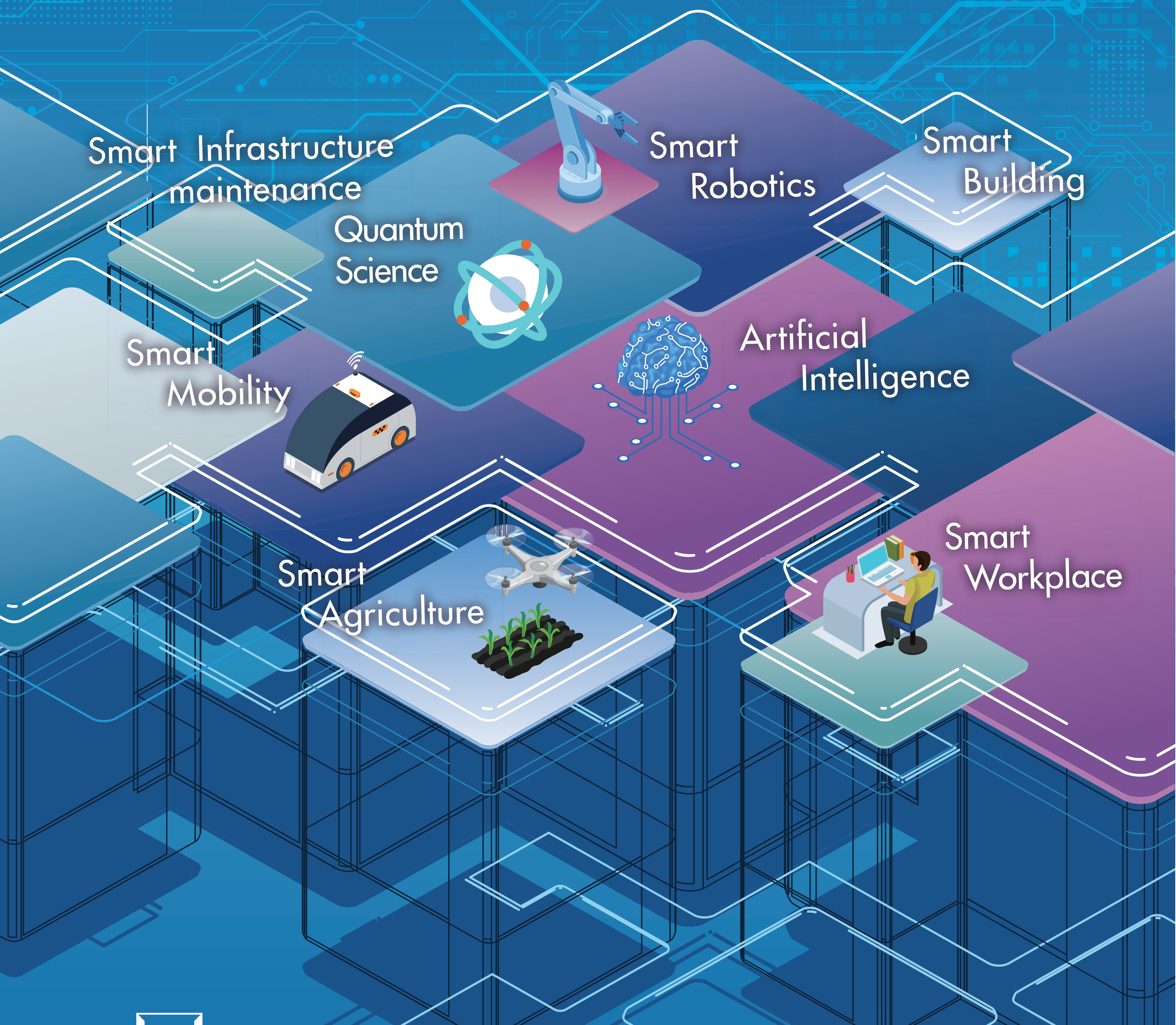
超スマート社会推進コンソーシアム
TokyoTech Super Smart Society Promotion Consortium

Super Smart Society Promotion Consortium

Activity Report



東京工業大学
Tokyo Institute of Technology

2022

Table of Contents

Super Smart Society Promotion Consortium Activity Report (2022 Academic Year)

1. Overview of Activities in the Fifth Year (2022 Academic Year)

1-1 What is the Super Smart Society Promotion Consortium?

The Super Smart Society Promotion Consortium was established in October of 2018 to create a platform for next-generation social collaborative education and research, where everything from human resource development to R&D are integrated through a collaboration with industry, government, and academia in order to foster leaders who can lead the coming super smart society (Society 5.0). As of April 2023, the 59 partners (not including individual members) shown in Table 1-1 including research institutes, local governments, and private companies are participating in this consortium to promote open innovation and open education for a super smart society.

The Super Smart Society Promotion Consortium has three committees, as shown in Figure 1-1. 1) The Super Smart Society Promotion Committee provides networking opportunities for a super smart society, plans and holds events such as the Super Smart Society Promotion Forum, and provides social enlightenment though One-Day Schools. 2) The Social Collaborative Education Steering Committee assists with human resource development and career support. It helps with human resource development in collaboration with the WISE-Super Smart Society (SSS) Program (established at the Tokyo Institute of Technology (Tokyo Tech) in April 2020), and supports off-campus projects (internships). 3) The Interdisciplinary Research Promotion Committee helps to coordinate research and development teams, holds matching workshops, and helps develop SSS research and education fields. The activities during the 2022 academic year are summarized in this report according to each committee.

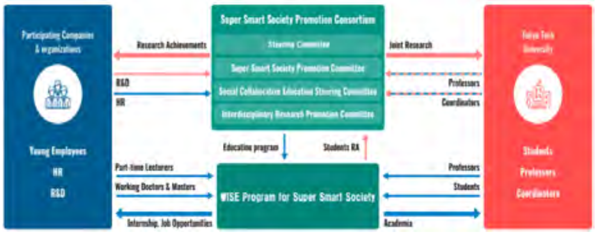


Figure 1-1 Organization of the Consortium

Table 1-1 Consortium partners (As of April, 2023)

1	Tokyo Institute of Technology	31	Nileworks Inc.
2	Japan Agency for Marine-Earth Science and Technology	32	NSK Ltd.
3	Information Technology and Human Factors, National Institute of Advanced Industrial Science and Technology	33	NEC Corporation
4	National Institute of Information and Communications Technology	34	NIPPON TELEGRAPH AND TELEPHONE CORPORATION
5	National Agriculture and Food Research Organization	35	Panasonic Corporation
6	RIKEN Center for Advanced Intelligence Project	36	Hitachi, Ltd.
7	National Institutes for Quantum and Radiological Science and	37	FUJITSU LIMITED
8	aiwell Inc.	38	Honda Research Institute Japan Co., Ltd.
9	Azbil Corporation	39	Makino Seiki Co., Ltd.
10	ANRITSU CORPORATION	40	Mazda Motor Corporation
11	ITOKI CORPORATION	41	Mizuho–DL Financial Technology Co., Ltd.
12	Idemitsu Kosan Co.,Ltd.	42	MITSUBISHI ESTATE CO., LTD.
13	ACSL Ltd.	43	Mitsubishi Jisho Design Inc.
14	AGC Inc.	44	Mitsubishi Electric Corporation
15	NTT Urban Solutions, Inc.	45	YASKAWA Electric Corporation
16	UMITRON K.K.	46	Yokogawa Electric Corporation
17	LG Japan Lab Inc.	47	Rakuten Mobile, Inc.
18	Kawasaki Heavy Industries, Ltd.	48	Ricoh Company, Ltd.
19	Kubota Corporation	49	ROCKY-ICHIMARU Co., Ltd.
20	KDDI CORPORATION	50	Ministry of Agriculture, Forestry and Fisheries
21	Koden Electronics Co., Ltd.	51	Ota City
22	Komatsu Ltd.	52	Meguro City
23	JTEKT CORPORATION	53	Kawasaki City
24	SHO-BOND CORPORATION	54	City of Yokohama
25	SoftBank Corp.	55	Kanto Head Office, Organization for Small & Medium Enterprises and Regional Innovation, JAPAN
26	DENSO Corporation	56	The Ocean Policy Research Institute, The Sasakawa Peace Foundation
27	Central Japan Railway Company	57	The Ecozzeria Association
28	Tokyu Research Institute, Inc.	58	Institute for Marine Culture and Research Promotion
29	TOSHIBA CORPORATION	59	Marine Open Innovation Institute
30	Tressbio Laboratory Co., Ltd.		

1-2 Activity highlights of the fifth year (2022 academic year)

Table 1-2 gives an overview of the activities and events of the Super Smart Society Promotion Consortium during the fifth year (2022 academic year), along with a list of corresponding committees. The various committees meet together four times a year in order to plan SSS promotion projects and various events. In the 2022 academic year, the restrictions on activities due to COVID-19 were gradually eased, allowing for the first in-person events in three years starting in September, which produced more active discussions than online. In particular, the autumn Super Smart Society Promotion Forum, held in an in-person/online hybrid format for the first time since the outbreak of COVID-19, was a very successful event with more than 500 people registering, organized under the motto “International Perspectives for 6G Communications towards Super Smart Society,” including demonstration exhibits. Details of each event, including this one, are summarized in this activity report.

The consortium has jointly obtained multiple competitive funds, including a grant from the WISE Program (Doctoral Program for World-leading Innovative & Smart Education) operated by Ministry of Education, Culture, Sports, Science and Technology. The purpose of these funds is to promote open innovation and open education pertaining to the Super Smart Society. Thus far, we have constructed the eight SSS research and education fields shown below (Table 1-3 on the next page). These research and education fields are positioned as microcosms of the ideal super smart society, and are open platforms that can be used for education and research by any Consortium Partner.

Table 1-2 Our activities in AY2022

Month	Events	Committee
Apr. 2022	Suruga-Bay Smart Ocean Symposium	(1)
Jun.	14th Joint Committee	(1)(2)(3)
Jun.	Matching Workshop (Spring, 2022)	(2)
Jun., Jul.	Super Smart Society Innovation A3	(3)
Aug., Sep.	Off-campus Project (Summer, 2022)	(2)
Sep.	Super Smart Society Promotion Forum	(1)
Oct.	15th Joint Committee	(1)(2)(3)
Oct., Nov.	Super Smart Society Innovation A1	(1)
Nov.	16th Joint Committee	(1)(2)(3)
Nov., Dec.	Matching Workshop (Autumn, 2022)	(3)
Dec., Jan. 2023	Super Smart Society Innovation A2	(2)
Dec., Jan.	Super Smart Society Innovation A4	(2)
Dec., Jan.	Ota Ward Entrepreneurship Seminar	(2)
Jan.	SSS One-Day School	(1)
Feb., Mar.	Off-campus Project (Spring, 2023)	(1)
Mar.	17th Joint Committee	(1)(2)(3)
Mar.	Super Smart Society Promotion Forum	(1)

(1) The Super Smart Society Promotion Committee
(2) The Social Collaborative Education Steering Committee
(3) The Interdisciplinary Research Promotion Committee

The themes and structure of the research and education fields were determined by having open recruitment at various committees during the previous academic year and having discussions with related Consortium Partners. We would like to ask all Consortium Partners to actively contribute to the construction and utilization of research and education fields. We are looking forward to hearing ideas such as for solving social issues and verifying social implementation by means of these research and education fields.

2. Activities of the Super Smart Society Promotion Committee

2-1 SSS Promotion Forum

In the 2022 academic year, we held two SSS Promotion Forums; one in the first semester and one in the second semester. Details are given below.

(1) 6th SSS Promotion Forum “International Perspectives for 6G Communications towards Super Smart Society”

“Beyond 5G/6G,” the next generation of wireless technology, will enable ultra-high-speed data transmission of several terabits per second throughout the entire range of human activity, which promises a revolutionary future where everything is connected to the network. Furthermore, by integrating this with technologies such as DTs (Digital Twins), AI (Artificial Intelligence), holographic communication, AR/VR/MR (Augmented Reality/Virtual/Mixed), industrial structures, social life, services, and lifestyles will evolve into something completely new. Based on this premise of the near future, the Super Smart Society Promotion Consortium held a technical forum titled “International Perspectives for 6G Communications towards Super Smart Society,” inviting experts from Japan and abroad. Looking ahead to the world of the coming 6G era, innovative technologies and cutting-edge knowledge on a wide range of topics from underlying technologies to services used for wireless communications and the resulting Super Smart Society were introduced, and visions for the future were discussed.

This forum was hosted by the Super Smart Society Promotion Consortium, co-hosted by Tokyo Tech and the Tokyo Tech Academy for Super Smart Society, and supported by the Information Processing Society of Japan (IPSJ), Institute of Electronics, Information and Communication Engineers (IEICE), the Japan Society of Applied Physics, the Society of Instrument and Control Engineers (SICE), Innovations and Future Creation Inc. (MIRAI SOUZOU), Beyond 5G Promotion Consortium, and the IEEE Japan Council, with the cooperation of Ota City, Meguro City, Kawasaki City, Yokohama City, and Tokyo Tech Alumni Association. The program is shown in Figure 2-1.

Table 1-3 SSS Research and Education fields

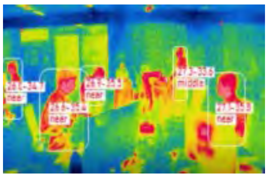
Smart Mobility	Smart Workplaces
 A platform for new smart mobility services by utilizing automated driving vehicles and cutting-edge technologies, such as digital twin, 5G/6G, millimeter Wave V2X.	 A platform for smart workplaces with the aim of establishing better workplaces. We are building workplaces for the post-COVID-19 era, including air conditioning control using a variety of sensors and AI.
Smart Robotics	Smart Agriculture
 A platform for utilizing robots in the fields of land, sky, aqua, and manufacturing. We are conducting researches about four-legged robots for outdoor fields (land), drones(sky), underwater robots and drones (aqua), and digital manufacturing technology, etc.	 A platform for smart agriculture in response to problems related small-scale agriculture in Japan. We are working on remote agricultural technology that enables automated and stable production of high-quality crops by fully utilizing AI, IoT, and robot technology.
Quantum Science	Smart Infrastructure Maintenance
 A platform for quantum computing and quantum sensors for the next generation. We are conducting research and application of ultrafast next-generation quantum computers and ultrasensitive quantum sensors.	 A platform for achieving Sustainable Social Infrastructure (SSI), which supports our life and society. Its goal is to ensure secure maintenance of infrastructure and to enhance urban functionality and resilience.
Artificial Intelligence	Smart Building
 A platform for artificial Intelligence (AI). The super computer "TSUBAME" and Wi-Fi6 are used to build a platform for the use of machine learning services.	 A platform for evaluating the safety and continuity of use of buildings and providing occupants with early notification of building condition in the event of earthquakes and typhoons. The platform uses data from high-performance sensors densely installed in buildings.

Figure 2-1 6th SSS Promotion Forum Program

Since keynote speeches were requested from Europe and the U.S., the forum was divided into a *Morning Session* and an *Afternoon Session* to accommodate the time difference, with an exhibition by the Consortium Partners in between. After opening remarks by Tokyo Tech Executive Vice President for Education Jun-ichi Imura and Director Hisashi Kanazashi from the IT Industry Division of the Commerce and Information Policy Bureau at the Ministry of Economy, Trade and Industry (METI), three speakers in the *Morning Session* and five speakers in the *Afternoon Session* spoke about innovative technologies and the latest findings on a wide range of topics for the 6G era.

First, Professor Hiroyuki Morikawa of the University of Tokyo's Graduate School of Engineering gave a keynote speech titled "How to face 5G/Beyond 5G/6G." He described how to face 5G/Beyond 5G/6G from three perspectives: getting on the 5G playing field, the importance of diversity, and expanding stakeholders, emphasizing the importance of engaging people with diverse backgrounds to discover problems, create value, and promote innovation. Then, Mr. Satoshi Nagata of NTT DOCOMO, INC. gave a presentation on "6G and NTT DOCOMO activity" from an industry standpoint, and Mr. Takanori Iwai of NEC Corporation gave a presentation on "AI x 6G: Intelligent wireless communication control technology." The *Morning Session* concluded with an explanation of the Super Smart Society Promotion Consortium by Vice President for Global Communication Nobuyuki Iwatsuki, Chair of the Super Smart Society Promotion Consortium Steering Committee.

A technology exhibition was held by the Consortium Partners during the lunch break (Figure 2-2). Twelve Consortium Partners participated, each with a poster exhibit (including displays and demonstrations of actual products) at their booths. The exhibition was also broadcast live via camcorder for online forum participants.


Figure 2-2 Technology Exhibition

In the *Afternoon Session* , three lectures entitled "Ookayama Beyond 5G Test Field towards Super Smart Society," "Future Life in 2030s and System Concept of Beyond 5G," and "Technical Challenges towards 6G and Ericsson Engagement" were presented by Professor Kei Sakaguchi (Dean of the Tokyo Tech Academy for Super Smart Society), Mr. Kentaro Ishizu (National Institute of Information and Communications Technology [NICT]), and Mr. Masanobu Fujioka (Chief Technology Officer, Ericsson Japan K.K.), respectively.

Finally, keynote presentations entitled "Metaverse-ready wireless networks" (from Europe, by Professor Haris Gačanin of the RWTH Aachen University) and "The Role of Digital Twins: An Implementation Perspective" (from the United States, by Mr. John Reynolds, Co-Chairman of the Natural Resources Working Group, Digital Twin Consortium) were given. Finally, Professor Kotaro Inoue (Dean of the School of Engineering) gave closing remarks.

This year's event was a hybrid of in-person and online sessions, with 119 participants (on-site) from within and outside of the Institute and 429 participants online, sharing cutting-edge technologies and engaging in lively discussions.

(2) 7th SSS Promotion Forum "Super Smart Society x Industry 5.0"

Production and factory-wide process management in the era of the Super Smart Society will be transformed by the advancing Digital Transformation (DX). Furthermore, by actively utilizing Information and Communication Technologies (ICT) such as AI, Machine Learning (ML), and Cyber Physical Systems (CPS), it will likely evolve into something more efficient and highly accurate. Furthermore, industrial structures and productions are expected to evolve into innovative frameworks through the coexistence of robots and humans, holographic communication, and integration with virtual, augmented, and mixed reality. On this basis, we held a technology forum titled "Super Smart Society x Industry 5.0." This forum was hosted by the Super Smart Society Promotion Consortium, co-hosted by Tokyo Tech and the Tokyo Tech Academy for Super Smart Society, and supported by the IEICE, IPSJ, the Japan Society of Mechanical

Engineers, SICE, Japan Society for Precision Engineering, Japan Machine Tool Builders' Association, Innovations and Future Creation Inc. (MIRAI SOUZOU), Sasagawa Peace Foundation, and IEEE Japan Council, with the cooperation of Kawasaki City, Ota City, Yokohama City, Meguro City, Tokyo Tech Alumni Association, and the Kanto Branch of the Society of Automotive Engineers of Japan, Inc. The program is shown in Figure 2-3.

Figure 2-3 7th SSS Promotion Forum Program

After opening remarks by Specially Appointed Professor Eisuke Fukuda, Chair of the Super Smart Society Promotion Committee, Mr. Kenta Kanto of DMG MORI CO., LTD. gave a keynote speech titled "Evolution of Processing Machines through Fusion with Automation and Measurement Technologies." The presentation included specific examples of DMG MORI's efforts from the perspectives of (1) process integration, (2) automation, and (3) DX.

Then, Mr. Shinichi Nakano (Kawasaki Heavy Industries, Ltd.) spoke on "Smart Manufacturing for Reforming Work Styles - Aiming for Solutions to Current Issues and Preparing for the Future -," followed by Mr. Keiichiro Kobuchi (Yokogawa Digital Corporation) on the "Utilization of AI Technology with the Goal of Autonomous Operation," then Mr. Tohru Onozaki (JTEKT Corporation) on the "Use of AI and Software for Labor-Saving in Production of Automotive Parts," and Mr. Shinji Murai (Yaskawa Electric Corporation) on the "Evolution of Robots and Realizing Data-Driven Autonomous Distributed Manufacturing." Finally, Associate Professor Tomohisa Tanaka of Tokyo Tech gave a lecture on "Trends in AM and Its Practical Application in Manufacturing Systems" (AM: Additive Manufacturing). Overall, the presentations showed that automation, digitalization, AI technology, and robotics solutions are being applied to a wide range of areas in the manufacturing process. Vice President for Global Communication Nobuyuki Iwatsuki, Chair of the Super Smart Society Promotion Consortium Steering Committee, then explained the Super Smart Society Promotion Consortium, and Professor Kei Sakaguchi, Dean of the Tokyo Tech Academy for Super Smart Society, gave closing remarks.

Once again, the event was a hybrid of in-person and online sessions, with 220 participants from within and outside of the Institute sharing cutting-edge technologies and engaging in lively discussions.

2-2 One-Day School

This One-Day School was held as a recurrent education and provided an opportunity for practical training in research and education fields in four disciplines (artificial intelligence, quantum science, smart mobility, and smart workplaces). The school was held for Consortium Partners of the Super Smart Society Promotion Consortium. Table 2-1 shows the programs. As implied by its name, this One-Day School features one day of lectures and practical training for a single research and education field. By giving an overview of the research and education field to the Consortium Partners, the school assists them in considering future utilization and R&D of the field.

In principle, the number of participants is limited to 5 to 10 per field. This ensures close discussions with the faculty members in charge, and opportunities for all participants to come into direct contact with the research and education fields. One-Day School for the Smart Workplace research and education fields was conducted at Otemachi 3x3 Lab Future,

Table 2-1 One-Day School Program

Research & Education Fields	Date	Contents of Program (lecture / practice)
Quantum Science	1/16	・Cooling down qubit devices and observation of quantum phenomena ・Hands on learning on techniques required for precise measurements ・Practice concerning fabrication of superconducting thin films that constitute quantum sensors and characterization of their physical properties
Smart Mobility	1/19	・Lectures on autonomous driving, ITS, and next-generation wireless communication technology ・Exercises using autonomous-driving vehicle
Artificial Intelligence	1/20	・Neural Networks, Stochastic gradient decent and Back propagation, RNN and CNN, introduction of TSUBAME, Practice using Google Colab, Experiment of building language models.
Smart Workplaces	1/26	・Introduction of Smart workplace education and research field ・Technologies and sensors in the smart workplace field ・Visualization of human thermal comfort and droplet nuclei behaviors

for the artificial intelligence field online, and for other fields at the Ookayama campus. Sixteen people from five companies participated in this year's One Day School. Through lively discussions and practical training, the School promoted technical contribution to Consortium Partners (Figure 2-4). In the future, we plan to expand the number of fields and their technical fields so that participating partners can further utilize these research and education fields.

Figure 2-4 One-Day School（Quantum Science）

2-3 The Ota City Start-up Experience Off-Campus Project

Continuing on from the 2021 academic year, the Ota City Start-up Experience Off-Campus Project was executed in collaboration with the Industrial Promotion Section, Department of Industry and Economy, Ota City. In the 2021 academic year, the project was executed in the form of a two-day seminar, but in the 2022 academic year, it was formally offered as a seven-day course with three part-time lecturers. The program is shown in Table 2-2.

The 2021 program focused on business plan writing exercises at Haneda Innovation City (HIC), but in the 2022 academic year, the program did not stop there, but also included lectures at Tokyo Tech Ookayama Campus and visits to unique facilities in Ota City, including the JAL Sky Museum, which is normally inaccessible, and the Omori-minami 4-chome Factory Apartment (Techno FRONT Morigasaki) in Ota City to educate the students (Figure 2-5).

For the preparation of business plans, as in the 2021 academic year, lectures on specific entrepreneurial know-how were given to students interested in starting a venture business on the assumption that they would commercialize their research topics, and people active in various industries participated as mentors to provide a practical curriculum. In addition, the students were able to learn about the career path of "entrepreneurship" through listening to business experiences of Tokyo Tech alumni, who were visiting as guests.

Table 2-2 Program of the Ota City Start-up Experience Off-Campus Project

Date	Location	Theme
12/7	Ookayama Campus	General guidance, introduction of Ota City's initiatives, alumni testimonials, lecture on business plan preparation
12/14	Ookayama Campus	Lectures on business plan preparation, preparation work, and mentoring
12/21	Ota City Araijyuku Special Branch Office Ryushi Memorial Museum	Lectures on business plan preparation, preparation work, and mentoring, visit Ota City Ryushi Memorial Museum
1/11	JAL SKY MUSEUM	Visit JAL Sky Museum, lecture on business plan preparation, preparation work, and mentoring, alumni talk
1/18	Techno FRONT Morigasaki Haneda Innovation City KicSpace HANEDA	Visit the factory apartment (Techno FRONT Morigasaki) and Haneda Innovation City (1), Lecture on business plan preparation, preparation work, and mentoring
1/25	Haneda Innovation City KicSpace HANEDA	Visit Haneda Innovation City (2), lecture on business plan preparation, preparation work and mentoring
2/1	Ookayama Campus	Final presentation, mentor critique, and awarding of certificates

Figure 2-5 Visiting JAL Sky Museum

3. Activities of the Social Collaborative Education Steering Committee

3-1 Implementation of cyber / physical off-campus projects

As part of the activities of the Social Collaborative Education Steering Committee, this consortium together with the Tokyo Tech Academy for Super Smart Society are planning cyber/physical off-campus projects (interdisciplinary internships for master's degree program and doctoral degree program students). In the 2022 academic year, we asked the Consortium Partners to recruit internships. Internships for master's degree programs are a major requirement for enrollment in the WISE-SSS Program, and internships for doctoral degree programs are a major requirement for completion of the WISE-SSS Program, so highly motivated students can be expected to apply.

For internships for master's degree programs, we posted information on the consortium's website about the openings at each Consortium Partner and made it widely known to students. Although it was a difficult time, with COVID-19 having a major impact, we were able to accept 18 students for internships at nine Consortium Partners for the summer of 2022. For the winter of 2022, four Partners have accepted four students for internships. The impact of COVID-19 was serious at this time and major issues remained; for example, it was particularly difficult to set up internships in English for international students.

Internships for master's degree programs in the 2023 academic year are envisioned for the summer break (August 2023) and the spring break of 2024. We look forward to your continued cooperation, including internships in English.

For internships for doctoral students starting in the 2022 academic year, while protecting the privacy of students, we built a framework for sharing information summarizing the research themes and research achievements of each student with Consortium Partners. This enabled reforms to ensure efficient matching with partners.

In the 2023 academic year, we hope to continue the active discovery of new fields where the needs of participating partners can be matched with the professional abilities of students, and that more internships can be accepted.

Also, because of the spread of globalization, we want to promote internships in English and plan overseas internships. We look forward to continued cooperation from Consortium Partners.

3-2 Courses related to Super Smart Society Innovation

The goal of the Tokyo Tech Academy for Super Smart Society is to cultivate the needed expertise and see the big picture for realizing a super smart society for students enrolled in the WISE-SSS Program or interested students in the master's degree program and doctoral degree program, and to offer omnibus lectures on trending issues in the real world in collaboration with Consortium Partners. This will allow us to create original science and technologies in specialized fields spanning both cyber and physical fields, and resolve various social issues by having an overview of the path from quantum science to a super smart society, with the aim of developing students with leadership skills capable of leading each sector of industry, government, and academia. In the 2022 academic year, with the cooperation of Consortium Partners, we started the social cooperation courses Super Smart Society Innovation A1, A2, A3, and A4. Omnibus lectures on the frontiers of quantum science (A1), IoT/robotics/smart cities (A2), smart agriculture (A3), and smart workplaces (A4) were given by researchers from Consortium Partners, using on-demand distribution of lecture videos and discussion via a bulletin board system. Super Smart Society Innovation A1 had a total of 19 students registered for courses, 14 of which earned credits. A2 had a total of 40 students registered for courses, 33 of which earned credits. A3 had a total of 27 students registered for courses, 23 of which earned credits. A4 had a total of 25 students registered for courses, 23 of which earned credits. The on-demand video-style lectures and discussions using a bulletin board system were extremely well-received by students in a variety of different systems and courses at Tokyo Tech. There was an enormous amount of positive feedback on the contents and format of the lectures. In the 2023 academic year, in addition to updating the existing lecture content, we are also in discussions with relevant partners to further offer "Super Smart Society Innovation A5" on manufacturing process innovation. We look forward to continued cooperation from Consortium Partners.

4. Activities of the Interdisciplinary Research Promotion Committee

4-1 Matching workshops

In the first semester of the 2022 academic year, interdisciplinary matching workshops were held on June 8 (in-person) and June 29 (online). The S-Round on June 8 was where students from Tokyo Tech offered the Institute's research seeds, while the N-Round on June 29 was where Consortium Partners of the Super Smart Society Promotion Consortium presented their needs in an opposite way. There were lively discussions among the 37 participating students, researchers from 23 partners, and Tokyo Tech faculty members. In the second semester, the S-Round (November 16) was similarly held in person, while the N-Round (December 7) was held online. 29 students, researchers from 17 partners, and Tokyo Tech faculty members participated. In the 2022 academic year, we were able to surmount the COVID-19 pandemic and hold the first in-person workshops in about two and a half years (Figure 4-1). At each workshop, questionnaires were provided to students and Consortium Partners based on which joint research and human resource matching was established. A total of 19 matches were counted in this fiscal year.

Figure 4-1 First in-person S-Round in about two and a half years

4-2 SSS research and education fields

4-2-1 Smart Mobility

We are building a platform to educate students enrolled in the WISE-SSS Program and conduct collaborative research on automated driving and mobility services with partners of the Super Smart Society Promotion Consortium.

In 2022, edge computing servers were installed in the Road-Side Units (RSUs), and a high-accuracy 3D model of Tokyo Tech, Ookayama Campus was also created. To achieve safe driving by utilizing edge servers, the 3D models, V2X (Vehicle to Everything) networks, and ITS (Intelligent Transport System) sensor networks built in 2021 and 2020, we developed a Smart Mobility Digital Twin (DT) at Tokyo Tech, Ookayama Campus, as shown in Figure 4-2. As shown in Figure 4-3, each RSU uses LiDAR (Light Detection and Ranging) and camera sensing data and processes it at the edge server to detect traffic conditions (e.g., vehicle and pedestrian positions, trajectories, and speeds) in real time. All the information is sent to a cloud server, creating a DT with global, real-time information about traffic conditions on campus. This allows various DT applications upon the smart mobility DT to be built in cyber space. To confirm the effectiveness of new technologies, such as digital twin, RSU, V2X, and edge computing, practical digital twin applications are also under development in smart mobility field. Specifically, two applications are currently under development: a car-sharing system for automated vehicles, and a collision avoidance system at intersections.

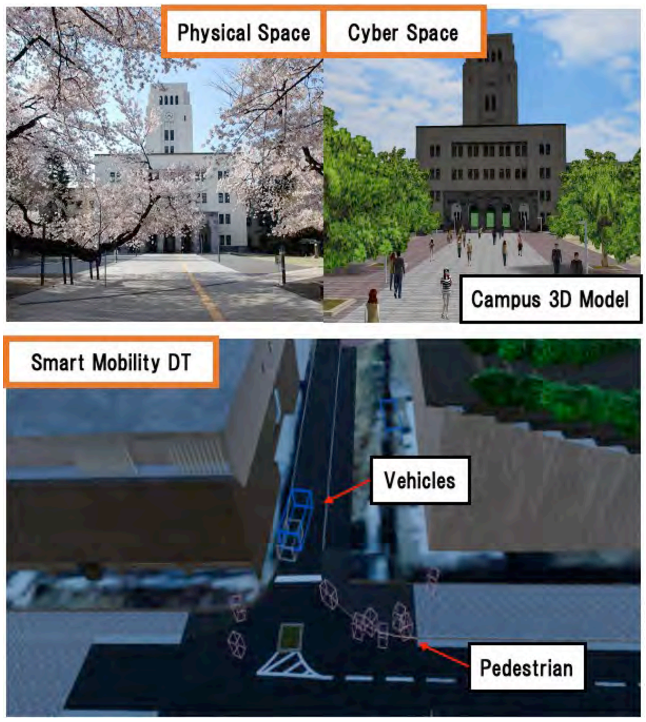


Figure 4-2 Smart Mobility Digital Twin at Ookayama Campus

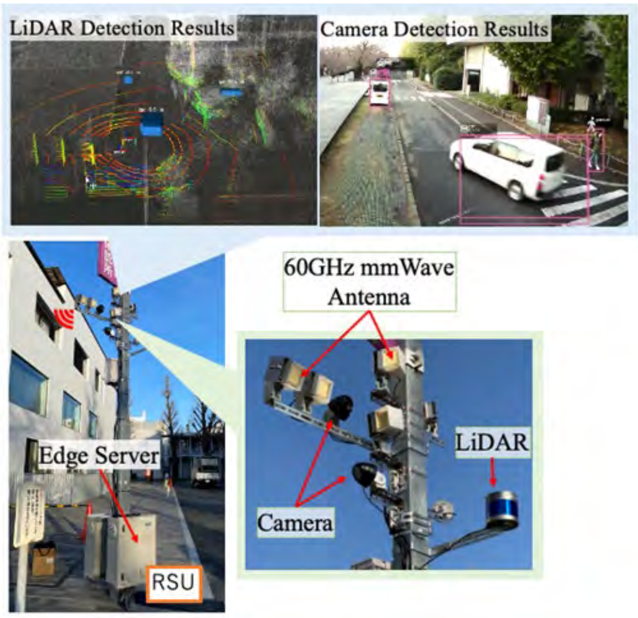


Figure 4-3 RSU and Millimeter Network

These environments are open to use by consortium partners and students enrolled in the Tokyo Tech Academy for Super Smart Society. We expect to create a platform for the creation of new services through the fusion of joint research from different fields. In addition, using this smart mobility field, we also held One-Day School events for consortium partners to learn and try out the fundamental technologies for achieving automated driving, as well as intensive practice for WISE-SSS students.

4-2-2 Smart Robotics

● Robot Zoo Sky

During the 2019 academic year, we built Robot Zoo Sky as a platform to simultaneously control heterogeneous drones and mobile robots. The main purpose of this research and education field is to develop efficient and robust environmental monitoring technologies that contribute to supporting damage assessment after a natural disaster, and to contribute to the realization of a super smart society in the context of enhancing societal resilience. Also, through exercises in this research and education field, students will be able to gain the skills to safely control and operate multiple systems connected via a network.

Figure 4-4 Cooperative Control System for Humans and Multi-Drones using VR Technology

In the 2022 academic year, students constructed a cooperative control system for humans and multi-drones using VR technology (Figure 4-4). To facilitate VR information processing, students installed a computer with the latest GPU RTX4090 and created a simple system configuration by combining it with a computer for motion capture. Research results using this system have already been accepted and published in international conference papers, and are steadily producing results.

We are also making good progress with our collaboration with the Smart Agriculture research and education field, which began in the 2021 academic year. For field experiments, we developed a system that implements a control method named Angle-aware Coverage Control without requiring motion capture. Furthermore, we implemented this control system in an actual vineyard in Inagi City, Tokyo, and confirmed that the desired monitoring performance could be achieved (Figure 4-5).

Figure 4-5 Field Experiments at Vineyard

For experiments in the Smart Agriculture research and education field, which is strongly affected by wind, several DJI Mavic 3.0s were deployed for more stable flights. The challenge was to build an automatic control system, and we succeeded in linking Mobile SDK (Software Development Kit) and ROS2 (Robot Operating System) in real time. This made it possible to implement any control algorithm on ROS2 to automatically control the Mavic 3.0. In addition, an RTK-GNSS (Real Time Kinematic - Global Navigation Satellite System) module, a high-precision positioning system, has been purchased in conjunction with the drones. If the location information obtained by this module can be transmitted to ROS2, it will be ready for experiments in the Smart Agriculture research and education field, and further research will likely be developed (Figure 4-6).

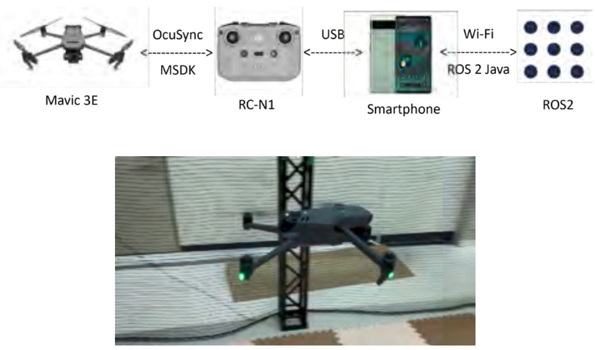


Figure 4-6 Mavic3.0 Automatic Control System Structure (Top) and Controlled State (Bottom)

● Robot Zoo Aqua

Robot Zoo Aqua aims to greatly expand the active field of robots to water. In the 2020 academic year, we established this research and education field in the experimental room for the Systems and Control Engineering Department, School of Engineering in Room B107 at West Building 8 on the Ookayama Campus, Tokyo Tech.

In the 2022 academic year, we simplified the water drone developed in the previous year and developed a new water drone, Karugamot, which can be mass-produced, and built an automatic control system using ROS2. The ROS2 linkage of the motion capture system installed during the previous year has also been completed, and as soon as the modeling work underway is completed, the environment for implementing feedback control of the water drone will be in place (Figure 4-7).

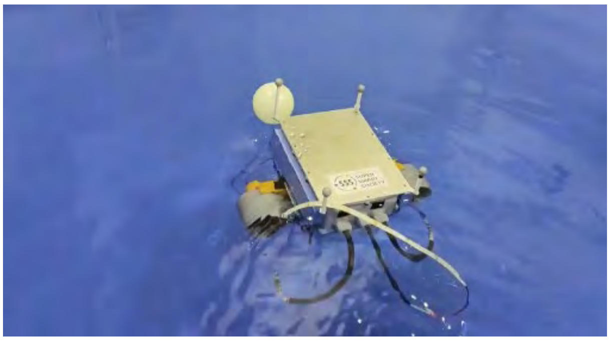


Figure 4-7 Water Drone “Karugamot”

We also developed a hand for a new underwater humanoid robot. Eight pressure sensors are embedded in the back and palm of the hand to estimate the fluid force acting on the entire hand from the pressure values. Performance tests were conducted in the field and confirmed that it is capable of adequately estimating fluid forces acting on the hand (Figure 4-8).

Figure 4-8 Hand for a New Underwater Humanoid Robot

●Robot Zoo Land

Robot Zoo Land consists of a group of robot platforms for education and research including collaborative robots, quadruped outdoor field robots developed by Tokyo Tech, and multifunctional robot actuator modules, as well as a group of robot evaluation and control equipment including digital signal processors and controller devices, high-speed motion capture systems for control, and high precision GNSS + INS (Global Navigation Satellite System + Inertial Navigation System) hybrid equipment. Through these efforts, we aim to provide an education and research environment and educational program for smart robotics that utilizes 5G, IoT, and AI. We also seek to promote practical education and research that addresses social issues such as disaster response, infrastructure inspection, and aging.

In the 2022 academic year, as shown in Figure 4-9, we collaborated with the DLab Challenge of the Laboratory for Design of Social Innovation in Global Networks (DLab) to build a remote-controlled robot system that uses VR technology. This will organically integrate the various robots,

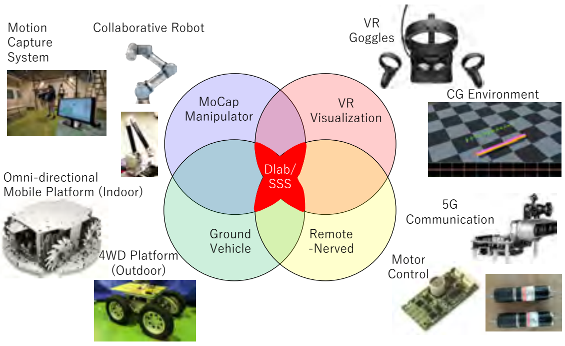


Figure 4-9 VR Remote-Controlled Robot System Overview

measurement devices, VR interfaces, and communication devices that have been developed as of the 2021 academic year. An example of the completed system is shown in Figure 4-10. Based on the images projected in the VR goggles, the cooperative robot's hand positions are controlled by giving instructions via VR interfaces held in both hands.

Figure 4-10 Experiment of VR Remote-Controlled Robot Operation

Robot Zoo Land also has a 3D printer that can print short carbon fiber-reinforced resin and a smart actuator module with many built-in sensors as shared equipment. By effectively utilizing these technologies, we have developed a long articulated robot for infrastructure inspection (Figure 4-11). This is an ultra-light horizontally articulated robot arm with a total length of 4.5 m, a mass of 11 kg, and a total of 5 degrees of freedom. By adjusting the mass of the water bag (green) with a pump attached to the rear end, the robot can operate with extremely low power consumption. The use of the smart actuator module allowed us to develop the robot in a short period of time.

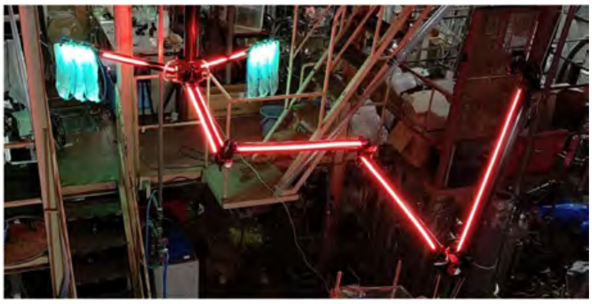


Figure 4-11 Long Articulated Robot for Infrastructure Inspection

●Smart Manufacturing

Continuing on from the previous year, the intensive exercises in interdisciplinary research planning for affiliated students are conducted. Assuming that most of the students have backgrounds in different fields, we began with a brief lecture on multi-axis NC (Numerically Controlled) machines, which have been widely used in recent years to manufacture precision products with complex shapes such as molds, and on the functions of 3D-CAD (Computer Aided Design) and CAM (Computer Aided Manufacturing).

We also explained the STL (Stereolithography) file format, which is a standard representation of 3D solid models and is widely used not only by 3D-CAD/CG modelers but also by 3D printers, and NURBS (Non-Uniform Rational B-Splines), which are also used in many software packages as a mathematical representation of free-form surfaces. As in the previous year, the students were able to learn about the actual production process of manufacturing molds for complex parts by observing the toolpath generation using CAM and actual machining for parts designed in advance with 3D-CAD. Since the class was held under time constraints, the students were not able to actually design and machine the products themselves, but we will try to work on this from the next year so that they can have even a partial hands-on experience by devising preparations.

On the other hand, we continued our research on high-speed, high-precision recognition of the position and posture of the machining target by combining high-speed recognition using a 3D camera and high-precision measurement using a touch probe, as well as high-precision NC machining using that measurement (Figure 4-12).

This effort has aimed to implement using the existing equipment in our field, and although some manual operation is required, the system has been completed in accordance with the concept initially targeted for the finishing process using 5-axis milling. As with the aforementioned education-related efforts, automation and further improvements in speed and accuracy are issues to be addressed from the 2023 academic year onward

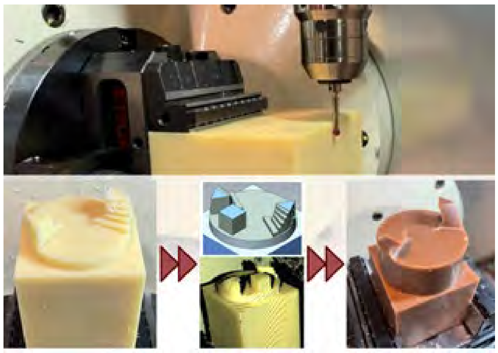


Figure 4-12 High-precision finishing process by measurement of position and posture of machined object

4-2-3 Quantum Science

● Quantum Computing

Quantum computers are expected to be put into practical use as ultra high-speed next-generation computers that are based on the principles of quantum mechanics. While a normal computer uses a state (bit) of either “0” or “1” for information processing, a quantum computer performs calculations by using a qubit that can take on a superposed state of both 0 and 1. Researchers hope to execute massively multiple computational paths simultaneously by operating qubits that are integrated on a large scale, and research into how to apply it is progressing. Such technology is also expected to contribute to solving the information processing problems required in a super smart society.

Research aimed at realizing qubits is being actively conducted in various physical systems. Although methods using superconductors are advancing, the spin in semiconductor silicon quantum dots is also viewed as a promising system. This method will enable the integration of devices in the future via semiconductor processing technology. It also has the advantage of a long coherence time corresponding to the information retention time.

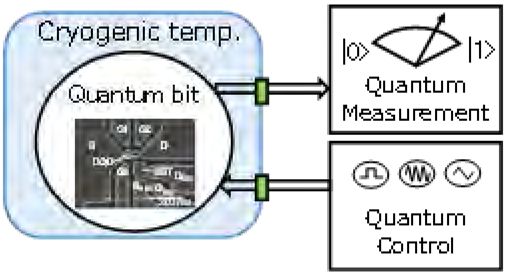


Figure 4-13 Schematic image of quantum bit measurement system

In this research and education field, while working primarily on this silicon-based method, we are cultivating human resources and conducting education and research for high-level quantum technology. In the 2022 academic year, we demonstrated single-charge readout and coherent manipulation of single spins by operating a qubit device fabricated by students of the Tokyo Tech Academy for Super Smart Society in a measurement system for implementing and evaluating qubits in combination with a cryogenic refrigerator, as shown in the schematic diagram in Figure 4-13. We are promoting joint research with partners in the Super Smart Society Promotion Consortium, and are eagerly expanding the field, including the extension to a high-precision, low-noise measurement system for observing quantum phenomena at cryogenic temperatures. In particular, in the 2022 academic year, new equipment for quantum computing device measurements was installed for the new cryogenic refrigerator, establishing an experimental system capable of demonstrating silicon qubit operation (Figure 4-14). In addition, the activities of the field were introduced in the MOOC (Massive Open Online Course) “Invitation to the Super Smart Society,” and the field was used to hold One-Day School events for Consortium Partners and seminars for students registered for WISE Program. They included exercises and demonstrations aimed at mastering high-frequency technology, precision measurement technology, cryogenic technology, vacuum technology, and other technologies used in cutting-edge quantum science research. We plan to continue expanding this research and education field and enhancing its functions from the 2023 academic year. We hope that related companies and National Research and Development Agencies will utilize this to promote collaborative research.

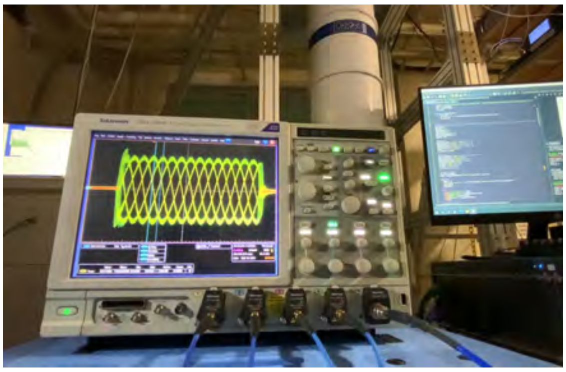


Figure 4-14 Quantum bit operation exercise system

● Quantum Sensor

A sensor is a device that converts a physical phenomenon or the state of an object into an electrical signal. In particular, a sensor that uses the quantum effect (a phenomenon that appears in quantum mechanics) is called a quantum sensor. These quantum sensors are expected to detect with greater sensitivity than conventional sensors and to contribute to the construction of an ultra-smart society by detecting phenomena that were previously undetectable.

There are many different types of quantum sensors. We are placing particular focus on the Superconducting QUantum Interference Device (SQUID), which is capable of detecting minute magnetic fields. In order to develop SQUID sensors that are smaller and can operate at higher temperatures, in the 2022 academic year, as in the past, we continued developing high-temperature superconductors with a thickness of several atomic layers. We focused on the change in superconducting properties when Te atoms are mixed into a single-layer FeSe thin film on a $SrTiO_3$ substrate. This material has a special superconducting state called topological superconductivity, which could be applied to the next generation of topological quantum computers.

In collaboration with Consortium Partners, from the 2021 academic year, we began searching for optimal surface oxidation conditions aimed at the development of new quantum sensors. These quantum sensors utilize oxygen defects on the surface of silicon carbide (SiC) crystals, which are wide-gap semiconductors. As an achievement in the 2022 academic year, we found that the luminescence properties after oxidation differ depending on the periodic structure of the SiC

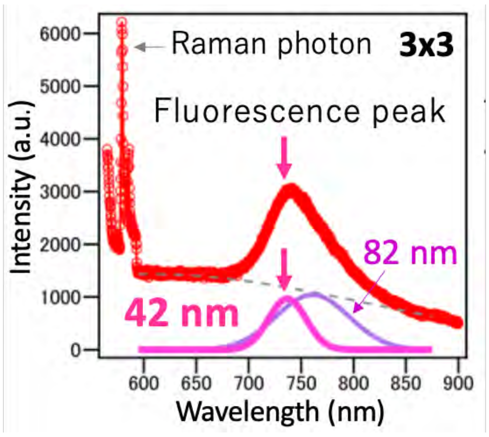


Figure 4-15 Emission Spectrum Gained by Oxidation of SiC 3×3 Surface

surface before oxidation. In particular, the 3x3 structure surface shows a sharp fluorescence peak with a narrow half-width (42 nm) after oxidation, as shown in Figure 4-15, and better properties can be expected than from the conventional method. In the future, we would like to identify the structure and energy levels of this emission source, reduce the defect density, and observe a single emission source.

Moreover, we used the constructed equipment to hold intensive training for interdisciplinary planning for students enrolled in the WISE Program and One-Day School for young employees of Consortium Partners. Participants commented that although the explanations about the research were challenging, they were able to gain insights by seeing the actual experimental facilities, and that although they did not understand the research in depth, they were able to get an overview of it. As shown here, in the Quantum Sensor research and education field, we are cultivating human resources and conducting education in quantum science at the same time as performing research. We hope that corporations and the National Institute for Educational Policy Research will also utilize this field.

4-2-4 Artificial Intelligence

In a super-smart society, we expect every device that we use in our daily lives to become smart and connected to computers, resulting in a safer and more convenient life. An essential item for control by computers is a system that can operate by recognizing and understanding surrounding conditions via sensors and cameras.

Much of the information in the physical world is noisy and unclear. Therefore, in order to properly process these in the cyber world, it must be converted into symbolic information that is easy for computers to process. At the Tokyo Tech Academy for Super Smart Society, we consider artificial intelligence technology to be a basic technology that can connect the cyber and physical worlds in a super smart society. Therefore, we are providing education with the aim of enabling enrolled students to master artificial intelligence technologies. Starting in the 2020 academic year, Institute-wide data science and AI (DSAI: Data Science and Artificial Intelligence) education for graduate students started at Tokyo Tech. Unlike existing classroom-only lessons, this allows students to practice while actually operating machine learning tools in a practical environment. For this purpose, we started the operation of an education system using Wi-Fi 6 from the 2020 academic year. To ensure the efficient use of the technology called “deep neural network,” which is one seed of artificial intelligence, there is the need for the advanced computational environment called GPUs (Graphics Processing Units). Currently, GPUs are still too expensive for all students to buy. However, if cloud services could be used, it would be possible to provide all students with the same computational resources at low cost. In this education system, students can easily access the learning environment in the cloud using WiFi from their own computers. On the cloud, it is possible to actually try handling the materials and themes presented by the teacher as a “moving textbook” using a service called Google Colaboratory[Note 1], thus making it possible for students to learn comfortably (Figure 4-16). This also allows the GPU of Tokyo Tech’s supercomputer TSUBAME (Figure 4-17) to be used.

The Tokyo Tech Academy for Super Smart Society requires students to acquire a certain level of expertise in artificial intelligence in order to complete the program. For even more motivated students, we have implemented intensive exercises in interdisciplinary research planning using artificial intelligence, starting in the 2020 academic year. Here, each student can learn about the latest research results directly from Tokyo Tech faculty members through demonstrations. By doing so, we aim to further improve the skills of the students. In 2022, 13 participants attended a lecture on neural network technology and performed an exercise with image recognition as the task on September 30. The students also presented the results of their studies.

Furthermore, in the 2022 academic year, as in 2021, we held a One-Day School for Consortium Partners. A total of two people from two partners participated. At the One-Day School, we explained the principle of neural networks and basic usage of Google Colaboratory. We also conducted simple exercises using PyTorch[Note 2]. In the exercises, students worked on one common task (image style transformation) and three elective tasks (PyTorch basics, image and speech recognition, and reinforcement learning).

(Note 1) Google Colaboratory: A development environment for machine learning education and research provided by Google

(Note 2) PyTorch: Python’s open source machine learning library used in computer vision and natural language processing

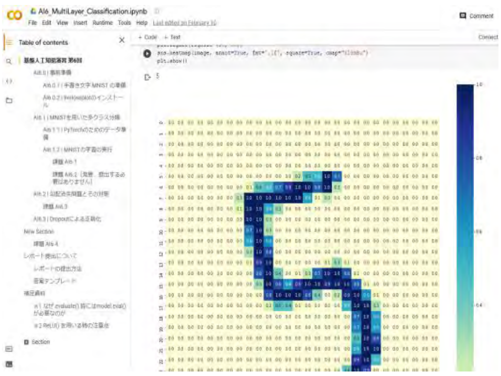


Figure 4-16 Google Colaboratory

Figure 4-17 TSUBAME

4-2-5 Smart Workplaces

In this research and education field, we are building a platform centered on the "Smart Workplaces" with the goal of creating a place where each individual can work healthily and vigorously.

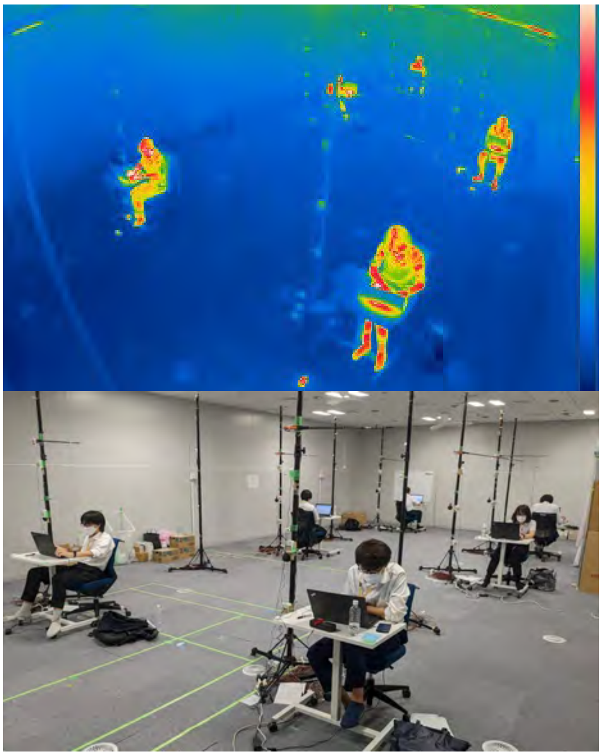


Figure 4-18 Subject Experiment using AI-based Thermal Comfort Assessment System

In the 2022 academic year, air conditioning control experiments were conducted using the thermal image plus AI-based thermal comfort assessment system developed in 2021 (Figure 4-18). The proposed air conditioning used thermal images and AI image analysis to calculate the Predicted Mean Vote (PMV), an index of thermal comfort, and performed air conditioning control that was tailored to the workers' conditions. The conventional air conditioning that controls room temperature at a constant level was used as a reference case. The results of a subject experiment showed that the proposed air conditioning method based on PMV significantly increased thermal comfort and subjective work efficiency.

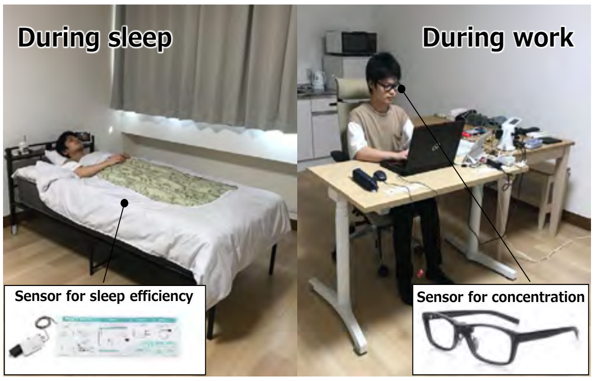


Figure 4-19 Subject Experiment using "Smart Work Home" that replicates a Work-from-Home Environment

In addition, a subject experiment was conducted using the "Smart Work Home," a field that replicates a work-from-home environment constructed at Tokyo Tech Suzukakedai Campus in the 2021 academic year. We used sleep efficiency to measure "rest," which is the traditional role of housing. Similarly, we used concentration and work efficiency to measure "work." We are verifying housing that maximizes both sleep and work efficiency from various angles, including interior design, ventilation, lighting, and aroma (Figure 4-19).In addition, we conducted subject experiments on work productivity in workplaces developed in urban green spaces at Otemachi's third place "3x3 Lab Future" and its outdoor "Hotoria Square" (Figure 4-20). Results indicated that outdoor workplaces may promote relaxation more than indoor ones.

These efforts were presented at the Japan Home & Building Show, one of the largest building exhibitions in Japan, where more than 20,000 professionals from construction companies, developers, and others, as well as home builders and design firms, attended.

Figure 4-20 Subject Experiment on Work Productivity in Outdoor Workplace

In the 2023 academic year, we plan to publicize the results to date at academic conferences and other venues, as well as to continue verification at the "office" field that was established in 2022.

4-2-6 Smart Agriculture

Smart agriculture is not only about making people's lives better through DX. There is a wide range of issues we need to address. From a global perspective, climate change, population explosion, food crisis, resource depletion, and the environmental impact of agriculture have all created a need for sustainable, high-yield production. On the other hand, we believe that remote farming, which can be done unmanned, is necessary to meet the challenges of Japanese agriculture, such as a shrinking population of farmers and the difficulty of increasing efficiency due to the large amount of small farmland in mountainous areas.

We have built the Smart Agriculture Field at Tokyo Tech Suzukakedai Campus as an education and research platform for underlying technologies to resolve these issues. These underlying technologies include accurate and detailed measurement of the growing conditions and growing environment of open field crops, data-driven agriculture, digital twin of agriculture (replicating crops and their growing environment in a virtual space), agricultural data collaboration infrastructure, agricultural robots, and going off-grid (self-sufficiency in electricity without connection to the power grid). We then aim to enhance these underlying technologies by leveraging Tokyo Tech's strengths in robotics, ICT, and AI technologies to enable remote agriculture with sustainable high yields and unmanned operations.

Figure 4-21 View of the Smart Agriculture field site

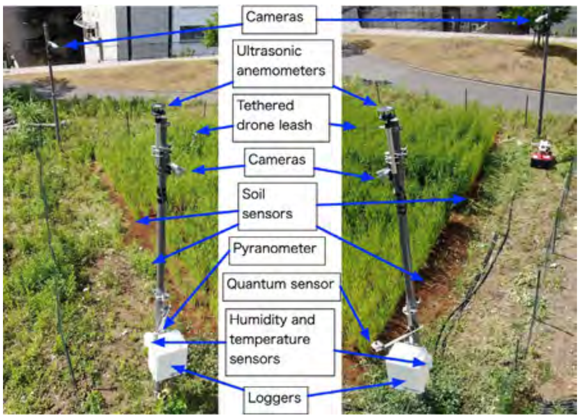


Figure 4-22 Iron Pole Equipped for Fixed-point Observation Sensor Networks

In the 2022 academic year, we established electricity, communication, water supply, and fixed-point observation sensor networks and tethered drone facilities (Figures 4-21 and 4-22). After extensive pruning of the surrounding trees to improve the light environment, we cultivated soybeans and evaluated the cultivation characteristics of the soil. To go off-grid, a tracked solar power generation and automatic irrigation system were installed (Figure 4-23).

Figure 4-23 Off-Grid System

In addition, an indoor field was constructed for remote control of the sensor network and data management, enabling real-time acquisition of environmental information on the field remotely.

In the 2023 academic year, we plan to implement wireless communication, off-grid sensor networks, development of automatic sensing technology using ground robots, and development of technology to measure crop traits using drones.

In addition, with the aim of fostering leaders who will promote smart agriculture, we plan to offer exercises in the Smart Agriculture Field in the 2023 academic year. Through these lectures and exercises, students will learn about the future of Japanese-style smart agriculture and practical examples of how it can be implemented.

4-2-7 Smart Infrastructure Maintenance

Ensuring the maintenance of infrastructure, which is the foundation of our daily lives and industry, is essential for ensuring urban functionality and resilience. One of Tokyo Tech's strategic areas is its work on Sustainable Social Infrastructure (SSI). The purpose of this research and education field is to develop and demonstrate the technologies that will be necessary in the future, such as inspection and investigation, evaluation technology, and repair and reinforcement, in order to make infrastructure maintenance smarter, which will be important in realizing a Super Smart Society.

This research and education field consists of an on-campus laboratory for the development of individual underlying technologies through experiments, and real structure fields for demonstrations and exercises of development technology and advanced technologies. The real structure field is expected to serve as a place to deploy various technologies targeting bridges, tunnels, and other infrastructure that actually exist on campus (Figure 4-24).

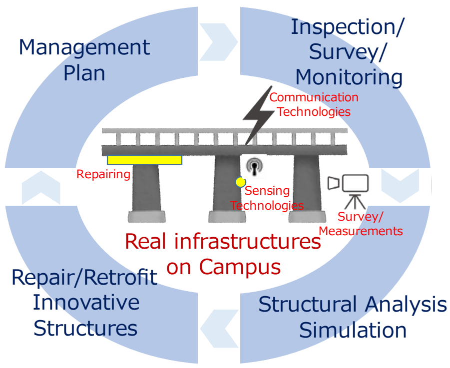


Figure 4-24 Expectation of Real Structure Fields

In the 2022 academic year, we promoted the creation of real structure fields and installed a system capable of continuously measuring acceleration and other parameters for three structures on campus (Fujimi Bridge, Todoroki Bridge, and the Ishikawadai Area Tunnel). Since material properties and deterioration are considered important factors in infrastructure maintenance, we plan to select structures made of concrete or steel (the main materials used in infrastructure) as targets and to develop the technology for their study.

Figure 4-25 Fujimi Bridge

Figure 4-25 shows the Fujimi Bridge (where the measurement system was installed) which consists of steel girders and concrete slabs. Sensors such as acceleration sensors are installed on steel girders, piers, and abutments for constant measurement, and on-site digital signage displays the measured data. Joint research has already begun in the real structure field for the Fujimi Bridge, and a measurement system to track the health of the information conduit is being constructed at the same time.

Based on acceleration and other measurement data introduced into each real structure field, we will promote technologies for analyzing the condition of each structure, building digital models that replicate the characteristics of each structure, tracking the environment in which the structure is used (weight of passing vehicles, etc.), analyzing its behavior during earthquakes, and studying damage indexes. Figure 4-26 shows an example of identifying the influence lines of displacement due to moving loads, one of the bridge's structural characteristics. Once influence lines are obtained, analysis of the weight of passing vehicles, etc. can be performed.

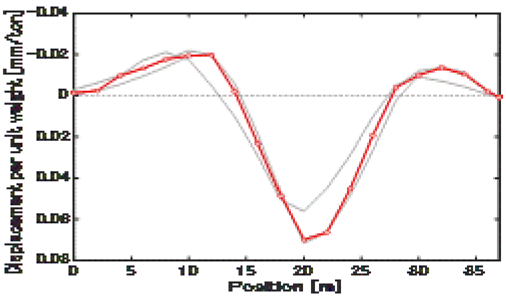


Figure 4-26 Influence Lines of Displacement at Fujimi Bridge

In the 2023 academic year, we plan to apply the same measurement system and maintenance techniques to the real structure fields for the Todoroki Bridge (Figure 4-27) and the Ishikawadai Area Tunnel, which were selected as concrete structures, as we did for the Fujimi Bridge.

Figure 4-27 Measurement System at Todoroki Bridge

4-2-8 Smart Building

This research and education field is a research platform for the evaluation of building safety and continuity of use during earthquakes and typhoons using high performance sensors densely installed in buildings, and for early notification methods for occupants. We aim to contribute to improving the resilience of not only buildings but also urban functions.

We have completed the installation of 2-channel anemometers and 84-channel acceleration, displacement, and strain sensors on the roof (Figures. 4-29 and 4-30) and 17-channel accelerometers on the ceiling and non-structural walls (Figure 4-31) of a high-rise seismically isolated building (Building J2-3, Figure 4-28) on the Suzukakedai Campus of Tokyo Tech. We have already built a system that allows those data to be viewed on computers and smartphones via the Internet. The system is used for constant observation. Here is an observation record of the magnitude 7.4 earthquake that occurred off the coast of Fukushima Prefecture at 11:36 pm on March 16, 2022, as an example. At the location of the J2-3 building (Midori-ku, Yokohama), the seismic intensity is about 3. We are able to measure the seismic response with high accuracy. Figures 4-32 and 4-33 show the text and attachments of e-mails sent immediately after the earthquake. Future research will focus on how these data can be communicated to residents to alleviate their concerns.

Figure 4-28 High-Rise Seismically Isolated Building (Building J2-3, Suzukakedai Campus)

Figure 4-31 Accelerometers on the Ceiling (Left) and Non-structural Walls (Right)

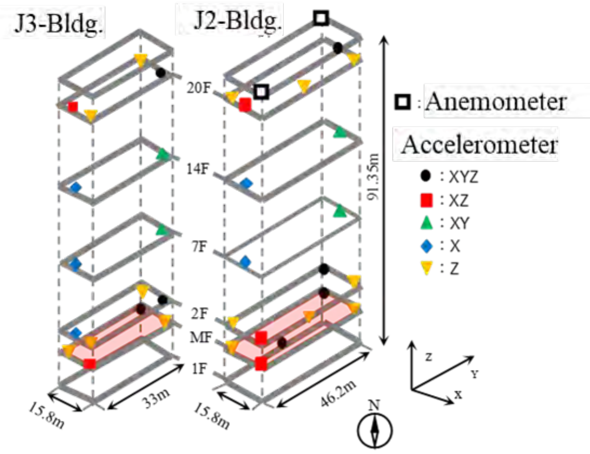


Figure 4-29 Locations of Anemometers and Accelerometers

Information on new earthquake records from the seismic monitoring system.

Location: J3- Bldg.

Date and time:
2022/03/16 23:37:24

Seismic intensity scale:
3 (2.9)

Maximum acceleration (3-component synthetic) :
15.9 (Gal)

Maximum
Ch.01: 13.9 Gal (J3 -MF-No.1-X-NN)
Ch.02: 10.8 Gal (J3 -MF-No.1-Y-NN)
Ch.03: 8.3 Gal (J3 -MF-No.1-Z-NN)
Ch.04: 15.9 Gal (J3 -20F-No.17-X-EE)
Ch.05: 20.0 Gal (J3 -20F-No.17-Y-EE)
Ch.06: 19.8 Gal (J3-20F-No.17-Z-EE)
Ch.07: 8.8 mm (J3 -H-2.Damper deformation)
Ch.08: 13.8 mm (J3 -H-3.Story drift X)
Ch.09: 8.4 mm (J3 -H-4. Story drift Y)

Recording time : 349 s

Figure 4-32 Text of e-mails Sent Immediately after the Earthquake

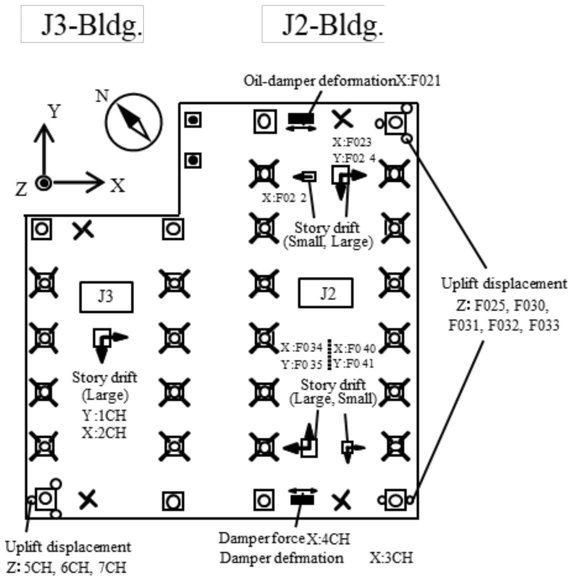


Figure 4-30 Locations of Displacement Sensors

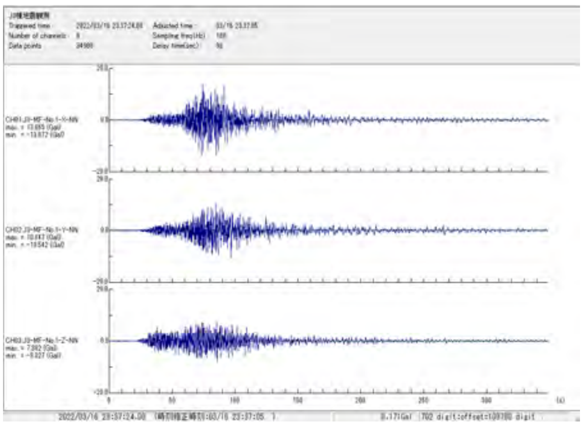


Figure 4-33 Attachments of e-mails Sent Immediately after the Earthquake

5 . Steering Committee Members (2023 Academic Year)

Steering Committee Chair

Nobuyuki Iwatsuki

Vice President for Global Communication
Professor, Dept. of Mechanical Engineering, School of Engineering
Field of Specialization：Synthesis and Control of Robotic Mechanisms, Acoustic environment, Actuator

Coordinator

Kei Sakaguchi

Dean, Tokyo Tech Academy for Super Smart Society
Professor, Dept. of Electrical and Electronic Engineering, School of Engineering
Field of Specialization：B5G, IoT, Millimeter-wave, Wireless power transmission, Connected Car, Automated Driving

Vice Coordinator

Kenichi Okada

Professor, Dept. of Electrical and Electronic Engineering, School of Engineering
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Super Smart Society Promotion Committee Chair and Overall secretary

Eisuke Fukuda

Specially Appointed Professor, School of Engineering
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Social Collaborative Education Steering Committee Chair

Mitsuji Sampei

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Field of Specialization：Nonlinear Control Theory and its Application, Underactuated system

Interdisciplinary Research Promotion Committee Chair

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Professor, Dept. of Computer Science, School of Computing
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Finance Chair

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Professor, Dept. of Civil and Environmental Engineering, School of Environment and Society
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Facility Chair

Koichi Suzumori

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Misako Takayasu

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Public Relations Chair

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