



TOHOKU  
UNIVERSITY

Annual Report 2022



TOHOKU FORUM for CREATIVITY



Message from the Director

## Toward the Promotion of the Tohoku Forum for Creativity

It has been approximately three years since the outbreak of the COVID-19 pandemic. The mission of the Tohoku Forum for Creativity (TFC) is to facilitate direct research exchanges among various researchers to create new knowledge, so the challenging situation of limited “in-person” interactions posed significant issues for us. However, we have strived to establish a system for hybrid delivery. Restrictions are gradually being eased in society. By further developing the fusion of cyber and physical spaces, we aim to expand the scope of our activities.

Since establishment in 2013, we have been operating the Forum for Creativity as our main project. The Thematic Programs within this framework involve hosting leading researchers at Tohoku University for approximately three months and engaging young researchers and corporate researchers to form a diverse intellectual network and delve into specific themes from fresh and multifaceted perspectives. We provide opportunities for young researchers to pioneer future research fields through the Junior Research Programs. Since FY2022, we have also implemented the Future Society Design Programs, which focus on discussing challenges faced by society and industries.

In FY2022, we could finally hold in-person events again, and completed the three programs that had been extended due to the pandemic. Among them, the Junior Research Program on “Dawn of Gravitational-wave Cosmology and the Theory of Gravity” enabled us to host a special lecture by Professor Barry C. Barish, the recipient of the 2017 Nobel Prize in Physics, which received a tremendous response. In FY2022, we carried out five Thematic Programs, two Junior Research Programs, and two Future Society Design Programs.

Furthermore, in the Design Hub for our Future Society, we conducted corporate collaboration programs on “Designing a Digital and Sustainable Society” and “Social Innovations in Insurance in the Digital Society.” In addition, the Research DX Support Center organized the “Data-Driven Science Webinar for Practice,” focusing on utilizing data-driven science in research practices, and the “Research DX Strategy Seminars,” which addressed the digital transformation of research at universities.

I would like to express my sincere gratitude to all those who have contributed to our activities throughout this year. I also would like to ask for your continued cooperation and support in the future. Throughout the history of humankind, advancements in science and culture have emerged from times of crisis. At the Tohoku Forum for Creativity, we hope to contribute to such positive change through various activities.

Tohoku Forum for Creativity Director

Tohoku University Executive Vice President (for Research)

Motoko Kotani

# Overview of the Tohoku Forum for Creativity

Since its foundation, Tohoku University has produced numerous academic achievements and leaders under the spirit of Research First, the philosophy of Open Doors, and the policy of Practice-Oriented Research and Education. To further develop this unique tradition, the university strives to contribute to global society and nurture creative talent under the slogans “Creation on the Leading Edge” and “Challenge for Great Changes.” In this vein, the Tohoku Forum for Creativity (TFC) was established in 2013.

## Mission

The TFC supports the creation of new knowledge that can improve the future of our societies. To produce new knowledge, it is necessary to prepare opportunities for collaboration in which various researchers can interact, as well as to cultivate emerging talent who can demonstrate their creativity in cooperation with others. Furthermore, to produce knowledge that benefits society, it is indispensable to collaborate and communicate with different stakeholders such as companies, local governments, and citizens. Moreover, we cannot ignore the importance of an environment that fosters creative research activities, because academic research is now becoming more and more inseparable from data utilization. With the above in mind, the TFC pursues the following missions:

### Building “a Fellowship of Knowledge” which Contributes to the Solution of the Major Issues Faced by Humanity

The TFC supports the creation of new research fields and the solution of social issues by providing opportunities for researchers to collaborate in tackling the increasingly advanced and complex issues facing society.

### Educating Global Leaders to Build the Future of Humanity

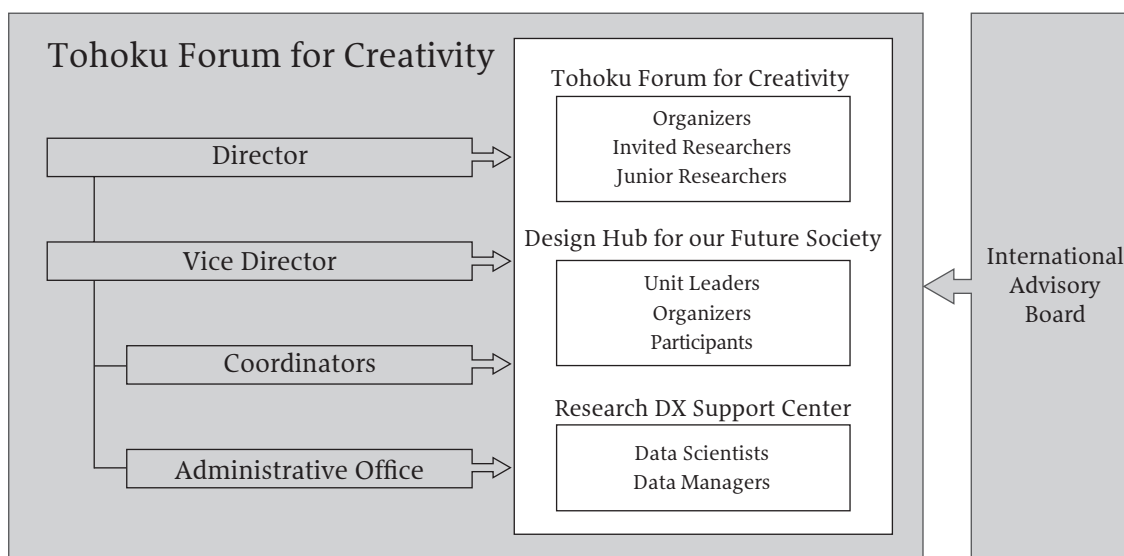
The TFC cultivates global and creative talent by promoting the participation of young researchers and students in our programs, and fostering an environment in which they can interact closely with world-class researchers.

### Contributing to Society by Sharing Academic Advances

The TFC promotes the sharing of knowledge by providing opportunities for intellectual exchange between researchers and the general public, including the children who will lead society in the future, through the planning and hosting of public events.

### Supporting the Organization of an Information Environment for Creative Research

The TFC supports the organization of an information environment which facilitates creative research through the promotion of DX (digital transformation).



## TFC's Projects and Organizations

### The "Forum for Creativity" Project

The TFC was established in 2013 as an organization equipped with Japan's first international visitor research center. Since then, it has run the Forum for Creativity project as its primary task. Its objective is to contribute to solving the major issues faced by humanity and support the creation of new research fields by providing opportunities for researchers to tackle issues collaboratively. For this purpose, we call for thematic programs from throughout the world, covering all academic domains, from humanities and social sciences to natural sciences and engineering. The TFC then selects themes for concentrated discussions over a three-month period, for which it invites leading international researchers and hosts international symposia or workshops. It is also actively engaged in the cultivation of global and creative talent by promoting the participation of young researchers and students in its programs. Junior Research Programs, in which young researchers exercise their initiative for creating new research fields, are hosted every year. Additionally, since FY2022 the TFC has been operating Future Society Design Programs which focus on discussing issues faced by society and industries.

### Design Hub for our Future Society

The TFC supports social value creation in collaboration with various stakeholders such as companies, local governments, and citizens, and the cultivation of young talent through collaborative activities. To assume this role, the Design Hub for our Future Society was established within the TFC in November 2020. Some collaborative programs involving business partners are already underway.

In April 2023, the Design Lab for our Future Co-existence was established as the Design Hub's successor, working to discover specific issues that need to be resolved in contemporary society from the perspectives of "co-existence with humans," "co-existence with nature," and "co-existence with technology," utilizing both cyber and physical space.

### Research DX Support Center

The TFC supports the promotion of digital transformation (DX) to organize an information environment that facilitates creative research, as research activities become more and more inseparable from data utilization. To perform this role, the Research DX Support Center was established within the TFC in November 2020. The Center supports the promotion of DX through surveying the situation in Japan and the world, as well as through information-sharing activities such as seminars.

## Tohoku Forum for Creativity, Organization for Research Promotion, Tohoku University

### Tohoku Forum for Creativity Programs

- Thematic Programs
- Junior Research Programs
- Future Society Design Programs
- Emerging Perspectives Programs
- Outreach Events

### Design Hub for our Future Society

Mathematical  
Science Unit

- Global Academy-Industry Collaboration and Fostering of Young Generation
- Mathematics Education for Industry Engineers

Humanities and  
Social Sciences Unit

- Future Society Design School from the Viewpoint of ELSI
- Academy-Industry Collaboration Program

Collaborative  
Innovation Unit

- Forum for Innovative Social Design considering Society 5.0
- Academy-Industry-Government Collaboration for Open Innovation

### Research DX Support Center

- Advanced Research DX Environment
- DX Support by Data Scientists / Data Managers





## Advisors

### Special Advisors

The TFC has invited two world leaders in business and academia to provide comprehensive advice about the activities of the TFC.

Tetsuro Higashi	Former CEO Tokyo Electron Limited
Makoto Kobayashi	Honorary Professor Emeritus High Energy Accelerator Research Organization

### International Advisory Board

The International Advisory Board was established as an organization to evaluate the proposed thematic programs gathered from throughout the world, and to provide advice on the activities of the TFC.

Sayaka Dake	Professor Graduate School of Law, Tohoku University
Arjen Doelman	Director of Lorentz Center Lorentz Center, Center for Scientific Workshops in All Disciplines
Peter Gruss	President/CEO Okinawa Institute of Science and Technology Graduate University
Yuko Harayama	Emeritus Professor Tohoku University
Mathias Kläui	Professor Institute of Physics, Johannes Gutenberg-University Mainz
Toru Nakano	Emeritus Professor Osaka University
Hiroshi Ooguri	Director Kavli Institute for the Physics and Mathematics of the Universe, The University of Tokyo Institutes for Advanced Study, The University of Tokyo
Huey-Jen Jenny Su	President National Cheng Kung University (NCKU)
Katsuya Yamori	Professor Research Center for Disaster Reduction Systems, Disaster Prevention Research Institute, Kyoto University

# POST 2011 Tohoku Triple Disaster: Lessons and Their Global Application on Multi-Hazards and Cascading Disasters

## Program Theme

The 2011 Great East Japan Triple Disaster (earthquake, tsunami and nuclear accident) painfully demonstrated the importance of mitigating major disasters and the need to consider their mitigation in terms of multi-hazards on a spatial scale (more than one disaster occurring simultaneously) and their cascading effects on a temporal scale (escalating disaster effects over time). As a memorial for the disaster, this program organized the events listed below to develop the post 2011 strategy in line with the Sendai Framework for Disaster Risk Reduction (SFDRR) and Sustainable Development Goals (SDGs). In these events, we systematically discussed how to minimize casualties, damage and their cascading impacts from multi-hazards on a global scale, in collaboration with outstanding experts from interdisciplinary fields.



Main Organizer  
Fumihiko Imamura (Tohoku University)

## Events

- Pre-Event 1 (Collaboration With Berlin Science Week) : Learning From Disasters for a Resilient Society : Experiences From the Great East Japan Earthquake and Tsunami and COVID-19 Pandemic (November 2, 2020)
- Pre-Event 2 : IRIDeS Symposium on 10 Years After the Great East Japan Earthquake and the Future (March 7, 2021)
- Student Workshop : Interdisciplinary Perspectives of Disaster Science (June 16, 2021 / June 23, 2021 / July 14, 2021)
- International Symposium and Workshop on POST 2011 Tohoku Triple Disaster : Lessons and Their Global Application on Multi-Hazards and Cascading Disasters (June 30, 2021)
- International Symposium : The 30th International Tsunami Symposium (ITS2021) (July 1, 2021 – July 3, 2021)
- World Bosai Forum 2023 : Special Organized Sessions (March 10, 2023 – March 12, 2023)

## Program Organizers

- Fumihiko Imamura (Tohoku University)
- Anawat Suppasri (Tohoku University)
- Elizabeth Maly (Tohoku University)
- David Eric Alexander (University College London)
- Andrew D. Gordon (Harvard University)
- Eddie Bernard (National Oceanic and Atmospheric Administration)
- Kenji Satake (University of Tokyo)
- Rajib Shaw (Keio University)

## Principal Invited Researchers

- Ahmet Cevdet Yalciner (Middle East Technical University)
- Tomoya Shibayama (Waseda University)
- Syamsidik (Syiah Kuala University)
- Punam Yadav (University College London)
- Meriel Jeater (Museum of London)
- Carrie Garrison-Laney (University of Washington)



Photo by IRIDeS





# Quantum-Annealing-Based High-Performance Computing – Optimizing Real-World Systems

## Program Theme

Large-scale combinatorial optimization problems are becoming increasingly important in various fields such as disaster prevention, finance, logistics and transportation, medicine, and cutting-edge technologies such as bioinformatics. However, their solution requires enormous computational power and therefore efficient solution methods are in high demand. Attracting attention in this regard is Quantum Annealing (QA), which searches for solutions in a massively parallel manner based on quantum phenomena. It is said that this quantum method, combined with conventional supercomputers, can provide large-scale computations required for application in real-world systems.

Against this backdrop, this program held the events listed below to bring together researchers and students from various fields and solve some of the world's most pressing problems through a combination of quantum and conventional computing.



## Events

- Pre-Event : Quantum and Quantum-Inspired Computation for Real-World Optimization (March 8, 2021)
- Workshop and Tutorial on Solving Combinatorial Optimization Problems Utilizing Quantum Annealing (May 11, 2021 – June 30, 2021)
- Quantum Annealing Solution Contest (December 18, 2021)
- Quantum Computing Future Vision Forum (March 23, 2022)
- Quantum Annealing Day – Towards a New Era of Work Through Quantum Computing (March 25, 2022)
- Symposium on Quantum-Annealing Based HPC (February 16, 2023)

## Related Events

- Quantum Computing for You (September 9, 2022 – November 22, 2022)
- Quantum Annealing for You 2nd Party! (QA4U2) (January 27, 2023 – March 18, 2023)
- Quantum Meeting for You of 1st Season (March 28, 2023)

## Program Organizers

Koichi Hashimoto (Tohoku University)  
Masanori Hariyama (Tohoku University)  
Hiroaki Kobayashi (Tohoku University)  
Masayuki Ohzeki (Tohoku University)

## Principal Invited Researchers

Mark W. Johnson (D-Wave Systems Inc.)



# Evolving and Emerging Redox Biology and Bioenergetics for Medicine and Human Health

## Program Theme

Redox biology, which deals not only with disease-oriented issues affecting human health but also with the most fundamental aspects of biology such as evolution and energy metabolism, is ushering in a new era of life sciences. Several breakthroughs in the redox biology are also expanding the frontiers in various fields of life sciences and clinical medicine. Against this backdrop, this program organized the events listed below to further promote research exchange on redox biology, covering three closely related subfields systematically combined with chemistry, biology, physiology, pharmacology, pathophysiology, and medicine: sulfur redox biology, mitochondrial redox biology, and environmental redox response.



Main Organizer  
Takaaki Akaike (Tohoku University)



## Events

- Exploring Sulfur Biology World in Redox Week in Sendai 2022 (October 29, 2022 – November 1, 2022)
- International Symposium 1 : In Conjunction With International Nitric Oxide Meeting (October 29, 2022 – October 30, 2022)
- International Symposium 2 : In Conjunction With International Persulfide Meeting (October 31, 2022)
- International Symposium 3 : In Conjunction With IDAC-CERA International Meeting (November 1, 2022)

## Program Organizers

Takaaki Akaike (Tohoku University)  
Hozumi Motohashi (Tohoku University)  
Fan-Yan Wei (Tohoku University)

## Principal Invited Researchers

Chris Kevil (LSU Health Shreveport)  
Philip Eaton (Queen Mary University of London)  
Jon M. Fukuto (Sonoma State University)  
Guenter Schwarz (University of Cologne)  
Miriam M. Cortese-Krott (University of Düsseldorf)  
Sruti Shiva (University of Pittsburgh)





# Insights Into Human History in the Eurasian Stone Age: Recent Developments in Archaeology, Palaeoanthropology, and Genetics

## Program Theme

Recent archaeological, paleoanthropological, and genetic studies indicate that two archaic humans (Neanderthals and Denisovans) lived in Central Asia from c. 130,000 years ago, and anatomically modern humans (*Homo sapiens*) also migrated to this region at c. 48,000 years ago. Although Neanderthals and Denisovans were genetically and culturally close to modern humans, they went extinct after the arrival of modern humans. In contrast, modern humans stably increased their population size and further migrated to the American continent. Little is known about why modern humans were able to increase their population size, while the other human species went extinct. In this program, the world-class researchers who are addressing this question through cutting-edge studies were invited to showcase recent advances in archaeology, paleoanthropology, and genetics, and also provided insights into human history in the Eurasian Stone Age.



Main Organizer  
Katsuhiro Sano (Tohoku University)

## Events

- International Symposium : Insights Into Human History in the Eurasian Stone Age : Recent Developments in Archaeology, Palaeoanthropology, and Genetics (September 27, 2022 – September 29, 2022)
- Workshop 1 : Emergence of Regional Diversity of Northeast Asia (September 30, 2022)
- [CANCELED] Public Lectures : Evolution, Dispersals & Replacement in Human History (October 1, 2022)
- Workshop 2 : Recovering Ancient Remains and Reconstructing Past (October 4, 2022)



## Principal Invited Researchers

Jean-Jacques Hublin  
(Collège de France / Max-Planck Institute for Evolutionary Anthropology)

Xing Gao (Chinese Academy of Science)

Viviane Slon (Tel Aviv University)

Cosimo Posth (University of Tübingen)

Tom Higham (University of Vienna)



## Program Organizers

Katsuhiro Sano (Tohoku University)

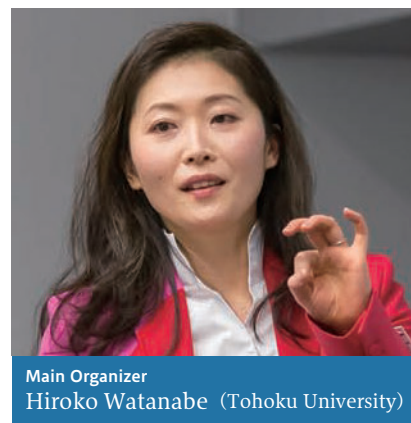
Masami Izuho (Tokyo Metropolitan University)

Kohei Tamura (Tohoku University)

Stefano Benazzi (University of Bologna)

# Frontier of Understanding Earth's Interior and Dynamics

**Program Theme** The interior of the Earth remains a mystery. We have only drilled 12 km deep into the crust and not yet reached the mantle, though it is some 6,400 km in total to the center of the Earth. Geobiologists have found micro-organisms thriving 1-2 km beneath the surface in the absence of photosynthetic processes. Using sound waves that emanate from earthquakes, seismologists have imaged the Earth's interior and defined its first-order physical properties. Since we neither know the interior structure and the depth and dimensions of the deep biosphere of the Earth fully, nor have sufficient techniques to measure and observe them, we have to rely more or less on speculation to understand them. Accordingly, we need to broaden our perspective and work across different disciplinary boundaries to achieve new insights into the deep biosphere and the Earth's interior. In this light, this program organized the events listed below to build an interdisciplinary community with physicists, geologists, biologists, and engineers who share the goal of understanding the Earth's interior and dynamics.



## Events

- International Symposium, Frontier of Understanding Earth's Interior and Dynamics (August 8, 2022 – August 9, 2022)
- Workshop, Cutting Edge Technology for Understanding the Earth (January 12, 2023)
- Lecture for Young Students, the Power Driving the Earth's Engine: What is in the Earth's Interior? ~Scientific Drilling and Neutrino Research~ (January 14, 2023)

## Principal Invited Researchers

- William White (Cornell University)
- Clive R. Neal (University of Notre Dame)
- Hrvoje Tkalčić (Australian National University)
- Matthew Jackson (University of California, Santa Barbara)

## Program Organizers

- Hiroko Watanabe (Tohoku University)
- Natsue Abe (JAMSTEC)
- Tamano Omata (JAMSTEC)
- Kunio Inoue (Tohoku University)
- Yasuhiro Yamada (Kyushu University)
- William F. McDonough (University of Maryland / Tohoku University)



# Dawn of Gravitational-wave Cosmology and Theory of Gravity

## Program Theme

The discovery of gravitational waves in 2015 opened a new era in cosmology a century after Einstein's prediction in 1916. This discovery furnished us with a novel lens through which to see the universe, enabling us to observe otherwise invisible cosmic bodies and even identify the moment of the birth of the universe. While gravity is the least well understood of the four fundamental forces in observational terms, it is thought that gravitational waves reflect the kinematic nature of spacetime, often described as "ripples in spacetime." In this regard, gravitational waves and their observations promise fresh insights into the mysteries of gravity. Amidst this thrilling phase of cosmological and astrophysical research, our program held the events listed below to pioneer the next generation of cosmology and gravitational theories, emphasizing the observational aspects of gravitational waves.



Main Organizer  
Atsushi Naruko (Kyoto University)

## Events

- [Canceled] School  
(April 14, 2020 – April 17, 2020)
- School on Modern Physics  
(August 31, 2020 – September 3, 2020)
- Special Lectures by Nobel Laureates "Gravitational Waves -From Their First Detection to Future Observations-"  
(November 25, 2020)
- Zao International Workshop "Dawn of Gravitational-wave Cosmology and Theory of Gravity"  
(February 28, 2022 – March 2, 2022)
- International Workshop "Dawn of Gravitational-wave Cosmology and Theory of Gravity"  
(March 2, 2022 – March 4, 2022)
- Special Lectures : Uncovering the Origins of the Universe With Gravitational Waves and Higgs Particles  
(March 5, 2022)
- Workshop "Dawn of Gravitational-wave Cosmology and Theory of Gravity"  
(January 23, 2023 – January 25, 2023 / January 28, 2023 – January 30, 2023)
- 2-day International Workshop "Dawn of Gravitational-wave Cosmology and Theory of Gravity"  
(January 26, 2023 – January 27, 2023)
- Tohoku Forum for Creativity and Tokyo Electron Limited Joint Project : Junior Workshop "Science of Gravitational Waves"  
(March 4, 2023 – March 5, 2023)
- Tohoku Forum for Creativity and Tokyo Electron Limited Joint Project : Special Lecture by Nobel Laureate Professor Barry C. Barish "From Einstein To Gravitational Waves"  
(March 6, 2023)

## Program Organizers

- Atsushi Naruko (Kyoto University)
- Rampey Kimura (Waseda University)
- Ryo Namba (RIKEN)
- Naoya Kitajima (Tohoku University)
- Kenji Toma (Tohoku University)
- Linyu Peng (Keio University)



## Principal Invited Researchers

- Rainer Weiss (Massachusetts Institute of Technology)
- Takaaki Kajita (University of Tokyo)
- Barry C. Barish (California Institute of Technology / UC Riverside)
- George Zahariade (Barcelona IFAE)
- Mainak Mukhopadhyay (Pennsylvania State University)
- Chunshan Lin (Jagiellonian University)



# Human Sociality: Comparative Studies of Social Evolution and Historical Dynamics

## Program Theme

Humans are highly social animals, often referred to as a “cooperative species.” Our abilities to cooperate even with unknown individuals on a huge scale have been claimed as a facet of human uniqueness. These abilities can be the basis of large complex societies, eventually leading to state formation. In addition to identifying human uniqueness, one of the major challenges in the fields of humanities and social sciences has been to grasp the consequences of this uniqueness: the process and mechanisms concerning the development of large complex societies, social hierarchy, as well as political systems in human history (i.e., social evolution). However, cooperation and complex societies are ubiquitous in animal societies. Sociality in humans and animals and its consequences have been investigated in various disciplines. Elucidating the uniqueness of human sociality in the animal kingdom thus requires cooperation among by researchers from various disciplines. In this regard, we organized the events listed below to promote interdisciplinary discussion and collaboration to tackle these issues of human sociality.



## Events

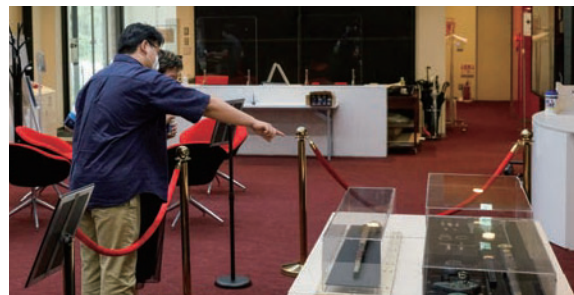
- Exhibition  
(August 10, 2022 – August 19, 2022)
- Workshop : Human Sociality : Comparative Studies of Social Evolution and Historical Dynamics  
(August 17, 2022 – August 18, 2022)
- Tutorial : An Introduction to Modelling and Quantitative Analyses of the Cultural Evolution of Human Social Systems  
(August 19, 2022)

## Program Organizers

Kohei Tamura (Tohoku University)  
Yui Arimatsu (Hiroshima University)  
Thomas Currie (University of Exeter)

## Principal Invited Researchers

Atsushi Iriki (RIKEN BDR)  
Nobuyuki Kutsukake (SOKENDAI)  
Ruth Mace (University College London)  
Takehiko Matsugi (National Museum of Japanese History)  
Naoko Matsumoto (Okayama University)  
Cedric Perret (University of Exeter)





# Creating Diversified and Inclusive Cities Through the Boccia at the Public Space

## Program Theme

In this program, we have organized the events listed below to explore the future possibility of inclusive urban development through the experience of playing parasports (boccia) in public spaces. With the hosting of the Tokyo Olympics and Paralympics, momentum has been growing toward the realization of an inclusive society in which people mutually recognize diversity in terms of disability, race, nationality, gender, and other factors. Meanwhile, in the field of urban development, there is a growing demand for “cities” that enhance urban attractiveness and generate innovation. It is also becoming increasingly important to create “comfortable and pleasant” cities where people want to walk, and to ensure diversity through the use of public spaces. Against this backdrop, we engaged in a dialogue between parasports and urban development, and considered the future of inclusive urban development.



Main Organizer  
Jun Mitarai (Tohoku University)

## Events

- Kick-off Workshop for Creating Diversified and Inclusive Cities Through the Boccia at the Public Space (May 29, 2022)
- Social Experiments : Boccia Experiences in Public Spaces (June 5, 2022 – November 20, 2022)
- Closing Workshop for Creating Diversified and Inclusive Cities Through the Boccia at the Public Space (March 15, 2023)

## Related Event

- Diversity × Inclusion Talk Session : Toward Inclusive Community Development Through Sports (May 22, 2022)



## Program Organizers

- Jun Mitarai (Tohoku University)
- Shigenori Kobayashi (Mori Memorial Foundation)
- Hiroyuki Uematsu (University of Marketing and Distribution Sciences)
- Ryuzo Hasegawa (FRONTYARD Co. Ltd.)
- Yusuke Horie (SHOWA Co., Ltd.)
- Ichiro Fujita (Tohoku University)
- Kazuhiro Tsubohara (Tohoku University)
- Takanori Matsumura (Tohoku University)
- Kazufumi Aoki (NEC Corporation)
- Aki Taguchi (Nippon Foundation Parasports Support Center)
- Hiroko Miura (Japan Boccia Association)
- Kazuo Izumita (Citizen's Sports Volunteers SV2004)
- Seiichi Ito (Social Welfare Corporation Miyagi Disability-welfare Association)
- Ryoichi Nagatomi (Tohoku University)
- Masataka Kataoka (Osaka Metropolitan University)
- Susumu Sakakibara (Urban Design Works, N.P.O.)
- Hitoshi Takeda (Sendai City Sports Promotion Foundation)

## Principal Invited Researchers

- Tatsuya Mitsuyasu (Ministry of Land, Infrastructure, Transport and Tourism)

# Establishment of Lightning Resistant Metal Coating Technology on CFRP Assisted by Kinetic, Physical and Chemical Energies

## Program Theme

There has been a significant shift from traditional metallic materials to lightweight carbon fiber composite materials in the development of aviation, primarily because weight reduction optimizes fuel efficiency. These composite materials, specifically carbon fiber-reinforced plastic (CFRP), are vulnerable to lightning strikes and protective metal meshes are required to mitigate the impact of these strikes. However, the conventional manual lamination process for these meshes is inefficient. The cold spray technique, a solid-phase deposition technology birthed in Russia in 1980s, is expected to provide a solution. Initially intended for metal-on-metal deposition, it now enables metal deposition on CFRP. While the deposition mechanism remains elusive, it is hypothesized that the technique's kinetic energy triggers physical and/or chemical bonding, leading to coating formation. This program organized the events listed below to discuss how to establish the technology for indispensable metal deposition on CFRP, which holds potential for application in offshore wind power generation, urban air mobility, and hybrid metal-polymer materials.



Main Organizer  
Kazuhiro Ogawa (Tohoku University)



## Program Organizers

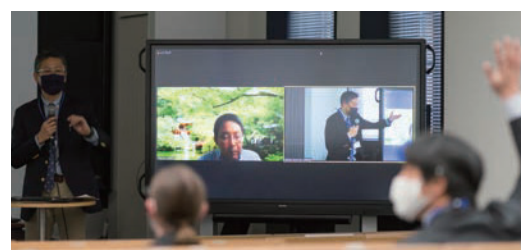
Kazuhiro Ogawa (Tohoku University)  
 Olivier Lame (INSA-Lyon)  
 Shinji Koyama (Gunma University)  
 Yoshihiro Naruse (Toray Industries, Inc.)  
 Stephen Yue (McGill University)  
 Yuji Ichikawa (Tohoku University)  
 Hiroki Saito (Tohoku University)

## Principal Invited Researchers

Tsuyoshi Saotome (Toray Composite Materials America, Inc.)  
 Yoshiyasu Hirano (JAXA)  
 Yoshihiro Mizutani (Tokyo Institute of Technology)

## Events

- Webinar : Metallization on Polymers by Cold Spray Technique (September 9, 2022)
- Public Lecture : Application of CFRP to Future Equipment and Structures, and Its Metallization Technique (December 19, 2022)
- Research Forum : Lightning Resistant Metal Coating Technology on CFRP Assisted by Kinetic, Physical and Chemical Energies (January 31, 2023)



# Contributions of XR Technology to Education and Society: The Metaverse and International Collaborative Creation

Extended Reality (XR) and Metaverse are expected to free our communication from the constraints of time and place. In education, they could provide space in which people from various countries can learn together. XR could also help promote industry-academia collaboration, which might bring fresh perspectives on social issues such as sustainability and aging society. This program aims to explore these potentials for XR and Metaverse to contribute to education and society in the future. In 2022, we held the following event.



## Events

- International Symposium 1 : The Metaverse and XR Technology – Educational Applications and International Collaboration  
(December 2, 2022 – December 3, 2022)

# Research DX Support Center

The utilization and integration of data in scientific research is becoming more and more significant. In recognition of this trend, TFC established the Research DX Support Center in November 2020 to promote digital transformation (DX) in scientific research. The center has since organized the “Research DX Strategy Seminar” and “Practical Data-Driven Science Online Seminar” to share information on future research DX. In 2022, the Research DX Strategy Seminar delivered informative lectures on the strategies to implement research DX on an institutional level, such as “Open Science Unfolded by Blockchain Technology.” The Practical Data-Driven Science Online Seminar dug into more practical methods of utilizing DX in research activities, such as “Quantum and Classical Computer Co-creation,” “Data Science from Materials Science Perspective,” and “Quantification and Qualification of Taste in Food and its Applications.”



## Events

- Fourth Seminar on Tohoku University Research DX Strategy  
(August 2, 2022)
- 14th Seminar : A Happy Future Society Realized by Solving Optimization Problems : The Co-creation of Quantum and Classical Computers  
(September 2, 2022)
- 15th Seminar : Gathering Data, Using Data – From the Field of Materials Science –  
(November 16, 2022)
- 16th Seminar : Data Conversion of Taste –Quantification and Qualitative Analysis of “Taste” of Food and Beverage and its Application–  
(January 16, 2023)



# TFC×TEL Collaboration Program: Designing a Digital and Sustainable Society

Since late 20th century, unstoppable economic and industrial globalization has continued to spark serious concerns over sustainability. While digital technologies might have accelerated this process and brought further challenges such as digital inequality and poverty, they also have the potential to mitigate environmental and societal impacts and contribute to the sustainable and resilient society. The pressing need is to explore how we can effectively design a future Digital and Sustainable Society to steer our course for the better. In this light, this program organized the events listed below to design a future sustainable society in collaboration with the Tohoku Forum for Creativity and Tokyo Electron Limited.

## Events

- Public Outreach Event : Citizens' Forum  
(June 4, 2022)
- Industry-Academia Collaboration, Seminar Series on the Management Practices of SDGs and Digital Transformation (DX) for Local Companies  
(June 22, 2022 – March 20, 2023)
- TEL & TFC Collaboration Workshop : Designing a Digital and Sustainable Society  
(September 27, 2022 – September 30, 2022)
- International Symposium on Design for the Sustainable Society via Digital Technology – Cooperated by Digital Transformation, Semiconductor, and Manufacturing –  
(February 2, 2023 – February 3, 2023)



# g-RIPS-Sendai 2022

The Research in Industrial Projects for Students (RIPS) program held at UCLA's Institute for Pure & Applied Mathematics expanded in 2018 to include the g-RIPS-Sendai program. This initiative was launched by Tohoku University's Advanced Institute for Materials Research in collaboration with IPAM, targeting graduate students in mathematical science and related fields. The program includes a cross-cultural collaboration between participants from the U.S. and Japan, who work on industrially-designed research projects. These projects, which provide intellectually stimulating challenges blending mathematical and computational work, hold significant interest for the industrial partners involved.



# TFC×AXA Collaboration Program on Social Innovations in Insurance in the Digital Society

Operated in collaboration with AXA, this program aims to identify the social issues to be solved by insurance and formulate the role of insurance in the future digital society. As part of this program, we organized the events shown below to provide opportunities for students, researchers, and industrial personnel to approach these social issues collaboratively. In addition, we delivered lectures to encourage students to improve their skills in data science and machine learning as well as their understanding of the social mechanisms of insurance.



## Events

- Lecture Course on Introduction to Life Insurance Business Management 2022 (April 14, 2022 – July 21, 2022)
- Intensive Course on Risk Data Science and Insurance 2022 (May 30, 2022 – June 2, 2022)
- Actuarial Mathematics Seminar 2022 (May 30, 2022 – October 6, 2022)
- Insurance Career Seminar 2022 (June 20, 2022 – November 7, 2022)
- Student Workshop on Applications of Big Data Analysis of the Cohort Biobank to Personal Healthcare (August 8, 2022 – August 9, 2022)
- Public Lecture on Applications of Big Data Analysis of the Cohort Biobank to Personal Healthcare (August 9, 2022)



## Sendai Round-table Talk “Japan’s Future Starts from Sendai: Creating a Business Model for the Town Planning by DX”



# Falling Walls Lab Sendai 2022

Since 2014, Tohoku University has hosted the Falling Walls Lab Sendai annually with the Falling Walls Foundation of Germany. The University has the honor of being Asia's pioneer venue for this esteemed competition for young researchers aged 18 and above. In 2021, the ninth competition was held in a hybrid format amidst the lingering effects of the pandemic. Out of 36 entries, 17 were selected for the presentation round. The passionate scholars responsible for the selected projects gave three-minute presentations on their research to break through global “walls.” The competition concluded with awards for the top three presenters. The first-prize went to Mohamed Atwa, a Ph.D. student from Okinawa Institute of Science and Technology, who was given the privilege of attending the Berlin finals.





## International Workshop “Exploring Quantum, Elements, and Life Interactions”



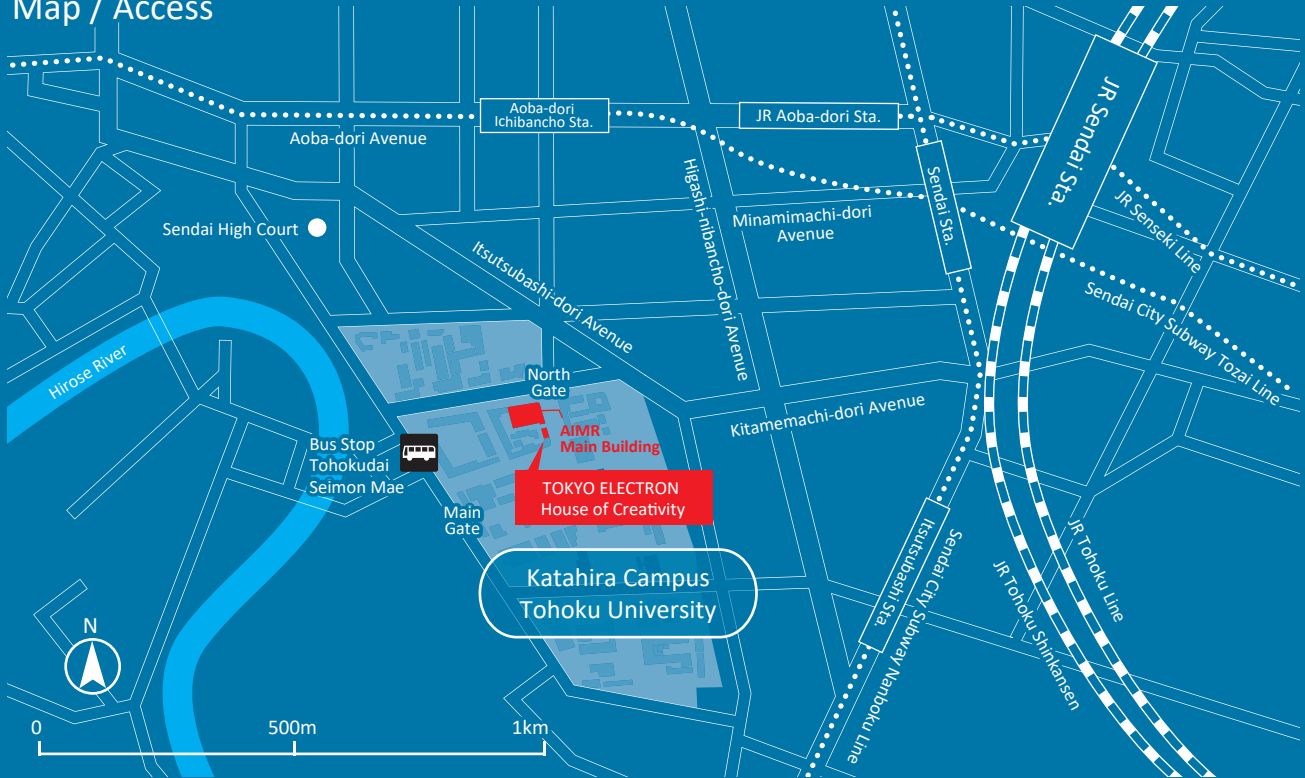
## 2022 Japan-Taiwan Advanced Quantum Technology Research and Development Workshop



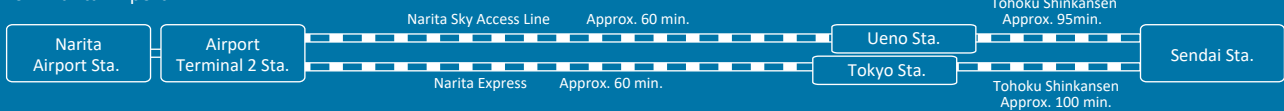
## Tohoku University – OIST Joint Workshop



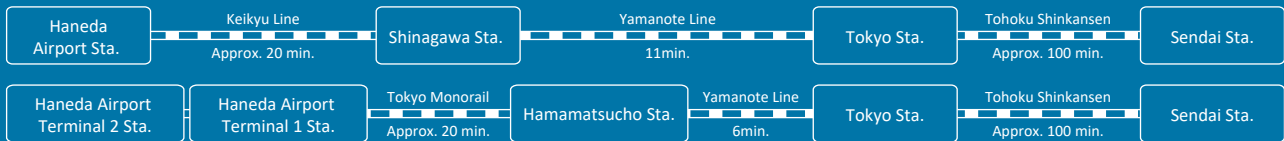
## Map / Access



### From Narita Airport



### From Haneda Airport



### From Sendai Airport



### From Sendai Sta.

By taxi : Approx. 10 min. by taxi from the West Exit on the first floor of Sendai Station  
By foot : Approx. 15 min. walk from the West Exit of Sendai Station

### From Aoba-dori Ichibancho Sta.

By foot : Approx. 10 min. walk from the South 1 Exit of Aoba-dori Ichibancho Station

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