



Researchers are now spreading their wings from  
Tohoku to the world.

# TI-FRIS

Tohoku Initiative for Fostering Global Researchers for Interdisciplinary Sciences



TI-FRIS





## Overview of the Initiative

The Ministry of Education, Culture, Sports, Science and Technology (MEXT)'s Strategic Professional Development Program for Young Researchers aims to enhance the research productivity of Japan. It supports universities and research institutions that promote the strategic development of excellent researchers. The project includes incorporating information about the best models in other countries into good examples of the development of researchers in Japan, creating programs for developing the world's top-class researchers, and establishing a coordinated system for researcher development (e.g., a system to publish papers in leading international journals, to obtain overseas research grants, etc.) rather than disparate schemes in each laboratory.

In 2020, the Tohoku Initiative for Fostering Global Researchers for Interdisciplinary Sciences (TI-FRIS) was incorporated into the MEXT Strategic Professional Development Program for Young Researchers. TI-FRIS, led by Tohoku University, formed a consortium with fellow universities of the Tohoku region Hirosaki University, Iwate University, Akita University, Yamagata University, Fukushima University and Miyagi University of Education as well as the Mitsubishi Research Institute. In partnership with cooperating research institutions and companies in Japan and worldwide, the initiative is building a new researcher development program covering the whole Tohoku region that will foster world-class researchers who are equipped with interdisciplinarity, internationality and are sociability.



### Interdisciplinarity

the ability to carry out interdisciplinary research with researchers in different fields



### Internationality

the ability to conduct research through friendly competition with researchers around the world



### Sociability

the ability to work with society to translate research outcomes into social applications

What is  
TI-FRIS?





## Message from the Program Manager

The Tohoku region of northern Japan is faced with numerous challenges from a declining birth rate to disaster recovery and the need to switch to green energy. These are issues that concern the future of humanity and are deeply connected to the SDGs, and they are shared globally. The seven national universities of the Tohoku region all have their strengths in terms of independent research related to these challenges. They have built strong foundations and boast good track records on education and research in all of these areas.

TI-FRIS aims to foster world-class researchers who will be essential to addressing those challenges. They must be equipped with interdisciplinarity (able to develop interdisciplinary research with researchers in different fields), internationality (to conduct research through friendly competition with researchers around the world) and sociability (to work with society to translate research outcomes into social applications).

TI-FRIS is led by Tohoku University, which has been working to foster research talent based on interdisciplinary research. A consortium was formed with fellow universities of the Tohoku region Hirosaki University, Iwate University, Akita University, Yamagata University, Fukushima University and Miyagi University of Education as well as the Mitsubishi Research Institute - all of which possess their own research strengths. This program seeks to harness those advantages and their own characteristic initiatives. In partnership with cooperating research institutions and companies in Japan and worldwide, TI-FRIS provides interdisciplinary researcher exchange, international collaborative research and socially implemented research programs, as well as a basic transferable skills training program. These programs will create a diverse, creative forum to flexibly serve and support the independent growth of researchers. Through these programs, our aim is to develop researchers to lead international collaborative research projects and projects to implement research findings in society.

### **Toshiyuki Hayase** Program Manager

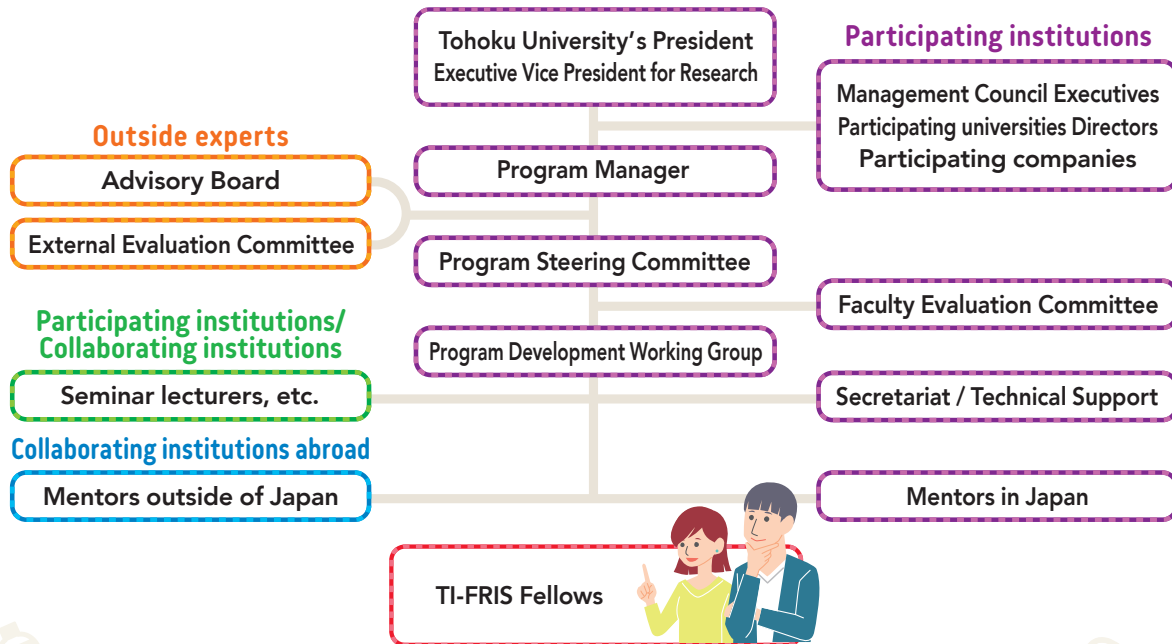
Director,  
Frontier Research Institute for Interdisciplinary Sciences  
Tohoku University





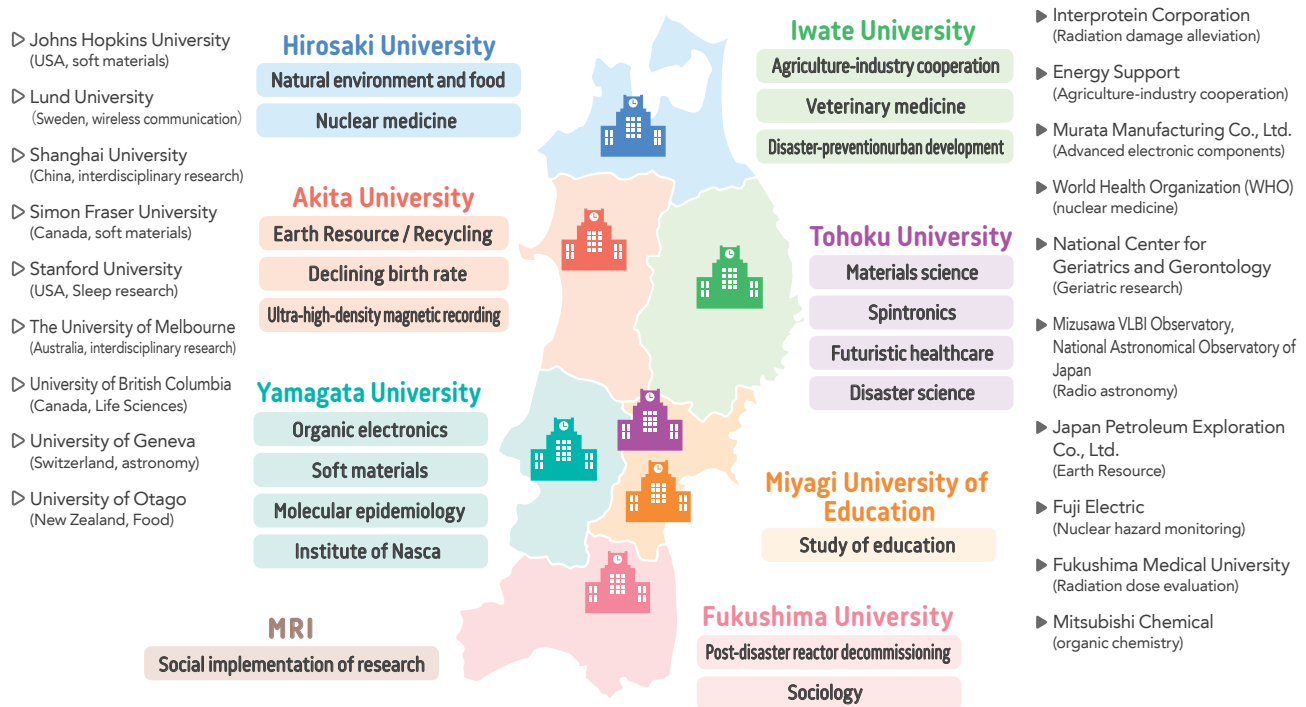
## Governance

The TI-FRIS Secretariat sits within the Frontier Research Institute for Interdisciplinary Sciences at Tohoku University, the lead institution. The Program Manager oversees the initiative overall, while the Program Steering Committee made up of members from each participating institution deliberates on important matters related to the initiative. The Advisory Board and External Evaluation Committee are made up of third-party experts. The Faculty Evaluation Committee selects and assesses program trainee candidates, while the Program Development Working Group is responsible for general implementation of the programs. Japanese and international mentors provide support to trainees. With its online researcher exchange and meeting system, TI-FRIS has established the conditions for both researcher exchanges and efficient working of the committees.





## Partnerships



Under TI-FRIS, a consortium has been formed with seven national universities of the Tohoku region with track records of partnership in all areas of education and research, as well as the Mitsubishi Research Institute, a multidisciplinary international thinktank. This researcher development program is being rolled out in partnership with research institutions and companies in Japan and worldwide, based on the building of a network that harnesses the strengths of each institution. This global network, anchored in the Tohoku region, will create a tremendously diverse and creative forum.



## Researcher Development Program

Five programs are being implemented under this initiative in order to foster field-leading world-class researchers who are equipped with the ability to develop interdisciplinary research with researchers in different fields (interdisciplinarity), the ability to conduct research through friendly competition with researchers around the world (internationality) and the ability to work with society to translate research outcomes into social applications (sociability). These are the International Collaborative Research Program, the Interdisciplinary Researcher Exchange Program, the Socially Implemented Research Program, the Transferable Skills Training Program and the Sharing Program.

Features

1



### Interdisciplinarity

#### Interdisciplinary Researcher Exchange Program

— 5 years —

Bringing together different specializations and institutions, research exchanges take interdisciplinary research to the next level through presentation and discussion of research findings. Builds ability to develop interdisciplinary research with researchers in different fields (interdisciplinarity).

Features

2



### Internationality

#### International Collaborative Research Program

— 5 years —

Program participants spend around one month every year at an overseas research institution, conducting ongoing international collaborative research with top-level foreign researchers. Builds ability to conduct research through friendly competition with researchers around the world (internationality).

Features

3



### Sociability

#### Socially Implemented Research Program

— 5 years —

Program participants undertake industry-academic joint research with participating companies and others, engaging in exchanges and supporting the application of research findings in society. Builds ability to work with society to translate research outcomes into social applications (sociability).

### Transferable Skills Training Program

— 5 years —

Featuring lectures from top researchers, academic impact lectures, social impact lectures, industry R&D and societal research implementation lectures and academic research lectures. Builds the essential skills for becoming a top-class global researcher. Note: Transferable skills are those skills that are applicable regardless of industry or work type, such as problem-solving, self-management and people skills.

### Sharing Program

In partnership with participating institutions, a research equipment sharing network is to be established providing the basic gear for research, in order to ensure that program participants are able to conduct research in an independent research environment. International symposia are also held for program participants to impart their findings, meet those from participating and partner institutions, and disseminate information about the program.



## TI-FRIS Fellow

TI-FRIS recruits TI-FRIS fellows from participating universities every year. The program takes up to five years, with a follow-up period of five further years. In the programs provided by TI-FRIS, they will engage in regular interdisciplinary researcher exchanges with different specializations and institutions, ongoing international collaborative research with overseas researchers, and application of research findings in society.



**Hirofumi Tazoe** Associate Professor  
Belongs/Hirosaki University ■  
Institute of Radiation Emergency Medicine

My study is method development of radionuclide in environmental and biological samples. In addition to solid phase extraction and mass-spectrometry, development of automated separation system is also investigated for establishment of international standard

**Keyword** 1. Radionuclide 2. Chemical separation 3. Automated system



**Katsuyuki Takahashi** Associate Professor  
Belongs/Iwate University ■  
Faculty of Science and Engineering, Systems Innovation Engineering

Applications utilizing high-density radicals produced in the plasma generated by the pulsed power technology for agriculture and food industries, such as an environmental management system for plant growth and keeping freshness of fruits and vegetables, are investigated.

**Keyword** 1. High voltage 2. Plasma 3. Collaboration of agriculture and engineering



**Kentaro Murata** Assistant Professor  
Belongs/Iwate University ■  
Faculty of Science and Engineering, Systems Innovation Engineering

Toward the practical application of microwave wireless power transfer technology, in addition to improving transfer efficiency, we aim to break multifaceted barriers, such as detecting the location of dead-battery devices and avoiding radio interference with human and existing wireless systems.

**Keyword** 1. Wireless power transfer 2. Wireless communication 3. Radar



**Naoya Onizawa** Associate Professor  
Belongs/Tohoku University ■  
Research Institute of Electrical Communication

The objective of this study is to establish invertible logic that can realize "bidirectional computing", where a current computing technology realizes only forward computing. In addition, the application using invertible logic is developed for artificial intelligence and various social issues.

**Keyword** 1. Computer science 2. Neural networks 3. Simulated annealing



**Yasunori Okamoto** Assistant Professor  
Belongs/Tohoku University ■  
Frontier Research Institute for Interdisciplinary Sciences

Artificial metalloenzymes (ArMs) are constructed by introduction of a synthetic catalyst into a protein scaffold. The current challenge is the concurrent use of ArMs with various catalysts, such as synthetic metal complexes and biocatalysts, leading to systems catalysis.

**Keyword** 1. Artificial metalloenzyme 2. Protein Engineering 3. Biofunctional Chemistry



**Yuanyuan Guo** Assistant Professor  
Belongs/Tohoku University ■  
Frontier Research Institute for Interdisciplinary Sciences

I am interested to bridge the gap between engineering and biology by developing multimodal fibers and biosensors to study complex biological systems, particularly the brain.

**Keyword** 1. Neurotechnology 2. Bioelectronics 3. Multifunctional fibers





**Joji Kusuyama** Assistant Professor  
Belongs/Tohoku University ■  
Frontier Research Institute for Interdisciplinary Sciences

My hypothesis is that the placenta is a transducer that conveys maternal information to their children. I try to utilize placental function for the prevention of lifestyle-related diseases and congenital diseases in the next generation.

**Keyword** 1. Endocrinological Metabology 2. Exercise Physiology 3. Epigenetics



**Yuta Nakayasu** Assistant Professor  
Belongs/Tohoku University ■  
Frontier Research Institute for Interdisciplinary Sciences

I use the green processes to convert the wood resources into various carbon materials and apply them to energy device materials that contribute to electricity storage and electricity creation. The goal is to incorporate these devices into our lives and create an eco-friendly lifestyle.

**Keyword** 1. Woody biomass 2. Green devices/Green processes 3. Eco-lifestyle creation



**Yuji Nashimoto** Assistant Professor  
Belongs/Tohoku University ■  
Frontier Research Institute for Interdisciplinary Sciences

My research interest is a development of a cell culture platform to engineer organ-mimic models. In TI-FRIS project, we develop electrochemical sensors and scanning probe microscopy for the new cell culture platform.

**Keyword** 1. Microphysiological system 2. Scanning probe microscopy 3. Microfluidic device



**Takuya Mabuchi** Assistant Professor  
Belongs/Tohoku University ■  
Frontier Research Institute for Interdisciplinary Sciences

The research involves theoretical and computer simulation studies of biomolecular and materials systems. Current research activities span both development of new computational methods and theoretical characterization of proton/hydroxide transport and protein/polymer phase behavior in biomolecular and polymer materials systems.

**Keyword** 1. Molecular simulations 2. Ion transport 3. Self-assembly of proteins/polymers



**Kazutoshi Haga** Associate Professor  
Belongs/Akita University ■  
Graduate School of International Resource Sciences

I am conducting research on the separation technology of valuable metals using mineral processing for unused resources. Combination of surface analysis and information technology with mineral processing technology is also investigating.

**Keyword** 1. Mineral processing 2. Extractive metallurgy 3. Surface analysis



**Takao Oto** Assistant Professor  
Belongs/ Yamagata University ■  
Graduate School of Science and Engineering

In this research, by deeply understanding optical characterizations for nanolasers fabricated by the introduction of semiconductor and/or metal nanostructures, we will develop nanolasers with low threshold power and multi-functionality and promote their new applications for various research fields.

**Keyword** 1. Nanolasers 2. Nanostructure physics 3. Semiconductor optical devices



**Hiroyuki Matsui** Associate Professor  
Belongs/ Yamagata University ■  
Graduate School of Organic Materials Science

We develop ultraflexible electronic devices using organic semiconductors and digital printing such as inkjet. Such devices can visualize the distribution of temperatures, pressures and electric fields on soft and curved surfaces.

**Keyword** 1. Organic transistors 2. Organic electronics 3. Applied physics



**Daitaro Ishikawa** Associate Professor  
Belongs/ Fukushima University ■  
Faculty of Food and Agricultural Sciences

The aim of this study is to develop the evaluation method of structural state of food/material polymers due to the effects of external perturbations in the processes using spectroscopic technology and complementarily X-ray analysis, thermal analysis and component analysis. The results of this study will lead to propose new spectroscopic technology and to develop new materials.

**Keyword** 1. Spectroscopy 2. Imaging 3. Structure-property relationship



**Shogo Nishiyama** Associate Professor  
Belongs/ Miyagi University of Education ■  
Faculty of Education

My primary research is in observational astronomy and astrophysics. By observing stars, star clusters and galaxies, I want to understand how they formed, how they evolved and what physical laws govern the formation and evolution of them.

**Keyword** 1. Infrared astronomy 2. Black hole 3. Stellar spectroscopy



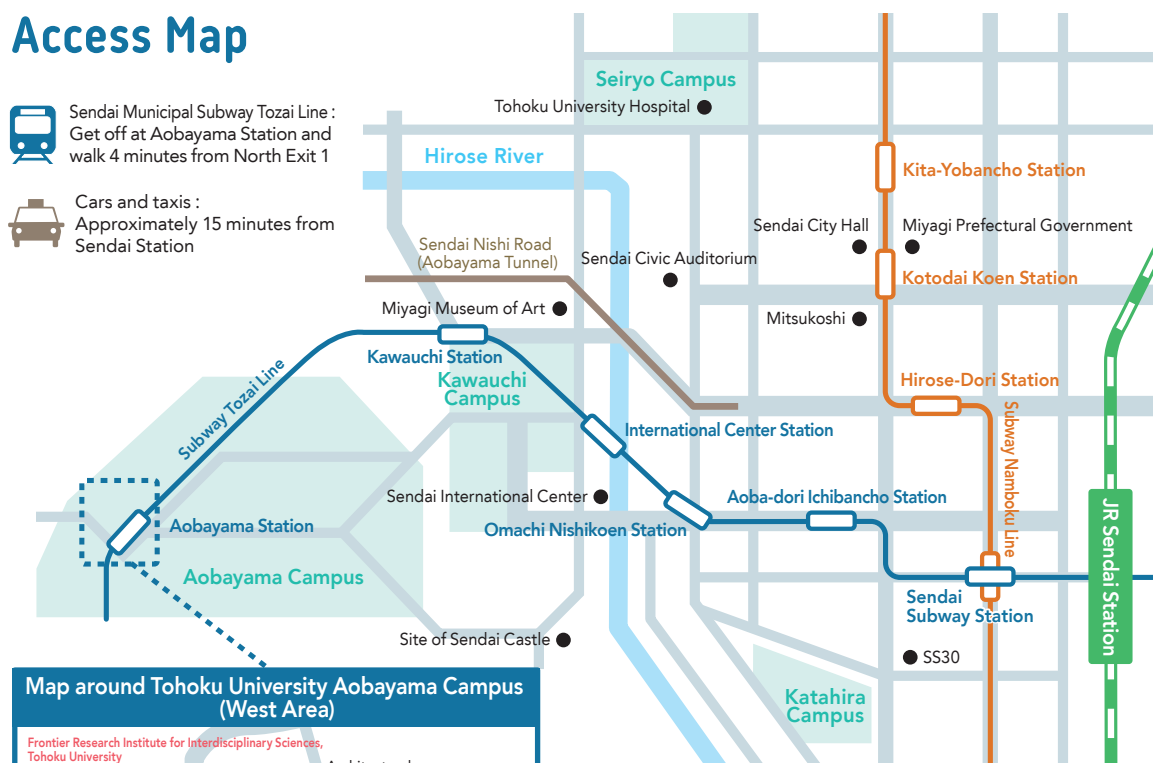
# Access Map



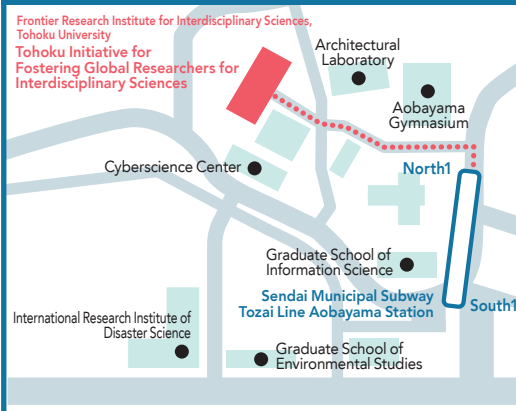
Sendai Municipal Subway Tozai Line:  
Get off at Aobayama Station and  
walk 4 minutes from North Exit 1



Cars and taxis:  
Approximately 15 minutes from  
Sendai Station



## Map around Tohoku University Aobayama Campus (West Area)



Tohoku University Frontier Research Institute for  
Interdisciplinary Sciences

**Tohoku Initiative for Fostering Global  
Researchers for Interdisciplinary Sciences**

6-3 Aramaki-aoba, Aoba, Sendai 980-8578, Japan

TEL: +81-22-795-5755 / E-mail: ti-fris@fris.tohoku.ac.jp



