



TOHOKU
UNIVERSITY



December 18, 2019

Interdisciplinary collaborations and young student programs based on mathematical sciences



Hiroshi Suito
Deputy Director, WPI-AIMR
Tohoku University

Mathematics - Materials Science Collaboration



Advanced Institute for Materials Research (WPI-AIMR)



non-equilibrium

Non-equilibrium Materials based on Mathematical Dynamical Systems

Analysis of atomic arrangement in amorphous materials by **persistent homology**. Importance of **geometrical binding variation** and **dynamics** was recognized.

topology

Topological Functional Materials

Identification of dependence on **local structure** in functional expression of **topological materials**.

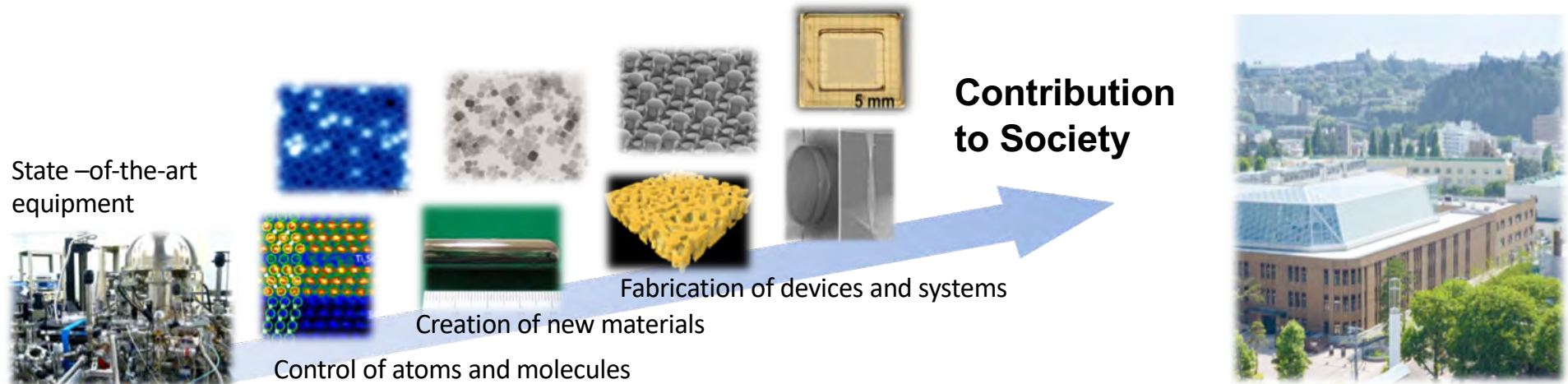
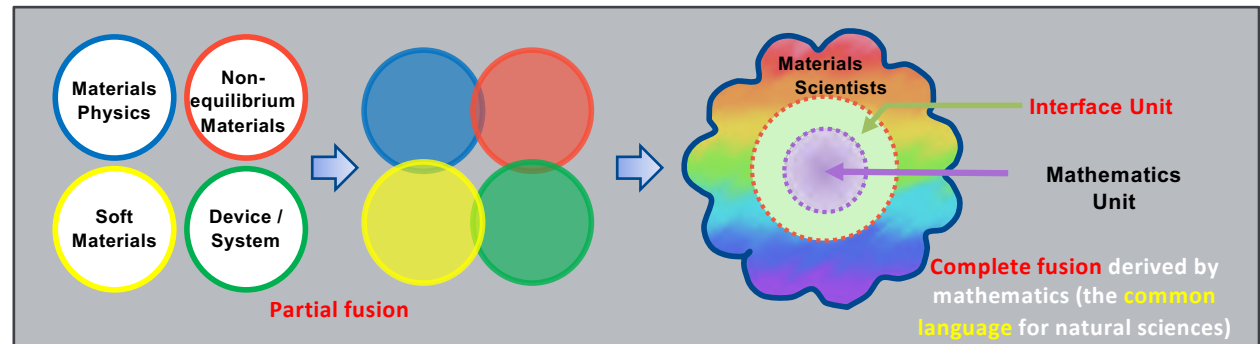
hierarchy

Multi-Scale Hierarchical Materials based on Discrete Geometric Analysis

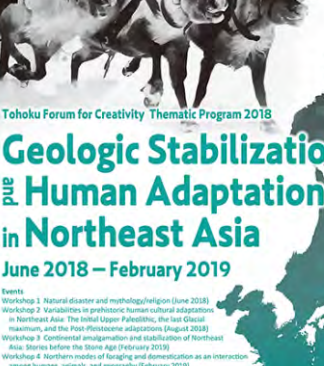
Creation of hierarchical materials (e.g., organic/inorganic hybrid materials, nanocrystal superlattices) by **self-assembly** and study of their structure-function relationships.


device systems
atoms molecules

Discrete Geometric Analysis
Non-equilibrium Dynamics
Persistent Homology
Graph Theory
Topology



A nighttime photograph of a large, multi-story brick building, likely a university or institutional structure. The building's windows are illuminated from within, casting a warm glow against the dark blue night sky. Several large, dark evergreen trees are positioned in front of the building, their silhouettes partially obscuring the facade. In the foreground, a paved walkway is lined with a series of small, cylindrical concrete bollards, each of which is illuminated from below, creating a rhythmic pattern of light and shadow. The overall atmosphere is quiet and scholarly.



 **TOHOKU UNIVERSITY**

Tohoku Forum for Creativity Thematic Program 2018

Geologic Stabilization and Human Adaptations in Northeast Asia

June 2018 — February 2019


Events

- Workshop 1: Natural disaster and mythology/religion (June 2018)
- Workshop 2: Variabilities in prehistoric human cultural adaptations in Northeast Asia: The Initial Upper Paleolithic, the Last Glacial maximum, and the Post-Pleistocene adaptations (August 2018)
- Workshop 3: Continental amalgamation and tectonization of Northeast Asia: Stories before the Silla Age (February 2019)
- Workshop 4: Northern routes of language and domestication as an interaction among humans, animals, and geography (February 2019)


Organizers: tsunetsuneyoshi@tohoku.ac.jp

Kazuo Tsukagawa	Tatsuki Tsujimoto	Kazuo Akasaka
Yoshitaka Kanomata	Hiroshi Yamada	Kinshi Oka
Satoshi Chiba		

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TOSHIBA



Brain Research Institute
Toshiba Corporation

Toshiba Forum for Creativity Thematic Program 2015

Frontiers of Brain Science

July 2015 – September 2015

International Symposia

Tools and Technologies

Development and Disease

Memory and Mind

(July 21 – 27, 2015)

(August 24 – 26, 2015)

(September 28 – 30, 2015)

Speakers include


<p>David Amaral University of California, San Diego</p> <p>Francis Guillemot University of California, San Diego</p> <p>Jeff Lichtman Harvard University</p> <p>Shinsuke Shimizu University of Tokyo</p>	<p>Howard Eichenbaum University of California, San Diego</p> <p>Wieland Hüttenlocher University of California, San Diego</p> <p>Gregor Knorr University of California, San Diego</p> <p>Susumu Tonegawa MIT</p>
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Organizers

<p>Naoki Iwasaki Toshiba Corporation</p> <p>Toshiko Kanda Toshiba Corporation</p> <p>Noriko Osumi Toshiba Corporation</p>	<p>Yoshio Kuroki Toshiba Corporation</p> <p>Kazuo Tanemoto Toshiba Corporation</p> <p>Ko Matsui Toshiba Corporation</p>
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Advisors

<p>Yutaka Imai Toshiba Corporation</p> <p>Yutaka Imai Toshiba Corporation</p> <p>Tamotsu Shimogori Toshiba Corporation</p>	<p>Shinji Kudo Toshiba Corporation</p> <p>Moeko Inokubo Toshiba Corporation</p> <p>Ken-ichi Takata Toshiba Corporation</p>
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 **Tohoku Forum for Creativity
Program 2014**

Recovery from the Great East Japan Earthquake and Tsunami

Future Strategies for Disaster Risk Reduction

July 2014 – March 2015

Events




- The Multi-Hazards Summer School (July 22-25, 2014)
- International Workshop on Implementation of Practical Disaster Risk Reduction
~ strengthening multi-stakeholder partnership ~ (November 7-10, 2014)
- International Conference on Future Strategies for Disaster Risk Reduction (March 10, 2015)

Speakers Include:

- J. Bonde, University of California, Davis
- R. Byles, Further Education Learning and the Assistant Secretary General, A. Gordon, Harvard University
- P. Keenan, University of Central Lancashire
- P. Steinbock, University College London

Organizers

- Franchise Program, IRIDeS, Tohoku University
- Kazuo Owa, IRIDeS, Tohoku University
- Takako Imai, IRIDeS, Tohoku University



Tahoku Forum for Creativity
Thematic Program 2017

New Horizons in Food Science via Agricultural Immunology

July - September, 2017

EVENTS

- International symposia and youth programs
- Stage 1: Frontiers in agricultural immunology (July 21-24, 2017)
- Stage 2: Food safety and functional evaluation (August 7-10, 2017)
- Stage 3: Social implementation of new food technology (September 29-30, 2017)

ORGANIZERS Tohoku University
Hiroshi Asa Masaki Toyoshima Haruki Kitahara Tomonori Nochi Shoichiro Kurata

PROGRAM SPONSORS

Support Fund of Agricultural Research, Tohoku University
 Hiroshi Asa Masaki Toyoshima Haruki Kitahara Tomonori Nochi Shoichiro Kurata
 2017 Grants-in-Aid for Scientific Research (S) 15H05001, 15H05002, 15H05003, 15H05004, 15H05005, 15H05006, 15H05007, 15H05008, 15H05009, 15H05010, 15H05011, 15H05012, 15H05013, 15H05014, 15H05015, 15H05016, 15H05017, 15H05018, 15H05019, 15H05020, 15H05021, 15H05022, 15H05023, 15H05024, 15H05025, 15H05026, 15H05027, 15H05028, 15H05029, 15H05030, 15H05031, 15H05032, 15H05033, 15H05034, 15H05035, 15H05036, 15H05037, 15H05038, 15H05039, 15H05040, 15H05041, 15H05042, 15H05043, 15H05044, 15H05045, 15H05046, 15H05047, 15H05048, 15H05049, 15H05050, 15H05051, 15H05052, 15H05053, 15H05054, 15H05055, 15H05056, 15H05057, 15H05058, 15H05059, 15H05060, 15H05061, 15H05062, 15H05063, 15H05064, 15H05065, 15H05066, 15H05067, 15H05068, 15H05069, 15H05070, 15H05071, 15H05072, 15H05073, 15H05074, 15H05075, 15H05076, 15H05077, 15H05078, 15H05079, 15H05080, 15H05081, 15H05082, 15H05083, 15H05084, 15H05085, 15H05086, 15H05087, 15H05088, 15H05089, 15H05090, 15H05091, 15H05092, 15H05093, 15H05094, 15H05095, 15H05096, 15H05097, 15H05098, 15H05099, 15H05100, 15H05101, 15H05102, 15H05103, 15H05104, 15H05105, 15H05106, 15H05107, 15H05108, 15H05109, 15H05110, 15H05111, 15H05112, 15H05113, 15H05114, 15H05115, 15H05116, 15H05117, 15H05118, 15H05119, 15H05120, 15H05121, 15H05122, 15H05123, 15H05124, 15H05125, 15H05126, 15H05127, 15H05128, 15H05129, 15H05130, 15H05131, 15H05132, 15H05133, 15H05134, 15H05135, 15H05136, 15H05137, 15H05138, 15H05139, 15H05140, 15H05141, 15H05142, 15H05143, 15H05144, 15H05145, 15H05146, 15H05147, 15H05148, 15H05149, 15H05150, 15H05151, 15H05152, 15H05153, 15H05154, 15H05155, 15H05156, 15H05157, 15H05158, 15H05159, 15H05160, 15H05161, 15H05162, 15H05163, 15H05164, 15H05165, 15H05166, 15H05167, 15H05168, 15H05169, 15H05170, 15H05171, 15H05172, 15H05173, 15H05174, 15H05175, 15H05176, 15H05177, 15H05178, 15H05179, 15H05180, 15H05181, 15H05182, 15H05183, 15H05184, 15H05185, 15H05186, 15H05187, 15H05188, 15H05189, 15H05190, 15H05191, 15H05192, 15H05193, 15H05194, 15H05195, 15H05196, 15H05197, 15H05198, 15H05199, 15H05200, 15H05201, 15H05202, 15H05203, 15H05204, 15H05205, 15H05206, 15H05207, 15H05208, 15H05209, 15H05210, 15H05211, 15H05212, 15H05213, 15H05214, 15H05215, 15H05216, 15H05217, 15H05218, 15H05219, 15H05220, 15H05221, 15H05222, 15H05223, 15H05224, 15H05225, 15H05226, 15H05227, 15H05228, 15H05229, 15H05230, 15H05231, 15H05232, 15H05233, 15H05234, 15H05235, 15H05236, 15H05237, 15H05238, 15H05239, 15H05240, 15H05241, 15H05242, 15H05243, 15H05244, 15H05245, 15H05246, 15H05247, 15H05248, 15H05249, 15H05250, 15H05251, 15H05252, 15H05253, 15H05254, 15H05255, 15H05256, 15H05257, 15H05258, 15H05259, 15H05260, 15H05261, 15H05262, 15H05263, 15H05264, 15H05265, 15H05266, 15H05267, 15H05268, 15H05269, 15H05270, 15H05271, 15H05272, 15H05273, 15H05274, 15H05275, 15H05276, 15H05277, 15H05278, 15H05279, 15H05280, 15H05281, 15H05282, 15H05283, 15H05284, 15H05285, 15H05286, 15H05287, 15H05288, 15H05289, 15H05290, 15H05291, 15H05292, 15H05293, 15H05294, 15H05295, 15H05296, 15H05297, 15H05298, 15H05299, 15H05300, 15H05301, 15H05302, 15H05303, 15H05304, 15H05305, 15H05306, 15H05307, 15H05308, 15H05309, 15H05310, 15H05311, 15H05312, 15H05313, 15H05314, 15H05315, 15H05316, 15H05317, 15H05318, 15H05319, 15H05320, 15H05321, 15H05322, 15H05323, 15H05324, 15H05325, 15H05326, 15H05327, 15H05328, 15H05329, 15H05330, 15H05331, 15H05332, 15H05333, 15H05334, 15H05335, 15H05336, 15H05337, 15H05338, 15H05339, 15H05340, 15H05341, 15H05342, 15H05343, 15H05344, 15H05345, 15H05346, 15H05347, 15H05348, 15H05349, 15H05350, 15H05351, 15H05352, 15H05353, 15H05354, 15H05355, 15H05356, 15H05357, 15H05358, 15H05359, 15H05360, 15H05361, 15H05362, 15H05363, 15H05364, 15H05365, 15H05366, 15H05367, 15H05368, 15H05369, 15H05370, 15H05371, 15H05372, 15H05373, 15H05374, 15H05375, 1

 Tohoku University

Tohoku Forum for Creativity Thematic Program 2017

Aging Science

from Molecules to Society

April - June, 2017

International Symposia

Aging Biology (May 10-12, 2017)

Bioinformatics and Preventive Medicine (May 18-19, 2017)

Smart Aging (May 24-26, 2017)

Outreach for the Public (May 27, 2017)

Venue (International Symposia)

International Conference Room,
Smarter Aging International Research Center,
IDAC, Tohoku University

Organizers IDAC, Tohoku University



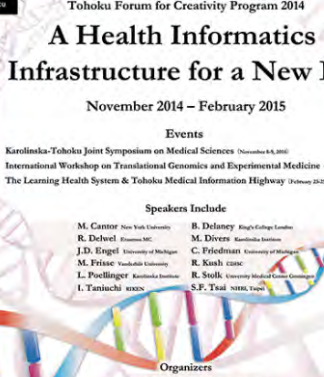
Main Organizer: Ryuta Kawashima


Organizers: Kozo Tanaka, Koetsu Ogasawara, Yasuyuki Taki,
Motoaki Sugiera, and Hozumi Motohashi



Program Sponsors

 Cures  JINS  KUMON  Hirotsugu  東北大学



 **Tohoku**

Tohoku Forum for Creativity Program 2014

A Health Informatics Infrastructure for a New Era

November 2014 – February 2015

Events


Karolinska-Tohoku Joint Symposium on Medical Sciences (November 6-8, 2014)
International Workshop on Translational Genomics and Experimental Medicine (February 5, 2015)
The Learning Health System & Tohoku Medical Information Highway (February 22-23, 2015)

Speakers Include

M. CARROF New York University	B. Delaney King's College London
R. Delwel Erasmus MC	M. Divren Karolinska Institute
J.D. Engel University of Michigan	C. Pflümler University of Heidelberg
M. Frisze Yonsei University	R. Koshizuka
L. Poellinger Karolinska Institute	R. Stolk University Medical Center Groningen
I. Taniuchi SIKEN	S.F. Tsai NHIH, Taipei

Organizers

Masayuki Yamamoto Tohoku University
Lorenz Poellinger Karolinska Institute
James Douglas Engel University of Michigan
Charles P. Friedman University of Wisconsin

 **RELAY FOR LIFE**
TOHOKU UNIVERSITY

Tohoku Forum for Creativity
Thematic Program 2016

The 21st Century Hasekura Project:
Japanese Studies as
the Interface of a New Knowledge

May 2016 – February 2017

EVENTS

Seminar Series: Philosophy/Art and Science around 1800
(May 2016)


Workshop on the Encounter between Japan and the Netherlands
(July 2016)

Workshop on the Effect of the Meiji Generation on Japanese Culture
(September 2016)

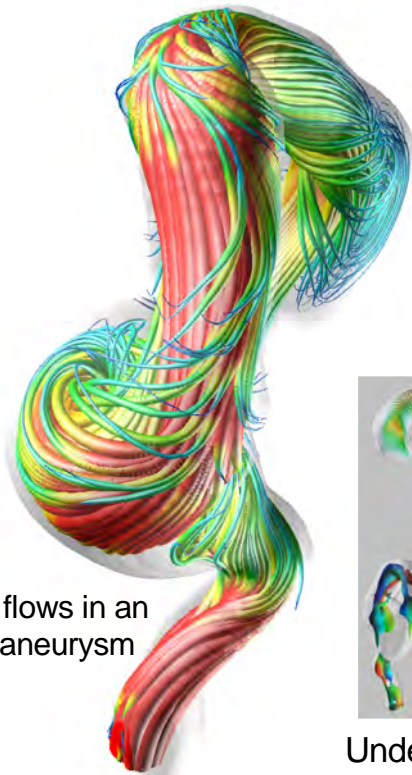
Symposium entitled "Knowledge and Art in the Meiji-Transformation and
Innovation of Knowledge through the Encounters of East and West"
(February 13-17, February 16, 2017)

Seminars on Japanese Studies at an Interdisciplinary Meeting Point
This seminar will be held once a month at Tohoku University during term hours.

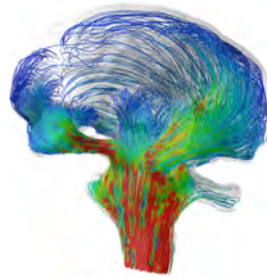
ORGANIZERS Tohoku University
Akihiro Otsuki Hiroo Kato Akimori Takahashi Ennosuke Fuchino



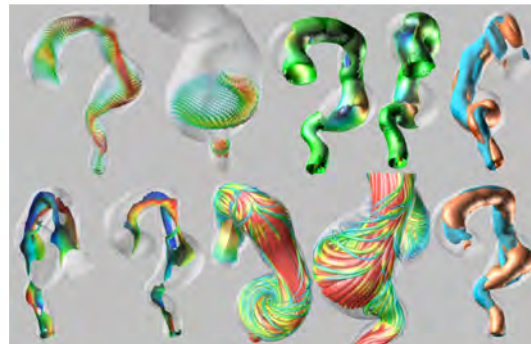
Collaboration with Clinical Medicine



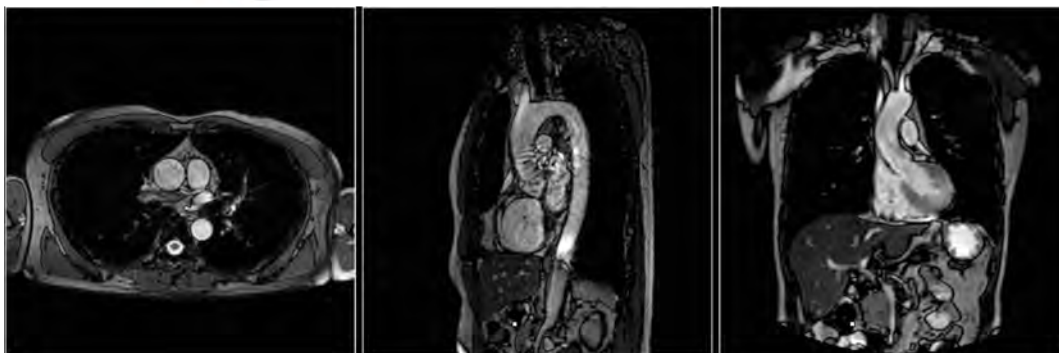
Blood flows in an aortic aneurysm



Cerebrospinal fluid flow



Understanding blood flow structures



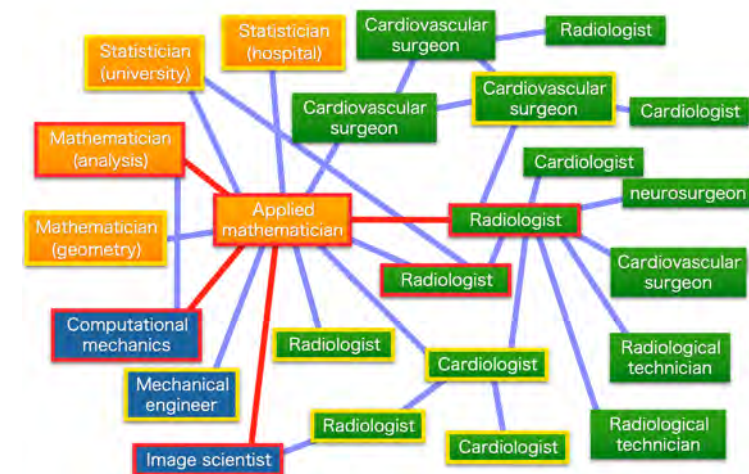
Medical imaging technologies

Proper setting for clinical questions

Appropriate setting for mathematical modeling

Goals

- Understanding disease mechanisms
- Provide new view points and algorithms
- Medical image diagnosis/detection
- Statistical analysis for EBM

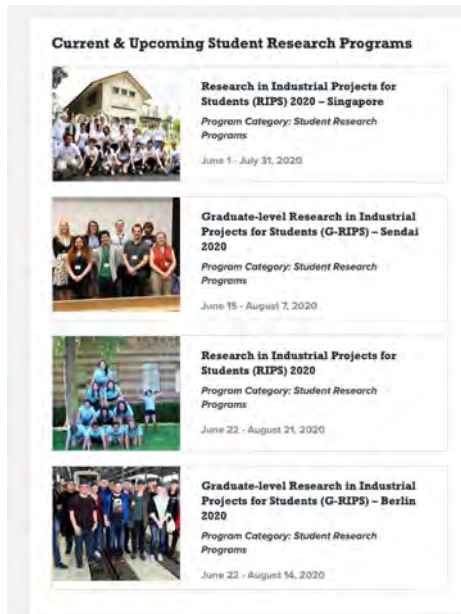


Researchers network including from pure mathematicians to clinicians

Incorporating young students to mathematics-based industrial problems

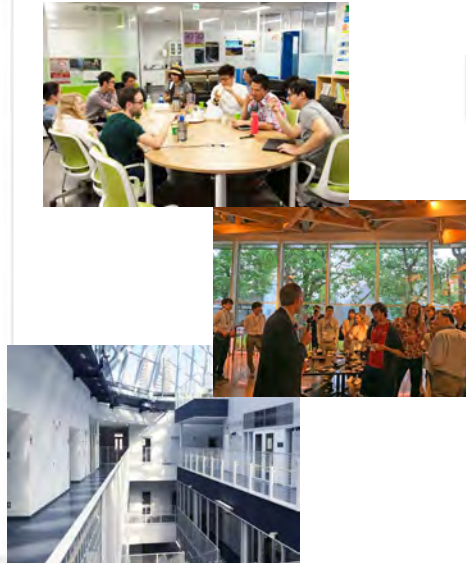


g-RIPS-Sendai program (since 2018)



Projects in g-RIPS Sendai 2018

- **TOYOTA:** Design for the next generation energy and mobility platform
US : UC San Diego, Renselaer Polytechnic Institute
Japan : Tohoku U.*2, Okayama U.
- **NEC:** Reliable wireless networking systems for industrial Internet-of-Things
US : Cornell U., California State Polytechnic U.
Japan : Tohoku U., Tsukuba U., Soka U.



- US and Japanese students spend 8 weeks in summer to tackle future-oriented industrial problems provided by companies.
- One team consists of 2 US and 2 Japanese students.
- Special thanks to IPAM, UCLA.

Projects in g-RIPS Sendai 2019

- **TOYOTA-1:** Design for the next generation mobility service in suburban areas - Mobility service for university campus
US : U. Tennessee, California State Polytechnic U.
Japan : Tsukuba U.*2
- **TOYOTA-2:** Design for the next generation mobility service in suburban areas - Mobility service for hospital guests
US : Stony Brook U., California State U.
Japan : Keio U.
- **FUJITSU:** Resolving real-world issues by "Digital Annealer"
US : U. Colorado Boulder, UC Merced
Japan : Ibaraki U.
- **NEC:** Combinatorial optimization using quantum annealing
US : U. Waterloo, Iowa State U.
Japan : Okayama U.