligence (AI). However, it is also possible that such urban spaces will produce numerous accidents due to the mixture of pedestrians, cars, PVs, and logistic drones, etc. Moreover, existing pedestrian space safety evaluation methods cannot simultaneously evaluate crowd flow and vehicle behavior. This background provides us with opportunities to holistically consider urban space design and vehicle mechanical engineering. Some remarkable achievements resulting from the studies shown below will be presented in the system construction process.



Figure： Research scheme for mixed mobility urban space

Automotive industry and CASE※ for smart city development and maintenance

Connected…Connected car
Autonomous…self-driving
Share & Service…Share service(MaaS)
Electric…Electrification, drive-by-wire, etc.



※ Based on a medium- to long-term strategy by Daimler AG CEO and Chairman of Mercedes Benz Dieter Cheche (2016 Paris Motor Show)

Taking into consideration AI, the IoT, big data, Society 5.0, and SDGs, it is clear that there is an urgent need for comprehensive research and development, issue creation, and new industries in the architectural city design, automotive, and vehicle control technology fields.

Research themes

- Research on attribute settings for “Person/person” avoidance behavior and the construction of integrated simulation algorithms
- Research on “Person/PM” and “Person/Drone” behavior modeling and mobility control
- Research on image tracking technology for the behavior of “Crowd flow, PV, and vehicles”
- Research on “Person/Vehicle” physiological and sensitive behavioral interfaces in urban space
- Research on stay activity descriptions in “Crowd/Vehicle” congestion situations

Research staff

Unit Leader/Professor
Hideaki Takayanagi

Professor
Hideo Miyachi

Associate Professor
Kazuma Sekiguchi

Associate Professor
Toshiyuki Sugimachi

Associate Professor
Yuichi Sueshige

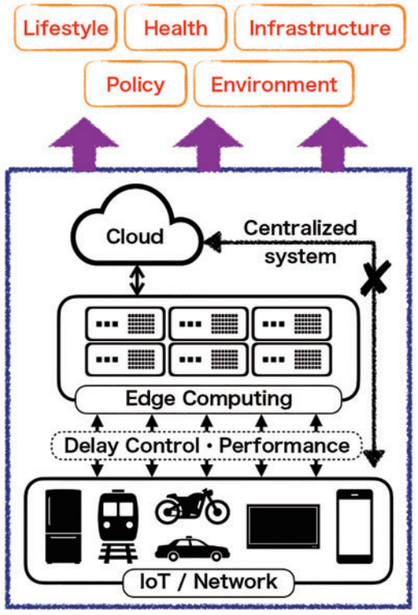
IoT & ICT Research Unit

Institute for Future City Studies

keyword ◆Big Data ◆Cloud ◆Edge Computing ◆5G ◆IoT

IoT & ICT for super-smart society
Power transmission control for sensor devices
Maintenance technologies for computing infrastructure

Although a wide variety of cloud services are offered by information technology (IT) companies such as Google, Apple, Facebook, and Amazon (GAFA), the Internet network environments in metropolitan areas can be expected to change dramatically in the future due to the global introduction of various services based on 5G and edge computing technologies. In this coming era, operation management and reliability assessment will become even more important for controlling local infrastructure under cloud service and edge computing conditions. Furthermore, while 5G, cloud, and edge computing are certain to be useful for many people in metropolitan areas, system failures by those technologies may result in private information leakage and various other damaging consequences. Therefore, appropriate cloud service management technologies based on edge computing and 5G are important for maintaining the conveniences we now expect in our daily lives. Hence, when considering the potential of future super-smart societies based on edge computing, it is clear that maintenance technologies and related services will be important for controlling information infrastructure. With those points in mind, our research unit focuses on problems related to infrastructure, the environment, lifestyle, and health as they pertain to the maintenance and assessment of edge computing.



Research themes

- Management for computing infrastructure
- Development of innovative IoT services

Research staff

Unit Leader/Professor Kohei Shiomoto
Professor Tsugumichi Shibata
Lecturer Kensyu Seto

Human-Centered Design Research Unit
Institute for Future City Studies

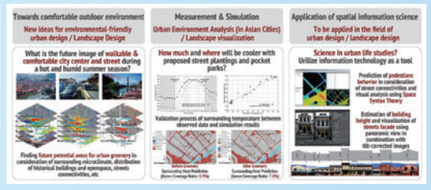
keyword
- Future Housing
- Urban Life
- Human-Centered Design
- Universal Design
- Environmental Harmony

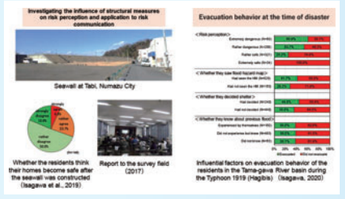
Exploring Optimum Future City Home Working Environments while Considering Pandemic-Mandated Reform Requirements

In this research unit, we study the most suitable work environments for future city homes that take into consideration the COVID-19 pandemic and emphasize pandemic-mandated reform requirements. The home workspace environments we propose are expected to contribute to sustainable development goals (SDGs) and incorporate continuation possibilities that will make them suitable for future Japanese cities. In this project, we emphasize the viewpoints of Universal Design, human-centered design, housing manufacturing techniques, environmental harmony, and urban disaster prevention.

Research themes

- Universal Design, Human-Centered Design: Toshiki Nishiyama
- Trailer House Development: Hiroyuki Shida, Yasuo Omi
- Designing Environmentally-Friendly Neighborhood Space: Kei Saito
- Town Planning the Considers Safety and Security: Teruyuki Isagawa





Research staff

Unit Leader/Associate Professor	Toshiki Nishiyama
Associate Professor	Hiroyuki Shida
Associate Professor	Kei Saito
Lecturer	Teruyuki Isagawa
Professor	Yasuo Omi

Urban Management Research Unit
Institute for Future City Studies

keyword
- Management
- Community
- Open space
- Platform
- Finance

Research on open spaces that have the potential to become places for diverse and voluntary community activities

Research on advanced community management by acquiring and utilizing data

Research on organizations and methods for helping residents to autonomously maintain and manage unused vacant city lot projects

Research on study frameworks for urban transitions

Research on new sustainable finance schemes to transform current cities into smart cities (particularly by focusing on the “Super City” concept being promoted by the Government of Japan)

Our research unit aims at the development of methods and frameworks to tackle emerging problems in urban areas, especially by focusing on Urban Digital Transformation (UDX) at two levels (community and city) as part of efforts to contribute to better urban and regional management.
At the community level, we will develop management methods that will allow residents to operate open spaces independently. More specifically, we will study the potential for community management of projects involving unused vacant lots. At the city level, we will study new management frameworks, including financing schemes, that will help local governments to realize their future visions – such as becoming a “smart city” or "super city". Hence, we will study urban management from both micro and macro perspectives.

Research staff

Unit leader/Associate Professor Koichi Kitami	Associate Professor Kyosuke Sakakura	Lecturer Noriaki Hashimoto
Professor Fumihiko Okiura	Associate Professor Yuki Akiyama	Professor Masaki Hamura

Social VR Research Unit

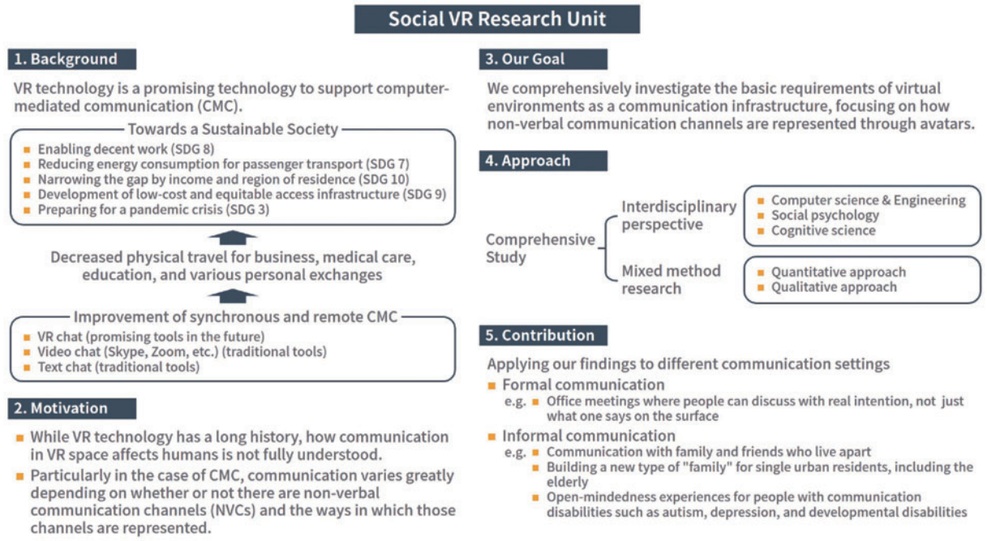
Institute for Future City Studies

keyword
- Human-Computer Interaction(HCI)
- Computer Supported Cooperative Work(CSCW)
- Computer-Mediated Communication(CMC)
- Virtual Reality(VR)
- Avatar Representation
- Non-Verbal Communication
- Mixed Methods Research, Mixed Analysis Method, Qualitative and Quantitative Approaches
- Interaction Analysis
- Physiological Measures

SUSTAINABLE DEVELOPMENT GOALS

Comprehensive understanding of the basic requirements of virtual environments as communication infrastructure

In this research unit, we focus on how non-verbal communication channels are represented through avatars, and comprehensively investigate the basic requirements of virtual environments as a communication infrastructure through a mixed-methods approach with interdisciplinary perspective.



Research staff

Unit leader/Professor
Tokyo City University・Faculty of Informatics
Junko Ichino

Professor
Tokyo City University・Faculty of Informatics
Hideo Miyachi

Professor
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Daisuke Okabe

TIS Inc.
Strategic Technology Center
Masahiro Ide

Associate Professor
Okayama University of Science・Faculty of Management
Hitomi Yokoyama

Associate Professor
Kogakuin University・Faculty of Informatics
Hirotoshi Asano

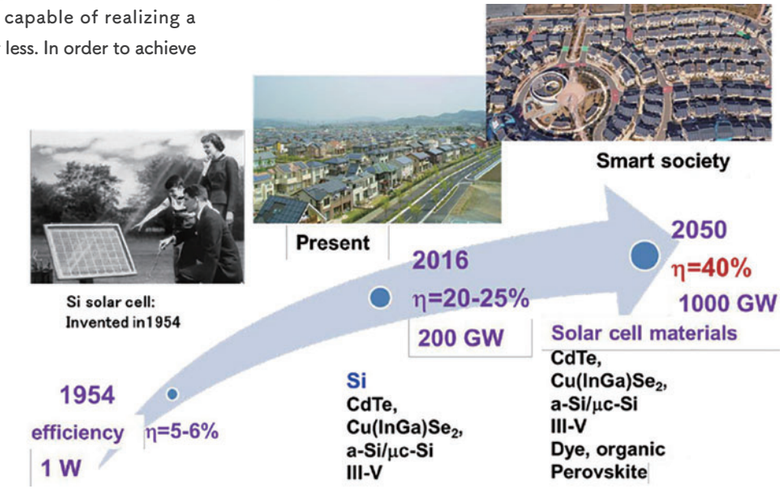
FUTURE-PV Laboratory

keyword
- Solar Energy Materials and Solar Cells
- Photovoltaics

SUSTAINABLE DEVELOPMENT GOALS

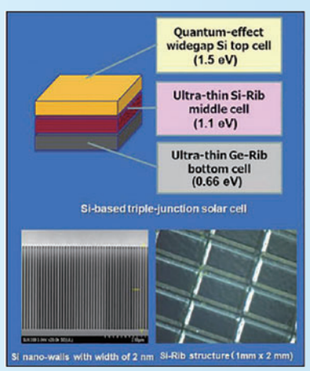
Manufacturing cost reduction and efficiency improvement of solar cells
Development of various photovoltaic systems

The 21stCentury is an era focused on energy and the environment. In response to both themes, our FUTURE-PV laboratory is dedicated to the development of photovoltaic (PV) power generation system technology. In order to meet the goal of introducing 10 TW of PV power generation systems into the world by 2050, we aim to develop technology that is capable of realizing a generation cost of 7 yen/kWh or less. In order to achieve this research goal, we are researching areas such as semiconductor device technology, nanotechnology for microfabrication, physical phenomena in microscopic fields such as quantum effects, and outdoor power generation characteristics. In addition to general power applications, we are also developing applications for transportation systems and PV cells for use as independent power sources for IoT devices.



Research themes
- Development of super-high-efficiency triple-junction Si solar cells
- High voltage bifacial amorphous Si quintuple-junction solar cells for IoT devices
- Power generation characteristics of various solar cells and development of new application fields
- Ultimate thin-film solar cell using 2D materials
- Lightweight and flexible perovskite / Si tandem solar cell


Meteorological data measurement equipments and solar cell modules



Research staff

Professor
Makoto Konagai

Associate Professor
Ryousuke Ishikawa

Visiting Professor Assistant Fellow
Yukimi Ichikawa

Assistant Fellow
Toshio Hama

Assistant Fellow
Hiroshi Noge

Assistant Fellow
Naoki Suyama

Assistant Fellow
Kimiko Furukawa

Assistant Fellow
Masatoshi Kumada

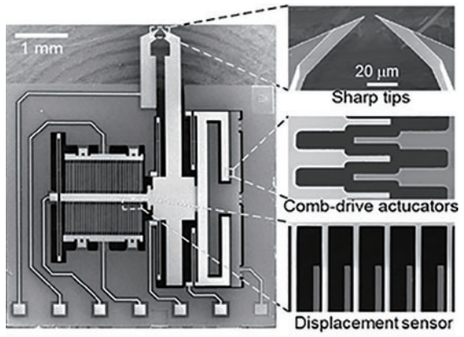
Assistant Fellow
Kazuyoshi Nakada

Micro-nano Systems Laboratory

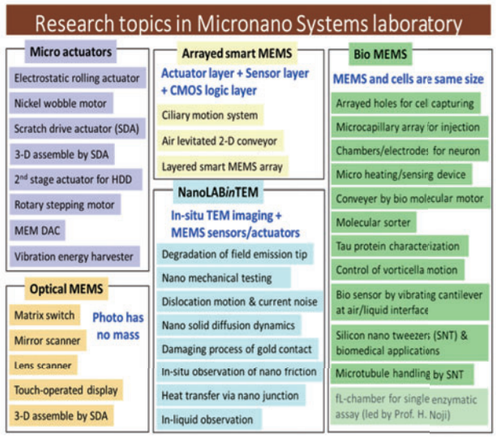
keyword ◆MEMS/NEMS ◆Bio-nanotech ◆Energy harvester

Micro-nano Systems for biotechnology, nanotechnology, and energy harvesting

In this laboratory, microelectromechanical system (MEMS) design, fabrication, and its application to nano and bio technologies, as well as vibrational energy harvesters, are investigated. Research on nano-scale science and engineering using MEMS devices covers the electro-mechano-thermal characterization of nano-contacts in transmission electron microscopes (TEMs) for in-situ atomic level observations of shapes and dimensions. MEMS tweezers have been developed for capturing, handling, and characterizing DNA, as well as other linear molecules. MEMS electrostatic energy harvesters can generate as large as 1 mW from environmental vibrations.



Silicon nano tweezers

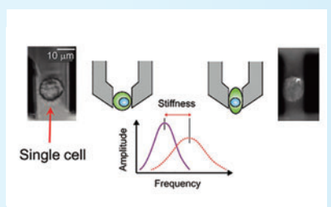


Research themes

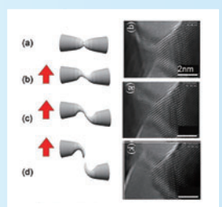
- MEMS tools for single cell or molecular manipulation and characterization features
- In-situ TEM observations using MEMS-in-TEM setup
- MEMS vibrational energy harvester

Research staff

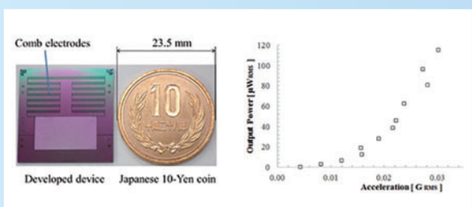
Professor Hiroyuki Fujita



Mechanical characterization of a cell



Shear deformation of an Ag nano contact



MEMS vibrational energy harvester

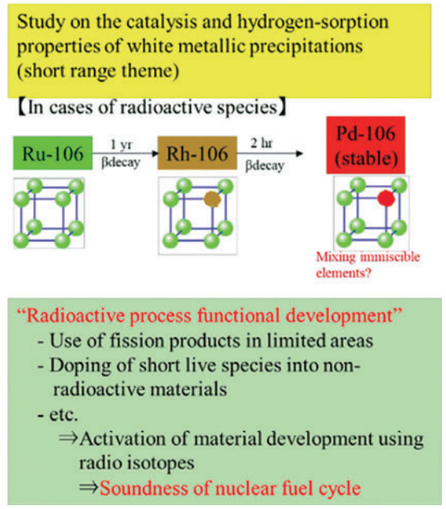
Nuclear Fuel / Fission Product Advanced Application Research Unit

Prioritized Studies

keyword ◆Nuclear Fuel ◆Fission Product ◆FP effective application ◆Fuel Debris

Study on Effective Utilization of Fission Products and Fuel Debris Handling for the Nuclear Fuel Cycle

This work will contribute to radioactive waste management by studying research applications to fission products and the relationships between waste fuel and accidents.

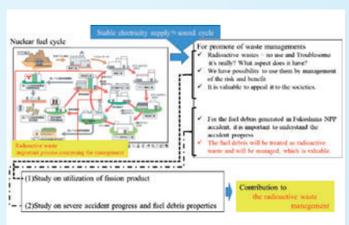


Research themes

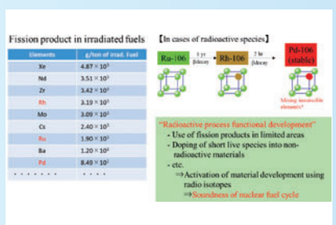
- Soundness of nuclear fuel cycle
- Functional development of radioactive processes
- Studying the progress of severe accidents and fuel debris properties

Research staff

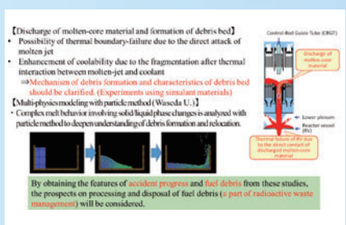
Unit Leader/Professor	Isamu Sato
Associate Professor	Haruaki Matsuura
Professor	Tohru Suzuki
Waseda Univ. Associate Professor	Akifumi Yamaji



Soundness of nuclear fuel cycle



Functional development of radioactive processes



Studying the progress of severe accidents and fuel debris properties

Ecological Evolutionary Paleontology Research Unit

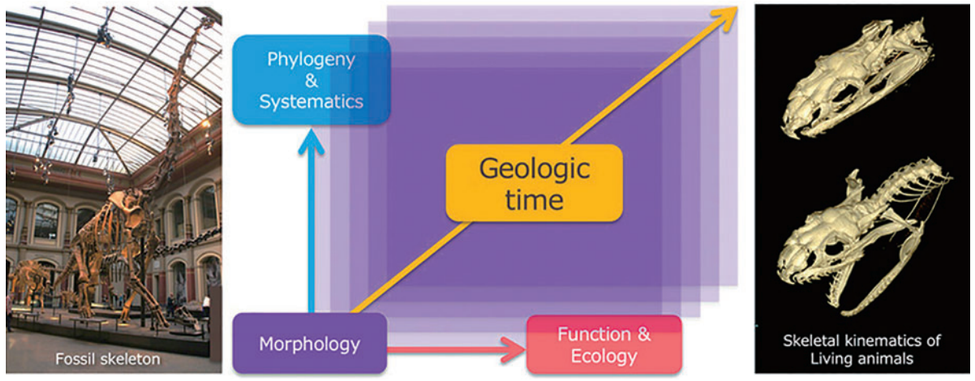
Prioritized Studies

keyword ◆Fossil ◆Ecology ◆Evolution

Exploring the History of Organismal Morphology and Ecology over the Past 500 Million Years

"Ecological Evolutionary Paleontology"

- Revealing the morphological and systematic diversity of ancient organisms based on fossil records
- Analyzing the paleoecology by integrating knowledge from fossils and living organisms
- Reconstructing the history of the modern ecosystem through geological ages



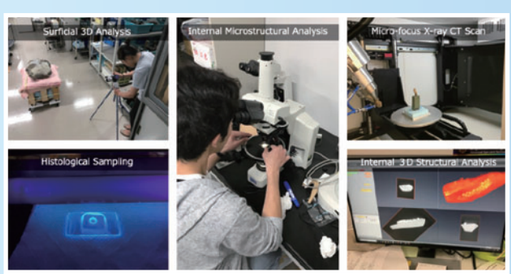
Research themes

- **Fossil Excavations**
- **Structural Comparisons of Past and Present Organisms**

Research staff

Unit Leader/Associate Professor Yasuhisa Nakajima
Unit Sub-Leader/Professor Tatsuya Fukuda

Fossil Excavation in the Field



Surficial & Internal (Micro-) Structural Analyses of Bones and Fossils

Urban Riverfront Safety & QOL Research Unit

Prioritized Studies

keyword ◆Basins in city areas ◆City type flood disaster ◆Attractive waterfront space use ◆Synergetic effects

Synergetic effects of "preparations for city-type flood disaster" and "attractive waterfront space use" for river basins in urban areas

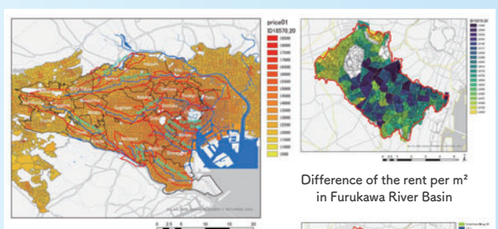
This research aims at solving the problems of river basins in urban areas toward the realization of "Sustainable Development Goals* (SDGs)." Our SDG research focus is on "Goal 11," which is to "Make cities and human settlements inclusive, safe, resilient and sustainable." In particular, we concentrate on SDG Goals 11.b and 11.7. Our research objective is to find synergetic effects related to "preparations for city type flood disaster (based on 11.b)" and "attractive waterfront space use (based on 11.7)" for river basins in urban areas.
*United Nations, General Assembly, the 2030 Agenda for Sustainable Development, 2015.

Research themes

Researchers from different fields of expertise exchange various research results and work together on a single task.

Flip Cards for Kids Facilitating Questionnaire Survey

Urban Rivers Captured by Kids



Average of the rent per m² by the districts in the river basins with strengthened prevention measures against floods

Difference of the rent per m² in Furukawa River Basin

Flood risk × Greenarea (Area, Distance)

Research staff

Associate Professor, City planning
Yukari Niwa

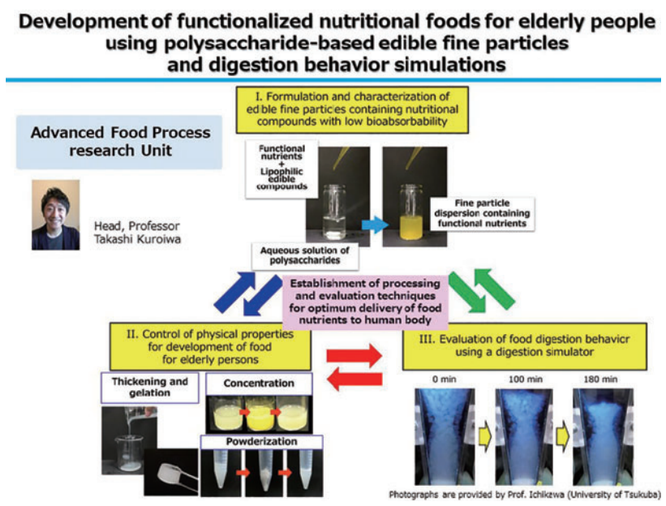
Associate Professor, Environmental dynamic analysis
Shigehiro Yokota

Advanced Food Process Research Unit

Prioritized Studies

keyword
- Foods for elderly people
- Food processing
- Evaluation of digestive properties

Japanese society is now facing the "100-year-life" time period. In recent days, the importance of meals and food has been increasing, which has resulted in diversified requirements for food functionality. The objective of the Advanced Food Process Research Unit is to develop novel processing technologies for high-quality food with various additional values, including food most suitable for elderly people and functionalized nutritional food. The basic concept of this research unit is "Designing food functionality" based on an advanced knowledge of food chemistry and food processing technologies.



Research themes

■ **Development of functionalized nutritional foods for elderly people using polysaccharide-based edible fine particles and digestion behavior simulations**

1. Formulation and characterization of edible fine particles containing nutritional compounds with low bioabsorbability
2. Control of physical properties for development of food for elderly persons
3. Evaluation of food digestion behavior using a digestion simulator

Research staff

Unit Leader/Professor
Takashi Kuroiwa

Associate Professor
Suguru Shiratori

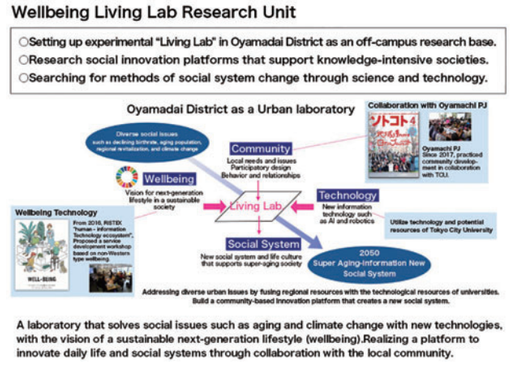
Wellbeing Living Lab Research Unit

Prioritized Studies

keyword
- Living Lab Approach
- Open Innovation
- Wellbeing Technology
- Urban Laboratory
- OYAMACHI Project

Established an off-campus research base "Wellbeing Living Lab," in the Oyamadai District. Realizing a platform to innovate daily life and social systems through collaboration with the community.

In order to fundamentally change the structure of Japan's social system, it will be essential to establish new innovation methods. In this research, we aim to develop a management method for social system creation that promotes personal wellbeing using information technology. To accomplish this, we set up our "Wellbeing Living Lab" in the Oyamadai District of Tokyo's Setagaya-Ward. This lab is designed to provide an experimental base for social technology developments that fuse cutting-edge technologies with visions for a sustainable next-generation lifestyle through collaboration with the local community. More specifically, we will promote design projects that tackle various regional issues together with people from various sectors. Through these initiatives, we will create an advanced ecosystem for local communities and build an innovation base that results in a new social system and civic culture to support the "super-aging- information society" of 2050.



Research subjects

1. Construction of an open innovation theory to promote urban social system transformations
2. Study of an innovation base management method via a living lab approach
3. Development of a participatory design method by local multi-generation stakeholders

Research staff

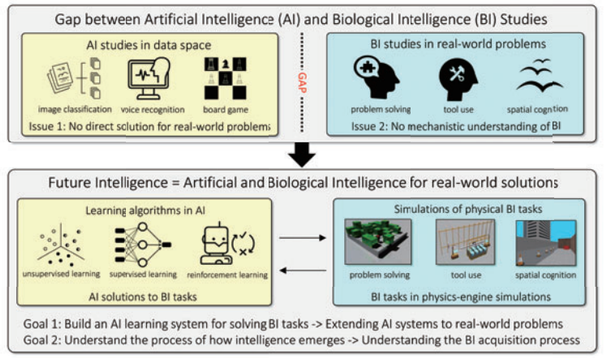
Associate Professor	Kyosuke Sakakura
Associate Professor	Yuichi Sueshige
Waseda Univ, Associate Professor	Dominick Chen
Osaka University of Arts. Professor	Hideyuki Ando

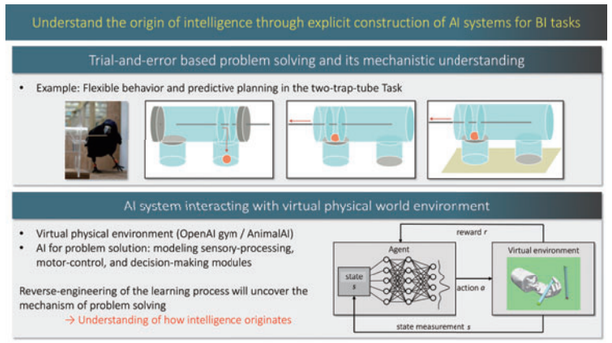
Future Intelligence Research Unit

Prioritized Studies

keyword ◆Artificial Intelligence ◆Biological Intelligence ◆Machine Learning

The missions of our research unit are (1) to develop an artificial intelligence (AI) system that can solve real-world problems and (2) to understand biological intelligence (BI) through which animals achieve adaptive and flexible problem-solving behaviors. Through incorporating BI into AI, we pursue a new kind of intelligence of what we call "future intelligence." Research topics include (1) construction of virtual environments obeying physical laws, (2) development of AI systems for general BI tasks and (3) understanding of the biological mechanisms of how BI is acquired in the brain. We hope to advance a bidirectional understanding of AI and BI fields and propose a new interdisciplinary field of future intelligence.





Research staff

Unit Leader・Professor
Hirokazu Tanaka

Professor
Hirohiko Mori

Professor
Kenya Jinno

Research Unit for Aerospace Materials Evaluation Technology

Prioritized Studies

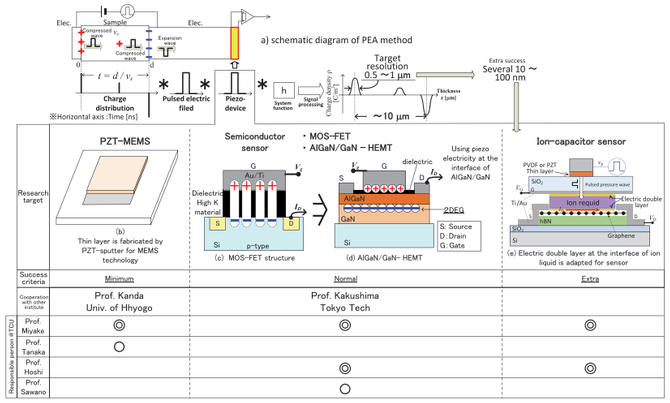
keyword ◆Measurement Technology development ◆MEMS Sensor ◆Piezo electric device ◆Dielectric materials ◆Spacecraft and aircraft materials

Adapting the developed sensors to electric aircraft and charging sensors for lunar exploration ⇒Promoted as flagship research

Building a platform for a basic aerospace technology development by promoting this research in collaboration with external organizations

Development and implementation of MEMS pressure wave sensor with submicron ultra-high position resolution

Aim: Achievement of charge measurement with sub-micron position resolution using thin-film pressure wave sensor with ps-ns time resolution developed by MEMS technology for pulsed electroacoustic method.



Role and purpose of the laboratory

Recently, the space charge distribution of insulators with sub-μm to several dozen nm positional resolution has been desired for motor windings, photoconductive films, and electronic components etc. In addition, there are cases of severe environmental conditions such as high temperature and radiation. In order to meet this demand, we will develop a piezoelectric PZT thin film using MEMS technology and a semiconductor sensor using a depletion layer as the polarization structure of a piezoelectric element to improve the positional resolution up to submicron in the pulsed electroacoustic (PEA) method. This method can obtain the charge distribution from the intensity and propagation time of nanosecond pulsed pressure waves generated from the accumulated charge.
The developed sensor will be applied as a sensor for the PEA method, aiming to realize the charging measurement of thin films.

Characteristics of research and development technologies

- PZT has good piezoelectricity, but it was very difficult to make thin films. However, thanks to improvements in sputtering technology, it has become possible to create films with a thickness of less than 3 μm, enabling us to do this research.
- We will apply a pressure wave sensor based on MOS-FET structure with AlGaN/GaN heterostructure HEMT, which is expected to be used as a high-speed, high-power, and high-efficiency device for various green ICT technologies.
- The ionic liquid electric double layer capacitor + MEMS-FET sensor uses the electric double layer formed at the interface between the ionic liquid and the electrode. This sensor aims to measure the charging in the micro region of nm order, which is beyond the conventional concept for pressure wave sensors.

Research subjects

1. **Development of high-resolution pressure wave sensor using thin-film piezoelectric element based on MEMS-PZT**
2. **Development of super high resolution pressure wave sensor using AlGaN/GaN heterostructure HEMT**
3. **Development of extra super high resolution pressure wave sensor using ionic liquid electric double layer capacitor + MEMS-FET sensor**
4. **Implementation of the developed sensor into the PEA method to measure the space charge distribution in a thin film insulator with a thickness of less than 50 μm.**

Research staff

Professor・
Department of Mechanical Systems Engineering
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Professor・
Department of Mechanical Systems Engineering
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Professor・
Department of Electrical, Electronics and Communication Engineering
Kentarou Sawano

Associate Professor・
Department of Electrical, Electronics and Communication Engineering
Yusuke Hoshi

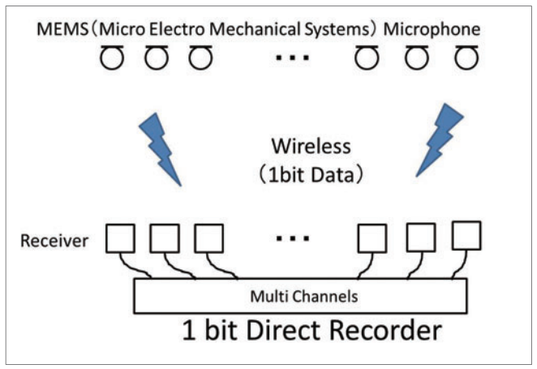
Cultural Diversity Laboratory

keyword ◆Culture ◆Entertainment ◆Acoustics

SUSTAINABLE DEVELOPMENT GOALS

Our mission:
Development of human resources and technology for cultural diversity

This incubation laboratory was established in 2014 in order to contribute to realization of a culturally diverse society through inter-media art and science studies. Our laboratory consists of a study group on entertainment and a study group on acoustics. It also facilitates the development of human resources who create content and advance communication across boundaries of regions, languages, generations, and principles.



Research themes

- Cultural support for the affected areas of the Great East Japan Earthquake
- Impromptu performance with potential or limit
- Open courseware
- Shibuya station area redevelopment plan: “Entertainment city Shibuya”
- Development of a deterring and inviting sounds for prevention of damage by wildlife
- Auditory guide system with parametric loudspeaker
- Education in acoustics for elementary and high school students
- Sound environmental designs in nursery and educational institutions

Research staff

Research Professor	Yoshio Yamasaki
Visiting Researcher	Sumihiko Hashimoto
Visiting Researcher	Kazuhiko Tabata
Visiting Researcher	Kenichi Komoguchi
Visiting Researcher	Jyunpei Kudo
Visiting Researcher	Tomoko Komoriya
Visiting Researcher	Mistuhiro Ikehata
Visiting Researcher	Sawori Namekawa
Assistant Fellow	Tadashi Konishi

Research Administration Center (RAC)

The Advanced Research Laboratories (ARL), which were established in 2004 as university-wide research facilities for promoting research with distinctive features, have been positioned as the foundation for internal priority research since 2015. The ARL established the Research Administration Center (RAC), which provides support for the expansion of research centers, the establishment of new research institutes, further enhancement of basic research, and the facilitation of social implementation of applied technology, also intends to play a role as TCU ERC* in promoting extensive activities.

- Planning of research strategies
- Assistance in obtaining external funds
- Assistance for industry-academia-government collaboration
- Trend surveys and analysis for national science and technology policies
- Assistance for researches and developments of research institutes and centers in TCU
- Assistance for holding of research meetings, seminars, and symposiums
- Publicization and dissemination of information on the RAC’s activities
- Strategies for intellectual properties of researches and developments

Research staff

Center Director/Vice President	Industry-Academia-Government Collaboration Coordinator	Research Promotion Advisor	URA (University Research Administrator)
Kenichiro Nonaka	Kimihiko Saito	Akifumi Suzuki	Yoshihiko Bando