SUPER SMART SOCIETY

Doctoral Program for World-leading Innovative & Smart Education

Tokyo Tech Academy for Super Smart Society

Tokyo Institute of Technology

SUPER SMART SOCIETY

The world is currently facing various problems such as population growth, global warming, and frequent natural disasters. In addition, the spread of a new coronavirus disease in 2020 has clarified problems in Japan, including the delay of digitization and the weakness of supply chains. Under these circumstances, solving these problems to lead to economic growth is critical to reinforce the Japanese global industrial competitiveness. I believe that realizing Super Smart Society, "Society 5.0," is the key to it.

"Society 5.0" is a concept of a new society following the hunting society, agricultural society, industrial society, and information society, which Japan introduced for the first time in the world in the 5th Science and Technology Basic Plan in 2016. At that time, I created this concept as a full-time member of the Council for Science, Technology, and Innovation (CSTI) in the Cabinet Office together with my colleagues. "Society 5.0" is the future vision for a human-centered society that simultaneously achieves economic advancement and the resolution of social problems by a system that highly integrates cyberspace and physical space using artificial intelligence, data, and digital technologies.

Some people are currently working on creating innovation that will realize "Society 5.0" in various fields. Human resource development is of most importance to accelerate these actions. In particular, young researchers need to acquire diverse knowledge not only in their specialized fields but also in various fields such as information and communication technology (ICT), and universities need to foster a "knowledge professional" that possesses both the sensitivity to detect new demands and the ability to solve problems.

I expect that Tokyo Tech Academy for Super Smart Society in Tokyo Institute of Technology, in cooperation with organizations participating in the consortium, will provide education that transforms knowledge into intelligence, with the aim to foster knowledge professionals that will realize Super Smart Society.

Kazuo Kyuma

National Agriculture and Food Research Organization
President

Tokyo Tech Academy for Super Smart Society
External Evaluation Special Advisor

"What is a super smart society? I'm not sure but it sounds interesting!" For those who think like this, please take advantage of "the WISE Super Smart Society Program" (the WISE-SSS program). What do you imagine when you think of a super smart society? Do you envision the world of science fiction movies where automated tractors plow through an enormous field in Smart Agriculture, automated buses and trucks lead the way in Smart Mobility, or avatar robots manage nursing care in Smart Medicine? In fact, such technologies are almost a reality. With the arrival of a super smart society, an abundant future will be realized by solving our current social issues, including an aging society with a low birth-rate and a labor shortage.

Are you at a loss for where to start learning about a super smart society? Our program aims to create such a society from engineering perspectives and to educate leading innovators. Although a wide range of fields from agriculture to industries and services have applications for a super smart society, the basic principles are the same. In fact, these applications have five unifying components: 1) sensors to measure the environment, 2) databases such as geographical information, 3) edge computing to make decisions, 4) actuators such as automobiles, and 5) AI and big data for learning. The first four reside in the real world (physical space) but the last one exists in the virtual world (cyber space). Therefore, it can be said that a super smart society is realized by integrating cyber and physical spaces.

Now that you know how to start, where can you learn these five principles in one program? Previously, there was no educational program where you could study all five of these components together. Therefore, the Tokyo Institute of Technology, in collaboration with the Super Smart Society Promotion Consortium (SSS promotion consortium) partners, launched the WISE-SSS program in April 2020 as a place to learn about a super smart society. This program is unlike any previous educational program because it offers social collaborative education (open education) and interdisciplinary joint research (open innovation) in cooperation with the consortium. To offer necessary education and research to create a future society, the program collaborates with a variety of related sectors such as municipal organizations, private corporations, and Japanese National Research and Development Agencies. Furthermore, comprehensive financial and career support is offered in collaboration with the consortium.

Together we can learn in the program and build an exciting future society!

Kei Sakaguchi

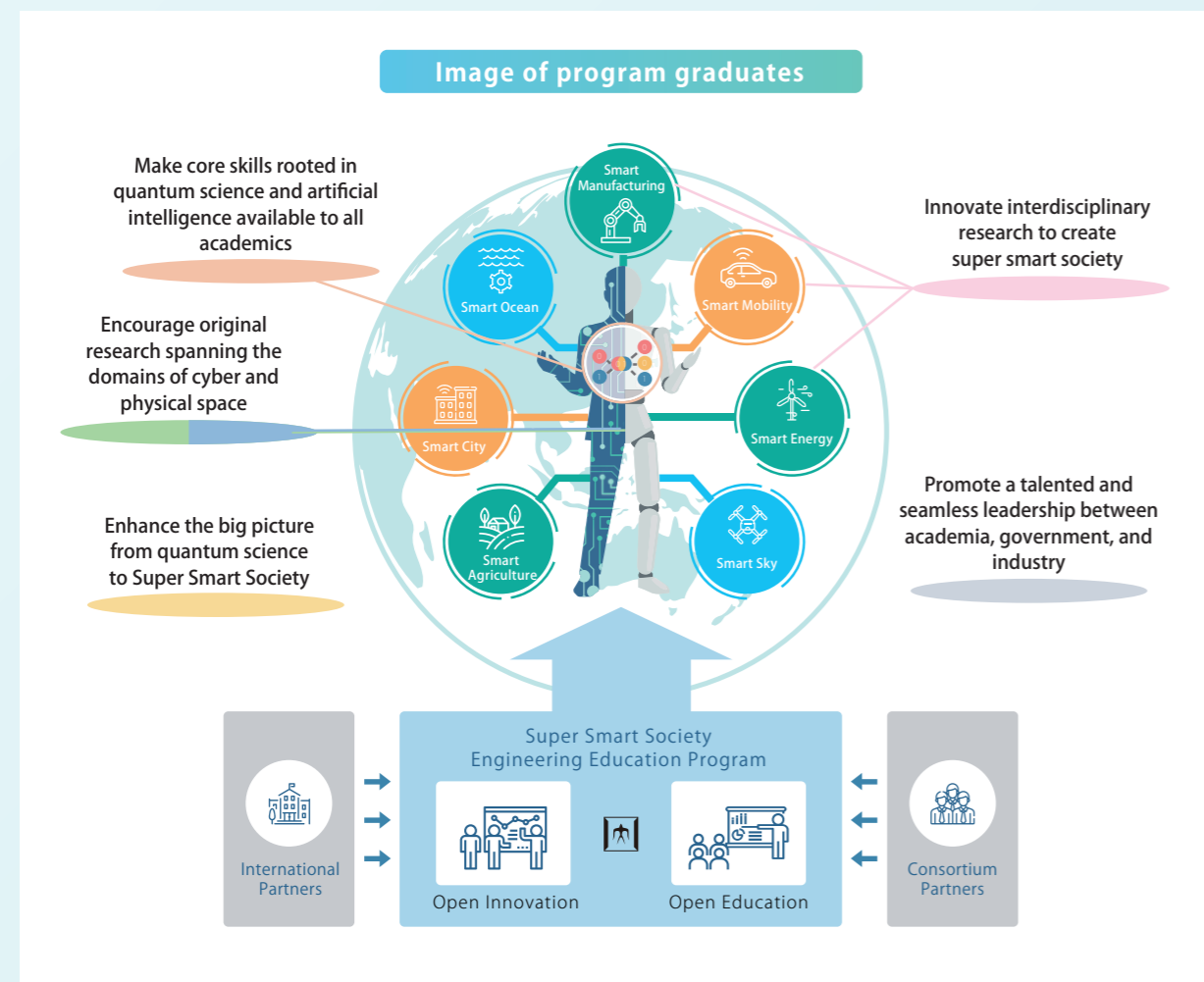Tokyo Tech Academy for Super Smart Society
Dean / Program Coodinator

Objective of the Tokyo Tech Academy for Super Smart Society

Modern social revolutions (thermodynamics + heat engine = the industrial revolution; information science + computer = the information revolution; etc.), advanced science (physics, information science, etc.), and innovative engineering (mechanical, electric/electronics engineering) have inspired paradigm shifts in society. To realize a super smart society, which is also called the upcoming fifth social revolution, it is essential to integrate physical space technologies developed since the industrial revolution such as machinery, electricity, and construction with cyber space technologies developed since the information revolution. Additionally, advanced sciences and technologies such as quantum science and artificial intelligence must be fused. Quantum science is a discipline based on quantum mechanics, which governs the smallest unit of materials and energy, the "quantum." This should contribute to massive parallel computing in quantum computers and dramatically improve the capabilities of artificial intelligence (deep learning, etc.). These advances will lead to secure network technologies using communication with quantum encryption and sophisticated automated driving with IoT using ultra-high sensitivity quantum sensors.

The Tokyo Tech Academy for Super Smart Society (WISE-SSS) offers a degree program that integrates masters and doctoral courses. The integrated program aims to train super-skilled PhD graduates with technical and professional knowledge so that they can lead a sector in industry-government-academia to realize a super smart society based on quantum science.

In addition to providing education to students enrolled in specialized courses, the program cultivates five essential skills to realize a future super smart society based on quantum science.

1. **Make core skills rooted in quantum science and artificial intelligence available to all academics**
2. **Encourage original research spanning the domains of cyber and physical space**
3. **Enhance the big picture from quantum science to Super Smart Society**
4. **Innovate interdisciplinary research to create super smart society**
5. **Promote a talented and seamless leadership between academia, government, and industry**

Image of program graduates

Make core skills rooted in quantum science and artificial intelligence available to all academics

Encourage original research spanning the domains of cyber and physical space

Enhance the big picture from quantum science to Super Smart Society

Innovate interdisciplinary research to create super smart society

Promote a talented and seamless leadership between academia, government, and industry

Smart Manufacturing · Smart Ocean · Smart Mobility · Smart City · Smart Energy · Smart Agriculture · Smart Sky

Super Smart Society Engineering Education Program

International Partners — Open Innovation · Open Education — Consortium Partners

Strength of Tokyo Tech and the WISE-SSS Program

A unique feature of the program is that education is offered by a joint effort of six graduate schools, the Institute of Innovative Research, and the Institute for Liberal Arts. The physical space technologies offered mainly by the School of Engineering, cyber space technologies offered mainly by the School of Computing, and quantum science offered mainly by the School of Science are integrated in education. This approach not only cultivates specialized academic skills across these fields but also fosters creativity. To realize a super smart society, social collaborative education (open education) and interdisciplinary joint research (open innovation) are crucial, and the SSS promotional consortium acts as a bridge between the program and external organizations: Japanese National Research and Development
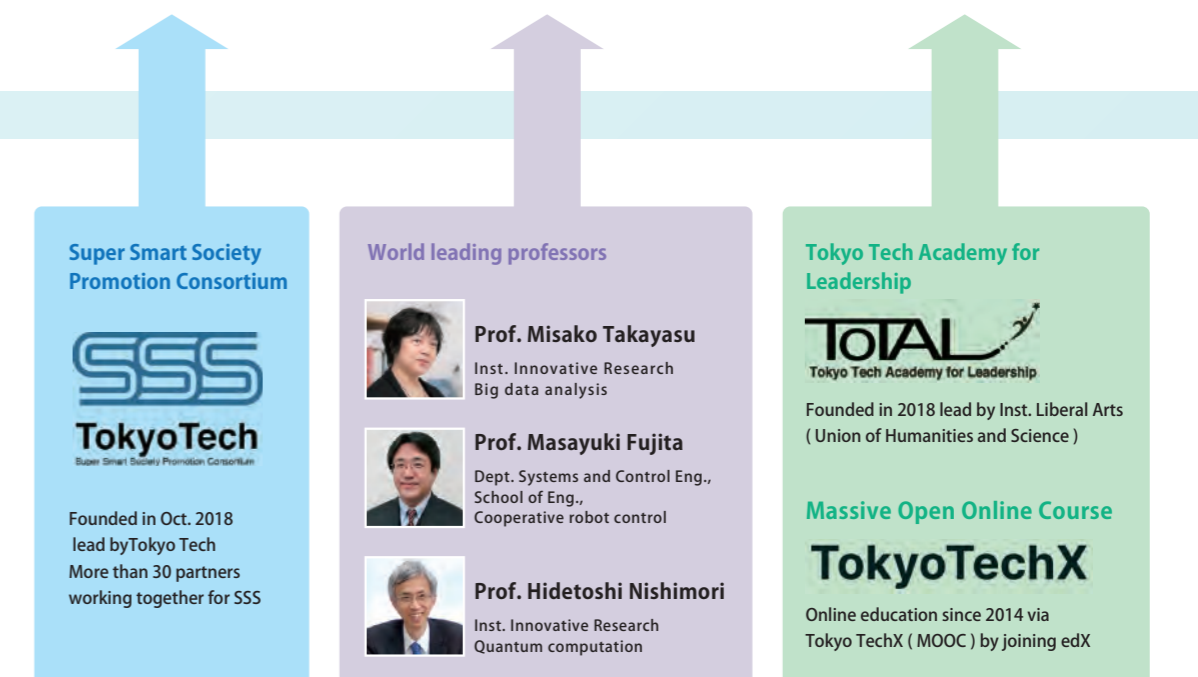
Agencies, private corporations, and local governments. Broad perspectives are cultivated through social collaborative education such as the Cyber Physical Off-Campus Project, while problem-solving abilities for social issues are fostered by interdisciplinary research such as the Super Smart Society Creation Research Project. In addition, the program trains highly ambitious global leaders with technical knowledge through global leadership education and the Global Off-campus Research Project in collaboration with the Tokyo Tech Academy for Leadership and overseas partner institutions. Furthermore, the WISE-SSS offers online courses, supporting a new type of student-centered education (student-centered learning) that is not constrained by time, place, and generation.
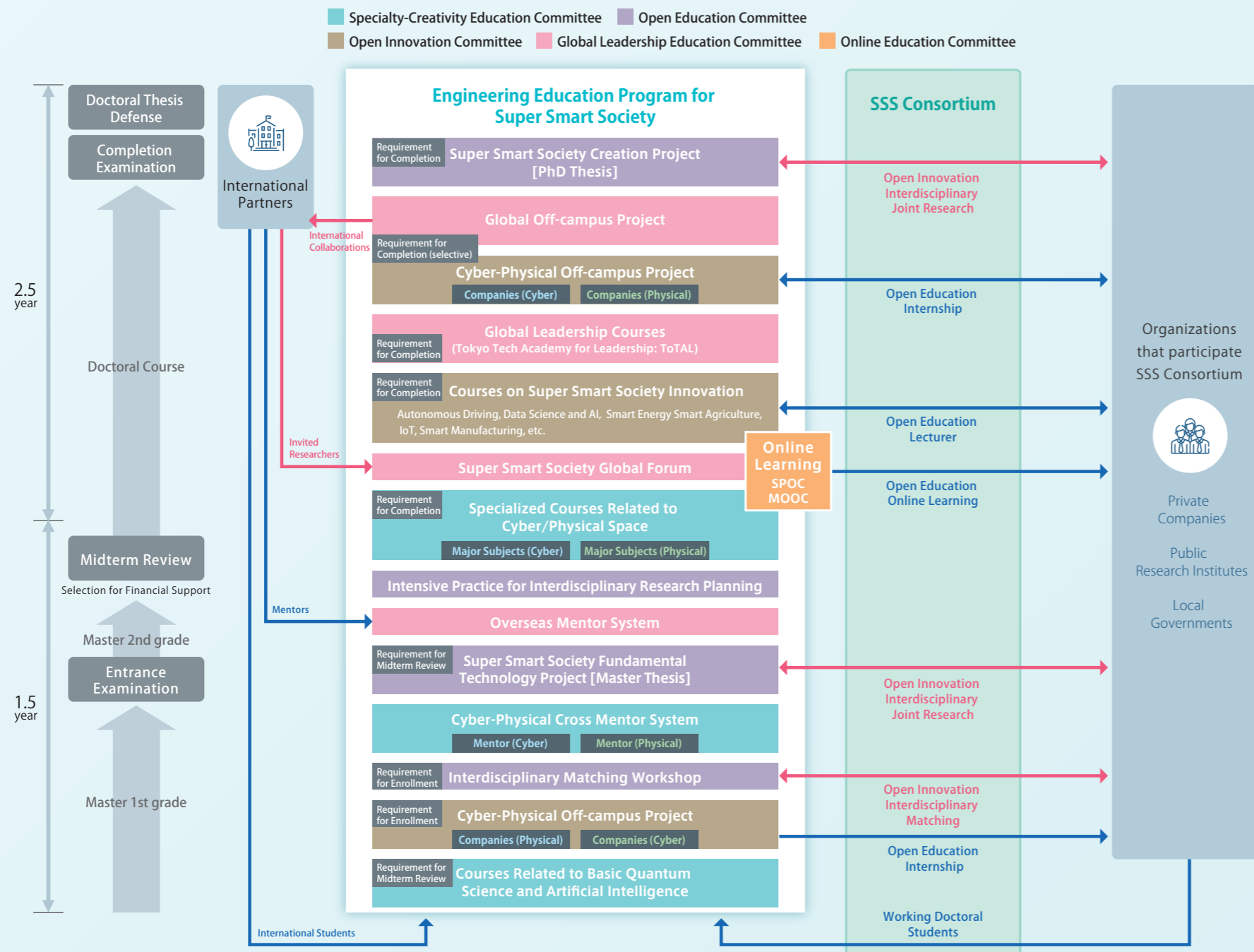
Features of WISE program for Super Smart Society

Integrated Education of **Physical Technology** by **School of Engineering**, **Cyber Technology** by **School of Computing**, and **Quantum Technology** by **School of Science**

Integrated Education of **Open Education** and **Open Innovation** via bridge of **Super Smart Society Promotion Consortium**

Global Leadership Education with **ToTAL (Union of Humanities and Science)** and **Online Education (Tokyo TechX)** for student centered learning

Super Smart Society Promotion Consortium

SSS TokyoTech

Founded in Oct. 2018 lead byTokyo Tech More than 30 partners working together for SSS

World leading professors

Prof. Misako Takayasu
Inst. Innovative Research
Big data analysis

Prof. Masayuki Fujita
Dept. Systems and Control Eng., School of Eng., Cooperative robot control

Prof. Hidetoshi Nishimori
Inst. Innovative Research
Quantum computation

Tokyo Tech Academy for Leadership

ToTAL
Tokyo Tech Academy for Leadership

Founded in 2018 lead by Inst. Liberal Arts (Union of Humanities and Science)

Massive Open Online Course

TokyoTechX

Online education since 2014 via Tokyo TechX (MOOC) by joining edX

Curriculum and thirteen strategies

Legend:
- Specialty-Creativity Education Committee
- Open Education Committee
- Open Innovation Committee
- Global Leadership Education Committee
- Online Education Committee

Engineering Education Program for Super Smart Society

Timeline (left axis):
- Doctoral Thesis Defense
- Completion Examination
- International Partners
- 2.5 year
- Doctoral Course
- Midterm Review — Selection for Financial Support
- Master 2nd grade
- Entrance Examination
- 1.5 year
- Master 1st grade
- International Collaborations
- Invited Researchers
- Mentors
- International Students

Program components (center):
- Requirement for Completion — **Super Smart Society Creation Project [PhD Thesis]**
- **Global Off-campus Project**
- Requirement for Completion (selective) — **Cyber-Physical Off-campus Project** — Companies (Cyber) | Companies (Physical)
- Requirement for Completion — **Global Leadership Courses** (Tokyo Tech Academy for Leadership: ToTAL)
- Requirement for Completion — **Courses on Super Smart Society Innovation** — Autonomous Driving, Data Science and AI, Smart Energy Smart Agriculture, IoT, Smart Manufacturing, etc.
- **Super Smart Society Global Forum**
- Requirement for Completion — **Specialized Courses Related to Cyber/Physical Space** — Major Subjects (Cyber) | Major Subjects (Physical)
- **Intensive Practice for Interdisciplinary Research Planning**
- **Overseas Mentor System**
- Requirement for Midterm Review — **Super Smart Society Fundamental Technology Project [Master Thesis]**
- **Cyber-Physical Cross Mentor System** — Mentor (Cyber) | Mentor (Physical)
- Requirement for Enrollment — **Interdisciplinary Matching Workshop**
- Requirement for Enrollment — **Cyber-Physical Off-campus Project** — Companies (Physical) | Companies (Cyber)
- Requirement for Midterm Review — **Courses Related to Basic Quantum Science and Artificial Intelligence**

Online Learning SPOC MOOC

SSS Consortium

- Open Innovation Interdisciplinary Joint Research
- Open Education Internship
- Open Education Lecturer
- Open Education Online Learning
- Open Innovation Interdisciplinary Joint Research
- Open Innovation Interdisciplinary Matching
- Open Education Internship
- Working Doctoral Students

Organizations that participate SSS Consortium:
- Private Companies
- Public Research Institutes
- Local Governments

SSS Online education

Recording Studio

The WISE-SSS utilizes online education as a key tool to foster human resources through community/industry outreach programs (open education) and interdisciplinary research (open innovation). By shifting university courses online and offering online courses for major 'Super Smart Society' topics such as quantum science and artificial intelligence, we create a learning environment where both Tokyo Tech students and working adults can study state-of-the-art knowledge and technology.

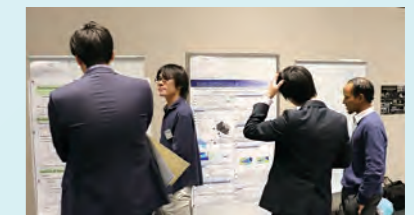## Cultivation of Specialized Academic Skills & Originality

① Courses related to basic artificial intelligence and quantum science
Students learn core academic skills necessary for research and development of advanced technologies in a super smart society.

② Specialized courses related to cyber/physical space
Students gain specialized subject knowledge related to cyber space and physical space to acquire "specialized academic skills & originality" for a super smart society.

③ Cyber-physical cross mentor system
To objectively assess the significance from different viewpoints and to develop multi-faceted problem-solving skills, each student is assigned mentors who specialize in different fields. By providing consistent guidance in an integrated manner from the masters to doctoral courses, students have improved outcomes, which cannot be obtained with short-term experiences such as a lab rotation.

Cultivation of broad perspectives through social cooperation comprehensiveness

④ Courses on Super Smart Society Innovation
To cultivate professional skills and a holistic view, courses on Super Smart Society creation are offered in collaboration with the SSS promotion consortium partners (Japanese National Research and Development Agencies, private corporations, local governments, etc.). Students learn about real social issues and advanced technologies towards a super smart society.

⑤ Cyber-Physical Off-Campus Project
Students complete an internship at a SSS promotion consortium partner. Through an experience involving an off-campus project at an organization in a different field from their specialization, students gain a broad perspective for a super smart society.

Cultivation of problem-solving abilities for interdisciplinary issues

⑥ Interdisciplinary matching workshop
Students participating in the program, faculty members, and SSS promotion consortium partners jointly attend biannual interdisciplinary workshops, which aim to match students' research achievements (seeds) and social research issues (needs). The program not only motivates students to contribute to society but also provides opportunities to collaborate on industry-academia joint research.

By exchanging opinions with experts in corporations and Japanese National Research and Development Agencies, students gain new perspectives and ideas. Matching workshop also produce interdisciplinary joint research projects.
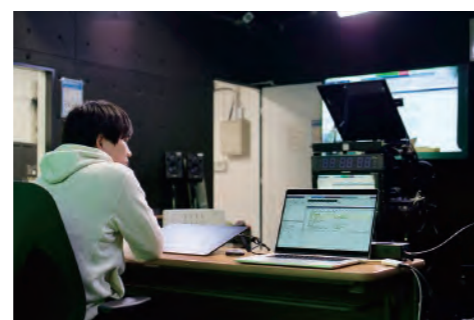
⑦ Intensive practice for interdisciplinary research planning
Students work on intensive exercises to formulate concrete research plans on self-selected interdisciplinary issues among those provided by the faculty and partner institutions. These exercises strengthen the interdisciplinary research capability of participating students.

⑧ Super smart society fundamental technology research project
To cultivate problem-solving skills that encompass interdisciplinary fields, the project supports basic technology research to realize a super smart society under the mentorship of not only the students' academic supervisors but also industrial and government advisors.

⑨ Super smart society innovation research project
For matched research themes, students jointly conduct a super smart society creation project with partner organizations to solve interdisciplinary social issues.

"Intensive practice for interdisciplinary research planning" provides an opportunity for learning by using SSS research and education field.

Cultivation of global leadership development

⑩ Global leadership courses
Students are required to complete the University's leadership education courses, which foster the power to drive a super smart society. Students demonstrate leadership skills acquired through these courses by participating in a super smart society creation research project and a global off-campus project.

⑪ Super smart society global forum
Students present research results at the super smart society global forum where leading researchers from around the world are invited. Discussions about research at the forum (including feedback on the research and finalization of the future research direction) foster an understanding from global perspectives.

⑫ Global Off-Campus project
Students intern at a research organization of an overseas partner or consortium partner for at least three months and conduct global joint research related to the students' research theme. This activity builds global leadership skills and deepens research content.

⑬ Overseas mentor system
Students have an opportunity to understand their strengths and weaknesses through interviews with overseas advisers. This provides an opportunity to build a career path from a global perspective.

SSS Research & Education fields

The goal of the super smart society research and education fields is to provide graduate students opportunities to conduct experiments that foster problem-solving abilities for interdisciplinary issues while working alongside corporations, local governments, and Japanese National Research and Development Agencies.

Automated driving cars

Smart Mobility

1 Smart mobility

This research platform is related to automated driving and mobility services utilizing it. We create new mobility services using electric vehicles controlled by open-source software and cutting-edge wireless systems (5G, millimeter-wave band wireless LAN) to process the sensor information delivered through cameras and LiDAR (a type of laser sensor).

Kazuki Maruta
Tokyo Tech Academy for Super Smart Society
Specially Appointed Associate Professor

2 Smart robotics — Robot Land

This research and education field is related to ground robots. We offer a smart robotics education research environment utilizing 5G, IoT, and AI. We promote practical education research to tackle social issues such as disaster response, infrastructure maintenance, and an aging society. The University created a quadruped hydraulic-driven robot for an outdoor environment, which can perform tasks in dusty or rainy conditions.

Gen Endo
Department of Mechanical Engineering,
School of Engineering
Associate Professor

Robot Land
Quadruped robot for outdoor fields

3 Smart robotics — Smart Manufacturing

This field offers an experiential learning environment through practice by seamlessly connecting digital manufacturing flow from parts design to processing. We offer cutting-edge education and research in smart manufacturing by combining cameras to obtain 3D data of the shape, position, and posture of a manufactured parts or tools.

Tomohisa Tanaka
Department of Mechanical Engineering,
School of Engineering
Associate Professor

Smart Manufacturing
On-machine measurements of target parts on the table

Supervisor

Koichi Suzumori
Department of Mechanical Engineering, School of Engineering
Professor

Smart Robotics

4 Smart robotics — Robot Zoo Sky

Robot Zoo Sky is the robotics experimental platform for simultaneous coordinated control of multiple robots such as drones. Utilizing cutting-edge distributed control technology, we develop environmental monitoring technologies to realize a reliable and safe society. Furthermore, we offer students opportunities to learn about technology that securely controls multiple components and systems connected in networks, which is a fundamental technical skill in the era of IoT.

Takeshi Hatanaka
Department of Systems and Control Engineering,
School of Engineering
Associate Professor

Robot Zoo Sky
Scene of environmental monitoring control

5 Smart robotics — Robot Zoo Aqua

The oceans – that is, water – account for approximately 70% of the Earth's surface. However, much of this aquatic environment remains unknown. To resolve this shortcoming, Robot Zoo Aqua employs approaches from the standpoint of robotics to social issues related to the aquatic environment. We conduct controlled experiments of underwater robots using real water surface drones. Such a practicum environment is unparalleled within and outside Japan.

Motomu Nakashima
Department of Systems and Control Engineering,
School of Engineering
Professor

Robot Zoo Aqua
Water-surface drone

Quantum Computing
Student experiment using cryogenic equipment

Quantum Sensors
Fabrication and measurement system for thin superconducting quantum films

6 Quantum computing

Quantum computers are expected to be the next-generation ultra-high–speed computers based on quantum mechanics. Manipulating qubits on a large-scale will enable massive parallel computing. Research on potential applications is also underway and should contribute to solving the information processing issues required for a super smart society.

Tetsuo Kodera
Department of Electrical and Electronic Engineering,
School of Engineering
Associate Professor

7 Quantum sensors

A sensor is defined as a device that converts a physical phenomenon and the state of an object into an electric signal. A quantum sensor is a type of sensor that uses the quantum effect (a phenomenon in quantum mechanics). Because quantum sensors are more sensitive than conventional sensors, they are expected to contribute to a super smart society. We are working on the development of such sensors with an emphasis on SQUID, which is a quantum sensor capable of detecting minute magnetic fields.

Toru Hirahara
Department of Physics,
School of Science
Associate Professor

8 Artificial intelligence

Tokyo Tech started "Data Science & Artificial Intelligence Research Group for Social Good" (DSAI), and began preparing for artificial intelligence education for graduate students. As part of this initiative, we retrofitted four lecture rooms with Wi-Fi 6 wireless LAN, which allow students to access the high-speed network for machine learning services in the cloud from their own PCs and tablets.

Koichi Shinoda
Department of Computer Science,
School of Computing
Professor

Artificial Intelligence
Supercomputer: TSUBAME 3.0

Body surface temperature by an infrared thermal image camera

9 Smart workplace

To create a comfortable living space in the architectural environment, we measure and sense the indoor environment and physical characteristics of occupants. A smart, comfortable, and productive environment is created by AI-controlled air conditioning, which estimates and adjusts the comfort level from the collected data. In this way, we demonstrate indoor environment sensing, air conditioning control, and the occupant specific comfort level in a real space.

Naoki Kagi
Department of Architecture and Building Engineering,
School of Environment and Society
Professor

Smart Workplace

10 Smart agriculture

To solve specific issues in Japanese style small-scale agriculture, including long work hours, low productivity, and low profitability, smart agriculture education research aims to realize automated, stable yields of high-quality crops using remote agricultural technology with AI, IoT, and robotics. We offer opportunities for students to learn technical elements related to smart agriculture for small open fields as well as farming. We also provide research opportunities for joint projects with partner organizations.

Kuniaki Uto
Department of Computer Science,
School of Computing
Assistant Professor

Smart Agriculture

Drone field

WISE-SSS Program members

Academic Supervisors

Program Director	Tomohiko Uyematsu	Dept. of Information and Communications Engineering, School of Engineering	Professor
Former Program Director	Nobuyuki Iwatsuki	Dept. of Mechanical Engineering, School of Engineering	Professor
Program Coodinator	Kei Sakaguchi	Dept. of Electrical and Electronic Engineering, School of Engineering	Professor
Vice Coodinator	Akinori Nishihara	Tokyo Tech Academy for Super Smart Society	Specially Appointed Professor
Vice Coodinator	Kenichi Okada	Dept. of Electrical and Electronic Engineering, School of Engineering	Professor
Vice Coodinator	Mitsuyasu Iwanami	Dept. of Civil and Environmental Engineering, School of Environment and Society	Professor
Vice Coodinator	Koichi Suzumori	Dept. of Mechanical Engineering, School of Engineering	Professor
Vice Coodinator	Misako Takayasu	Advanced Data Analysis and Modeling Unit, Institute of Innovative Research	Professor
Vice Coodinator	Naoyuki Hayashi	Dept. of Social and Human Sciences, Institute for Liberal Arts	Professor
Exective Advisor	Takao Kashiwagi	Solution Research Center for Advanced Energy Systems, Institute of Innovative Research	Institute Professor
Exective Advisor	Hidetoshi Nishimori	Quantum Computing Unit, Institute of Innovative Research	Specially Appointed Professor
Manager, Steering Committee	Gia Khanh Tran	Dept. of Electrical and Electronic Engineering, School of Engineering	Associate Professor
Manager, Steering Committee	Takeshi Hatanaka	Dept. of Systems and Control Engineering, School of Engineering	Associate Professor

Specialty-Creativity Education Committee

Chair	Toshimasa Fujisawa	Dept. of Physics, School of Science	Professor
Vice Chair	Toru Hirahara	Dept. of Physics, School of Science	Associate Professor
Vice Chair	Tomohisa Tanaka	Dept. of Mechanical Engineering, School of Engineering	Associate Professor
	Masafumi Okada	Dept. of Mechanical Engineering, School of Engineering	Professor
	Isao Yamada	Dept. of Information and Communications Engineering, School of Engineering	Professor
	Akiyoshi Shioura	Dept. of Industrial Engineering and Economics, School of Engineering	Professor
	Susumu Saito	Dept. of Physics, School of Science	Professor
	Keisuke Tanaka	Dept. of Mathematical and Computing Science, School of Computing	Professor
	Takehiko Ito	Dept. of Life Science and Technology, School of Life Science and Technology	Professor
	Haruyuki Fujii	Dept. of Architecture and Building Engineering, School of Environment and Society	Professor
	Tsubasa Okaze	Dept. of Architecture and Building Engineering, School of Environment and Society	Associate Professor
	Takayuki Iwasaki	Dept. of Electrical and Electronic Engineering, School of Engineering	Associate Professor

Open Education Committee

Chair	Mitsuji Sampei	Dept. of Systems and Control Engineering, School of Engineering	Professor
Vice Chair	Hiroya Nakao	Dept. of Systems and Control Engineering, School of Engineering	Professor
Vice Chair	Yoshimi Takuwa	Dept. of Social and Human Sciences, Institute for Liberal Arts	Associate Professor(Lecturer)
	Masayuki Fujita	Dept. of Systems and Control Engineering, School of Engineering	Visiting Professor
	Jiro Hirokawa	Dept. of Electrical and Electronic Engineering, School of Engineering	Professor
	Makoto Hagiwara	Dept. of Electrical and Electronic Engineering, School of Engineering	Associate Professor
	Yoshihiro Miyake	Dept. of Computer Science, School of Computing	Professor
	Masashi Matsuoka	Dept. of Architecture and Building Engineering, School of Environment and Society	Professor
	Takashi Asawa	Dept. of Architecture and Building Engineering, School of Environment and Society	Associate Professor
	Yoshihiro Watanabe	Dept. of Information and Communications Engineering, School of Engineering	Associate Professor

Online Education Committee

Chair	Jun-ichi Imura	Dept. of Systems and Control Engineering, School of Engineering	Professor
Vice Chair	Cross Jeffrey Scott	Dept. of Transdisciplinary Science and Engineering, School of Environment and Society	Professor
Vice Chair	Kazuhiro Kezuka	Dept. of Social and Human Sciences, Institute for Liberal Arts	Associate Professor(Lecturer)
	Dai Senoo	Dept. of Industrial Engineering and Economics, School of Engineering	Professor
	Gen Endo	Dept. of Mechanical Engineering, School of Engineering	Associate Professor
	Naoki Kagi	Dept. of Architecture and Building Engineering, School of Environment and Society	Professor
	Yu Ara	Tokyo Tech Academy for Super Smart Society	Specially Appointed Assistant Professor
	Toru Nagahama	Center for Innovative Teaching and Learning	Associate Professor

Global Leadership Education Committee

Chair	Jun-ichi Takada	Dept. of Transdisciplinary Science and Engineering, School of Environment and Society	Professor
Vice Chair	Yukihiko Yamashita	Dept. of Transdisciplinary Science and Engineering, School of Environment and Society	Associate Professor
Vice Chair	Nobuhiro Hayashi	Dept. of Life Science and Technology, School of Life Science and Technology	Associate Professor
	Toru Yagi	Dept. of Mechanical Engineering, School of Engineering	Associate Professor
	Mutsuko Hatano	Dept. of Electrical and Electronic Engineering, School of Engineering,	Professor
	Kazuhiko Fukawa	Dept. of Information and Communications Engineering, School of Engineering	Professor
	Kayoko Nohara	Dept. of Transdisciplinary Science and Engineering, School of Environment and Society,	Professor

Open Innovation Committee

Chair	Koichi Shinoda	Dept. of Computer Science, School of Computing	Professor
Vice Chair	Jun Miyazaki	Dept. of Computer Science, School of Computing	Professor
Vice Chair	Takahiro Shinozaki	Dept. of Information and Communications Engineering, School of Engineering	Associate Professor
	Tetsuo Kodera	Dept. of Electrical and Electronic Engineering, School of Engineering	Associate Professor
	Kotaro Inoue	Dept. of Industrial Engineering and Economics, School of Engineering	Professor
	Mikio Kozuma	Dept. of Physics, School of Science	Professor
	Yasunori Aizawa	Dept. of Life Science and Technology, School of Life Science and Technology	Associate Professor
	Toshiyasu Osaragi	Dept. of Architecture and Building Engineering, School of Environment and Society	Professor
	Eiichi Sasaki	Dept. of Civil and Environmental Engineering, School of Environment and Society	Associate Professor
	Yasuko Yanagida	Laboratory for Future Interdisciplinary Research of Science and Technology, Institute of Innovative Research	Professor
	Takamichi Nakamoto	Laboratory for Future Interdisciplinary Research of Science and Technology, Institute of Innovative Research	Professor
	Yukio Kawano	Dept. of Electrical and Electronic Engineering, School of Engineering	Associate Professor
	Shoichi Kishiki	Laboratory for Future Interdisciplinary Research of Science and Technology, Institute of Innovative Research	Associate Professor
	Takuya Oda	Solution Research Center for Advanced Energy Systems, Institute of Innovative Research	Specially Appointed Professor
	Kenji Suzuki	Laboratory for Future Interdisciplinary Research of Science and Technology, Institute of Innovative Research	Specially Appointed Professor
	Hiroyuki Ito	Nano Sensing Research Unit, Institute of Innovative Research	Associate Professor
	Takatoki Yamamoto	Dept. of Mechanical Engineering, School of Engineering	Associate Professor
	Motomu Nakashima	Dept. of Systems and Control Engineering, School of Engineering	Professor
	Takeshi Hatanaka	Dept. of Systems and Control Engineering, School of Engineering	Associate Professor
	Kazuhide Nakata	Dept. of Industrial Engineering and Economics, School of Engineering	Associate Professor
	Kazuki Maruta	Tokyo Tech Academy for Super Smart Society	Specially Appointed Assosiate Professor
	Jun Yoneda	Tokyo Tech Academy for Super Smart Society	Specially Appointed Assosiate Professor
	Yusuke Shinyama	Tokyo Tech Academy for Super Smart Society	Specially Appointed Assistant Professor

International Advisor

Magnus Egerstedt	Georgia Institute of Technology
Jeng-Shiou Leu	National Taiwan University of Science and Technology
Wilfred G. van der Wiel	University of Twente
Marco Ceccarelli	University of Rome Tor Vergata
Chia-Hsiang Menq	The Ohio State University
Taweep Chaisomphob	Thammasat University
Ian Watson	University of Glasgow
Sandra Hirche	Technical University of Munich
Thomas Haustein	Fraunhofer Heinrich-Hertz-Institute
Branka Vucetic	University of Sydney
Susi S. Varvayanis	Cornell University
Michiel Bacchiani	Google LLC
Ali Sadri	SOLiD Gear Inc.
Emilio Carvanese Strinati	CEA Leti
Sumei Sun	Institute for Infocomm Research(I 2 R)
Masaaki Maeda	Asurion LLC
Seong-Lyun Kim	Yonsei University
Haris Gačanin	RWTH Aachen University

Message

My name is Sumei SUN. I am a Principal Scientist, and Head of the Communications and Networks Dept at Institute for Infocomm Research (I2R), Agency for Science, Technology, and Research (A*STAR), Singapore. I am also holding a joint appointment with the Singapore Institute of Technology, and an adjunct appointment with the National University of Singapore, both as a full professor. I have a strong passion in use-inspired industry-relevant research and technology creation.

My current research interests are in next-generation wireless communications (Beyond 5G/6G), Industrial Internet of Things, and integrated secure sensing-communications-computing design, and Communications Intelligence and Optimization. It is a great pleasure and honor to be part of the WISE Program for Super Smart Society. I wish the Program all the successes!

Private Companies/Public Research Institutes/Local Governments

Kiyohito Yoshihara	KDDI Research, Inc.	Hidehiko Wada	Yokogawa Electric Corporation
Teruya Fujii	SoftBank Corp.	Yoshiki Sugiyama	Ota City
Shintaro Arata	Koden Electronics Co., Ltd.	kazunori Sato	Kawasaki City
Yuichi Nakamura	NEC Corporation	Takashi Toyofuku	Japan Agency for Marine-Earth Science and Technology
Chosei Kaseda	Azbil Corporation	Hiromi Arai	RIKEN Center for Advanced Intelligence Project (AIP)
Hirofumi Kuwabara	JTEKT CORPORATION	Takeshi Oshima	National Institutes for Quantum and Radiological Science and Technology
Nobuaki Kawahara	DENSO CORPORATION	Fumihide Kojima	NICT Wireless Networks Research Center
Masahiro Yamazaki	Hitachi Industrial Equipment Systems Co., Ltd.	Hirotaka Ogawa	The National Institute of Advanced Industrial Science and Technology,
Yukio Tsutsui	YASKAWA Electric Corporation		Information Technology and Human Factors
Shinji Miyata	NSK Ltd.	Kazuo Kyuma	National Agriculture and Food Research Organization
Koyo Takeo	SHO-BOND CORPORATION		

External Evaluation Special Advisors

Pramod Khargoneka	Vice Chancellor for Research of UC Irvine, Former NSF Assistant Director for Engineering
Makoto Ando	Advisor of KOSEN National Institute of Technology, Ex-president of IEICE
Kazuo Kyuma	President of National Agriculture and Food Research Organization, Ex-executive member of CSTI
Hironori Hibino	Tokyo University of Science

SSS Promotion Consortium
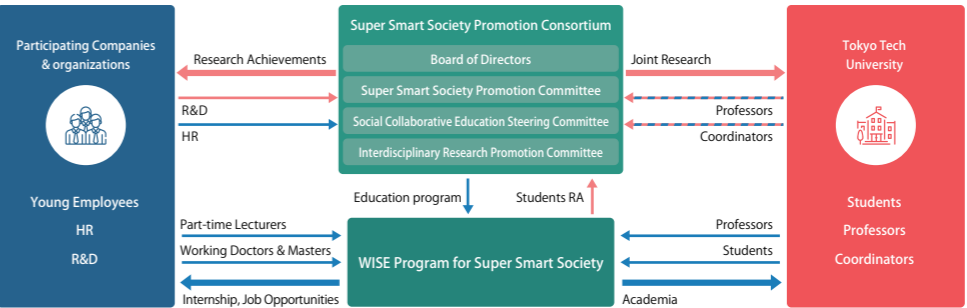
The SSS promotion consortium was jointly established through industry-government-academia collaboration in October 2018 for the purpose of co-creating the next generation social collaborative education research platform, which integrates education and research development. The platform fosters future leaders of the upcoming super smart society. Currently, over forty organizations, including Japanese National Research and Development Agencies, local governments, and private corporations, are participating.

The SSS promotional consortium established the following three committees: 1) Super Smart Society Promotional Committee, which offers networking opportunities; 2) Social Collaborative Education Steering Committee, which nurtures the human resource development program in collaboration with industry-government-academia; and 3) Interdisciplinary Research Promotion Committee, which builds interdisciplinary research teams. Each committee closely collaborates with the WISE-SSS.
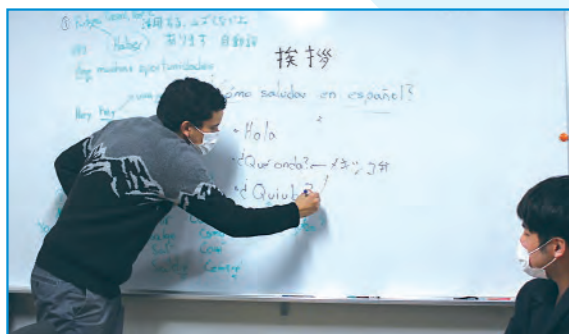
Consortium Partners

- Tokyo Institute of Technology
- Japan Agency for Marine-Earth Science and Technology
- RIKEN Center for Advanced Intelligence Project (AIP)
- National Institutes for Quantum and Radiological Science and Technology
- NICT Wireless Networks Research Center
- The National Institute of Advanced Industrial Science and Technology, Information Technology and Human Factors
- National Agriculture and Food Research Organization
- KDDI CORPORATION
- SoftBank Corp.
- NIPPON TELEGRAPH AND TELEPHONE CORPORATION
- Rakuten Mobile, Inc.
- Koden Electronics Co., Ltd.
- Ricoh Company, Ltd.

- TOSHIBA CORPORATION
- NEC Corporation
- Panasonic Corporation
- FUJITSU LIMITED
- NISSEICOM, LIMITED
- Azbil Corporation
- Yokogawa Electric Corporation
- DENSO Corporation
- Honda Research Institute Japan Co., Ltd.
- Mazda Motor Corporation
- JTEKT CORPORATION
- Hitachi Industrial Equipment Systems Co.,Ltd.
- YASKAWA Electric Corporation
- NSK Ltd.

- Kawasaki Heavy Industries, Ltd.
- Kubota Corporation
- Komatsu Ltd.
- Makino Seiki Co.,Ltd.
- SHO-BOND CORPORATION
- The Bank of Yokohama,Ltd.
- aiwell Inc.
- Ota City
- Kawasaki City
- The Ecozzeria Association
- Kanto Head Office, Organization for Small & Medium Enterprises and Regional Innovation, JAPAN
- Tokyo University of Science (Individual Member)
- KOSEN National Institute of Technology (Individual Member)

I am currently working on research and development related to bearingless motors. Using magnetic levitation technology, bearingless motors rotate while the rotor is suspended by magnetic force. Benefits of such motors are no friction, high efficiency, and low-energy consumption. Specifically, I am developing the inner workings of next-generation motors through analysis, design, production, and experiments. I find my research to be very enjoyable.

At the WISE-SSS program, in addition to the knowledge of electronics, mechanics, and informatics, you can also learn a wide range of technologies such as quantum science and artificial intelligence. Unlike regular masters and doctoral courses, this very attractive educational program allows you to acquire plenty of knowledge and information in diverse topics. Therefore, you can aim to become a super-skilled PhD graduate who brings innovation not only in future industries but also in an interdisciplinary super smart society. Furthermore, there are many benefits such as lectures to learn cutting-edge technologies, experiencing

automated driving, which is expected to be a major technology in a super smart society, financial support, and career development support. This educational system offers everything you need to improve yourself and your future research. At first glance, you may feel overwhelmed because there are more required classes and assignments. However, it is the best opportunity to absorb a wide range of knowledge and information and train your intelligence. In fact, the workloads are very manageable, and I even have time to study English and Spanish with international students in the lab during the break time.

In a super smart society, "energy conservation" will be a keyword. In the future, I want to expand my motor research into a different research discipline. In addition, I hope to develop innovative technical elements to eliminate energy problems.

Through the WISE-SSS program, you can participate in industry-academia collaborative research that encompasses multiple disciplines through the broad perspectives acquired from joint research and the interdisciplinary mentor system. If you desire to become a super-talented PhD graduate with a variety of knowledge across disciplines, and are interested in realizing a super smart society, please apply for this program.

Takahiro Noguchi

Major in Electrical and Electronic Engineering,
Department of Electrical and Electronic Engineering,
School of Engineering
The first year in the doctoral program

Studying Spanish with an international student, Hector.

I belong to the Iwanami lab. My research is related to the proper management of infrastructure. In particular, I specialize in cathodic protection, which is a technology to extend the lifetime of building structures by flowing electric current from the surface of a concrete structure to control internal rebar corrosion.

Multiple factors often compound infrastructural management issues. Thus, it is necessary to consider the interactions among a variety of elements across disciplines such as science and technology, politics, and behavioral economics. In an effort to acquire deeper knowledge of related disciplines, I was self-studying cutting-edge technologies and exploring methods to apply in the field of civil engineering. When I learned that Tokyo Tech began offering the WISE-SSS, I quickly recognized the strong support system that the curriculum would provide both in learning and research. Therefore, I immediately registered for the WISE-SSS. I was

surprised by the level of support. The program offered not only advanced powerful technologies such as artificial intelligence and quantum mechanics, but also other enriching activities such as global leadership and interdisciplinary practicums. Now I am confident that I am utilizing knowledge from other fields into my own discipline.

Currently, I am working on an interdisciplinary joint project in the framework of the WISE-SSS. In the project, I regularly encounter eye-opening surprises in terms of how others view the same phenomenon. Due to different backgrounds, students at Tokyo Tech have diverse perspectives. I think that different viewpoints allow the discovery of issues and innovative solutions to realize a super smart society. Therefore, in parallel to working on my specialization studies, I want to expand my interactions with different fields and collaborations more globally.

Finally, I find fulfillment by collaborating with a variety of people to realize the proper management of infrastructure, which is one reason that I was attracted to civil engineering. I want to be a researcher who can contribute to the mutual understanding and diverse happiness of people through the management of infrastructure by utilizing my education at the WISE-SSS.

Akira Hekizono

Major in Civil Engineering, Department of Civil and
Environmental Engineering, School of Environment
and Society
The first year in the doctoral program

50t load-test apparatus for studying the mechanical properties of reinforced concrete

My name is Yin Yue, a D2 student from Sakaguchi-Tran lab. My current research is focusing on radio resource management (RRM) for millimeter-wave (mmWave) vehicle-to-everything (V2X) communications. There are lots of challenges in RRM for mmWave V2X communications such as dynamic beam alignment, scheduling, association, multi-hop relay, and interference control. The objective of my research is to ensure reliable mmWave V2X communications by advanced RRM and improve the safety and traffic efficiency with automated driving. My first-half work aimed to improve the reliability of V2V communications, I proposed to allocate a single mmWave channel and apply a novel antenna configuration method called "ZigZag" for all V2V links. This research improved spectrum utilization and ensured higher throughputs (over 1 Gbps) for V2V in the dynamic vehicular environment with interference. My ongoing work is to develop new scheduling and association algorithms based on CSI (channel state information) prediction for the RRM of Vehicle-to-Infrastructure (V2I). I was glad to be a member of Sakaguchi-Tran Lab and had opportunities

to research one of the most state-of-the-art wireless communication technologies, mmWave V2X communications, attend international conferences, and communicate with big persons in this field. Owing to these experiences, I realized that we, as PhD candidates, should not limit ourselves to a single area, conducting research with in the small campus (even the small lab space). It is no longer suitable for modern job markets and society demands. Together with a solid expertise foundation, we also need interdisciplinary knowledge and enough interactions with industries. The WISE-SSS program provides us such a platform. The involved students are guided to specify and deal with various social challenges. Interdisciplinary communications are highly valued. Moreover, Automated driving which is my most interesting subject is one of the primary research topics of the SSS program. So, I registered for the SSS program.

After Joining the SSS program, I am also lucky to take part in the collaborative research with the company, DENSO. It is my precious experience. By communicating with the company's researchers, I learned that doing research should not only pursue innovation but also consider the possibility of implementation. In the future, I hope to contribute to the realization of automated driving and wish the roll-out of high-level automated vehicles can reduce mortality due to traffic accidents and improve traffic efficiency.
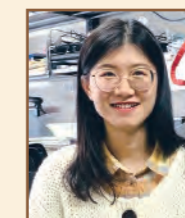
Yin Yue

Major in Electrical and Electronic Engineering,
Department of Electrical and Electronic Engineering,
School of Engineering
The second year in the doctoral program

Intensive practice for interdisciplinary research planning with other group members (Yin Yue is the furthest left).

MESSAGE TO STUDENTS

The mission of the WISE-SSS is to realize a super smart society by cross-disciplinary efforts and to cultivate talents who can lead such a society. The majority of undergraduate students in the University enroll in a graduate school, but only 15% of students continue to a doctoral program. In other countries, obtaining a research position (almost always) requires a doctoral degree, and PhD graduates actively work in other fields. Japan should also take initiatives to allow more PhD graduates to take charge. To this end, our faculty members will support you in a variety of aspects. Please accept this challenge.

Akinori Nishihara

Tokyo Tech Academy for
Super Smart Society
Specially Appointed Professor, COO

From registration to completion

From registration to completion, there are four assessments during the program:

1 Assessment
Enrollment selection: Students are required to participate in both the cyber-physical off-campus project in their own field and the interdisciplinary matching workshop. Students submit a short essay describing their motivation for applying, research plan from the masters to the doctoral courses, and their relation to super smart society. The program faculty members assess them.

2 Assessment
Midterm review: Students are required to submit a short paper outlining their master's thesis, list of achievements, a doctoral research plan, and their contributions to a super smart society. The program faculty members assess those who obtained the required credits from basic subject groups in artificial intelligence and quantum science.

3 Assessment
Completion examination: Students are required to orally present a summary of their doctoral dissertation and activities in the program. By presenting the meaning of their research to a broad audience from different disciplines, their fundamental academic abilities, originality, and holistic view are judged. For students who have already satisfied the completion requirements, the program faculty members assess whether they possess the ability to be a knowledge professional.

4 Assessment
Doctoral degree examination: Students' doctoral dissertations are judged from each discipline's expert viewpoints. Those who pass all four assessments receive a degree along with a certification of completion of WISE-SSS added to their Doctor of Science, Doctor of Engineering, or Doctor of Philosophy diploma.

Financial support for enrolled students

To create an environment where students can prioritize their studies, we offer the "Education and Research Expense Support System," which provides financial support to students.

Super Smart Society Doctoral Leadership Scholarship

Among the program's enrolled students, those with a high research ability and outstanding potential are awarded a scholarship up to two million yen per year. Recipients are selected during the mid-term examination based on the evaluations of participation at an "Interdisciplinary Matching Workshop" and interviews with the program faculty members.
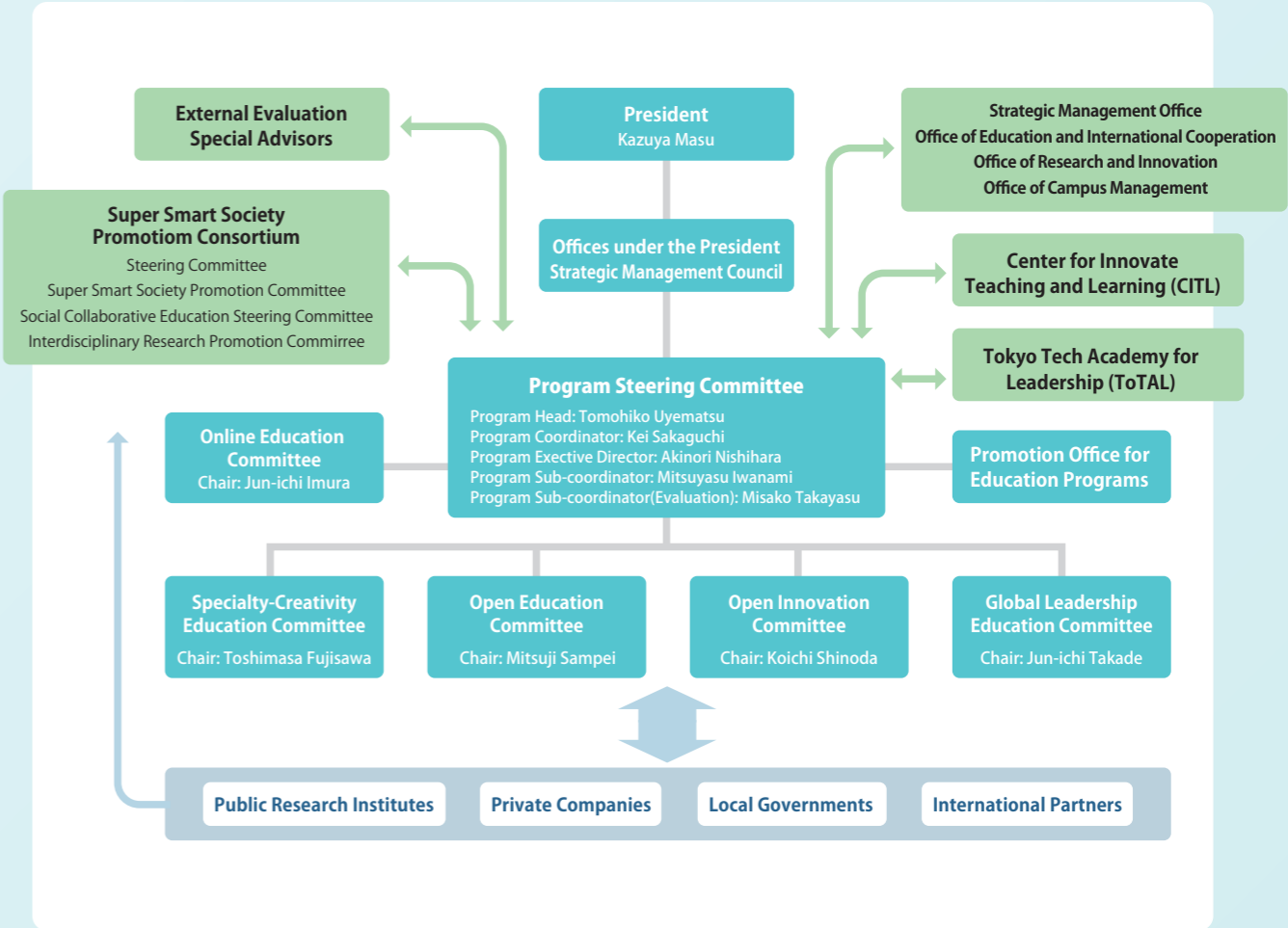
Note: If you are receiving RA salary from a joint research project with an SSS promotion consortium partner or from a national project, the scholarship is provided within a total of two million yen or less, in principle. The same applies if you have other scholarships except for the Tsubame Scholarship.

Research assistantship (RA) for promoting interdisciplinary collaborative research

If the research seed of the enrolled student matches the need of a consortium partner, the student is granted the position of RA (research assistant) to conduct interdisciplinary collaborative research.

Management System

The entire program is supervised by the "Program Steering Committee" under the direction of the President and the Office of the President (Strategic Management Council). The "Program Steering Committee" consists of the Program Director, Program Coordinator, Program Vice coordinator (Finance), and Program Vice coordinator (Evaluation). Each educational program is planned and operated by five educational committees, which are comprised of program faculty members that report to the Program Steering Committee. The five educational committees are 1) Specialty-Creativity Education Committee, 2) Open Education Committee, 3) Open Innovation Committee, 4) Global Leadership Education Committee, and 5) Online Education Committee. The education offered by the Online Education Committee is new, student-centered, and rapidly evolving because it is not constrained by time, place, and generation. It is operated in collaboration with CITL (Center for Innovative Teaching and Learning).

The SSS promotional consortium serves as a bridge between the program and society. Social collaborative education and interdisciplinary research are realized in collaboration with SSS promotion consortium partners.

The Program Steering Committee maintains and smoothly executes the strategies using an iterative PDCA (The Plan-Do-Check-Act) cycle with input of the evaluation committee members within and outside the University.

External Evaluation Special Advisors

President Kazuya Masu

Strategic Management Office Office of Education and International Cooperation Office of Research and Innovation Office of Campus Management

Super Smart Society Promotiom Consortium Steering Committee Super Smart Society Promotion Committee Social Collaborative Education Steering Committee Interdisciplinary Research Promotion Commirree

Offices under the President Strategic Management Council

Center for Innovate Teaching and Learning (CITL)

Tokyo Tech Academy for Leadership (ToTAL)

Program Steering Committee Program Head: Tomohiko Uyematsu Program Coordinator: Kei Sakaguchi Program Exective Director: Akinori Nishihara Program Sub-coordinator: Mitsuyasu Iwanami Program Sub-coordinator(Evaluation): Misako Takayasu

Online Education Committee Chair: Jun-ichi Imura

Promotion Office for Education Programs

Specialty-Creativity Education Committee Chair: Toshimasa Fujisawa

Open Education Committee Chair: Mitsuji Sampei

Open Innovation Committee Chair: Koichi Shinoda

Global Leadership Education Committee Chair: Jun-ichi Takade

Public Research Institutes **Private Companies** **Local Governments** **International Partners**

SUPER SMART SOCIETY

超スマート社会卓越教育院
Tokyo Tech Academy for Super Smart Society