Inter-University Research
Institute Corporation

Research Organization of Information and Systems

2017 / 2018

National Institute of Polar Research

National Institute of Informatics

The Institute of Statistical Mathematics

National Institute of Genetics

Joint Support-Center for Data Science Research

Pioneering Research Frontiers in the Data Age to Solve Modern Society Problems

President's Message

Today, big data and creative use of it hold the key to innovations as it provides new lenses through which to look at our society. The ROIS has worked to build a strong foundation for data and analytics by promoting collaborations among Japanese universities. As an organization that has been on the forefront of "data science" from day one, I believe the Research Organization of Information and Systems (ROIS) will play an increasingly important role within the research community in solving the world's problems.

We intend to become a main resource for data science for universities through our efforts in the following areas:
- Consolidating and sorting data that are useful to society as well as research universities
- Revolutionizing methodologies for gleaning meaningful knowledge from big data
- Developing real-time technologies for aggregating and processing a large volume of scattered data
- Developing visualization technologies to help people grasp astronomical amount of high-dimensional data

The ROIS opened in 2004 as an inter-university research institute, which is a system unique to Japan. Serving as the umbrella institution for four other inter-university organizations that came together to form the ROIS, we are well-positioned to leverage the expansive network of expertise to promote open science and exploration of new research areas among all national and private universities in Japan.

In 2016, the ROIS created the Office of Strategic Planning to strengthen alliances between the ROIS and the research institutes that it oversees. The ROIS has also founded the Joint Support-Center for Data Science Research to boost partnerships among academic and other types of organizations. The Center works to promote the use and analysis of data in all fields and provides fellowship opportunities for all those interested in joint research projects.

In these productive research environments, the ROIS and the four research institutes strive to foster the next generations of data scientists at Sokendai, for which they serve as some of the core operating organizations.

At the ROIS, we are determined to do our best to advance data science that can be applied to tackle issues facing modern society. As we take on the 21st Century challenge, it is critical for us to ensure a free flow of ideas and knowledge. For this reason, we intend to encourage Japanese universities and research institutions to pursue collaborative relationships with their counterparts from around the world, as well.

At the ROIS, we are committed to serving as the hub of research related to information and systems in Japan. We hope you will join us in our effort to advance data science through the power of academic partnership.
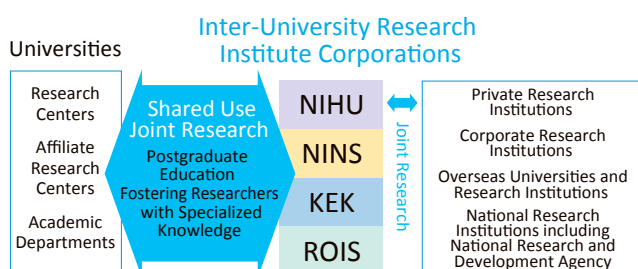
Sincerely,

Ryoichi Fujii

President of Research Organization of Information and Systems

About Inter-University Research Institute

An inter-university research institute helps promote research collaborations and resource sharing among universities across Japan. It provides universities with access to cutting-edge equipment, voluminous academic data and hard-to-find research materials that would be difficult for them to obtain and maintain individually. It also offers them support for analysis of such data.

Universities
- Research Centers
- Affiliate Research Centers
- Academic Departments

Shared Use Joint Research — Postgraduate Education Fostering Researchers with Specialized Knowledge

Inter-University Research Institute Corporations
- NIHU
- NINS
- KEK
- ROIS

Joint Research
- Private Research Institutions
- Corporate Research Institutions
- Overseas Universities and Research Institutions
- National Research Institutions including National Research and Development Agency

Research Hub for Academic Institutions

The four research institutes that comprise the Research Organization of Information and Systems have researchers- in-residence from respective fields from various national and private universities in Japan. A total of 2,951 researchers from 764 institutions participated in the residency programs during 2016.

Number of Institutions and Joint Researchers Enrolled in Inter-University Joint Research Projects, FY2016

	Number of Institutions	Total	Breakdown of organizations to which joint researchers belong							
			National Universities	Inter-University Research Institutes	Public Universities	Private Universities	Public Institutions	Private Institutions	Foreign Organizations	Others
NIPR	190	1,122	442	3	88	79	251	203	22	34
NII	139	418	240	15	19	83	10	31	18	2
ISM	327	1,003	433	20	59	303	134	34	15	5
NIG	97	395	217	6	31	79	25	6	29	2
DS	11	13	6	4	0	0	1	0	2	0
Total	764	2,951	1,338	48	197	544	421	274	86	43

Joint Support-Center for Data Science Research (DS)
― Better Future through Academic Partnerships and Collaborations ―

The Joint Support-Center for Data Science Research opened in April 2016 to further the ROIS's effort in promoting interdisciplinary research and aggregating and processing a large volume of data for advanced analysis.

Our ROIS-DS is to support a variety of researchers in conducting projects on the subjects of data-driven and data-oriented sciences (collectively called here as data science) using technologies for big-data analysis through collaborations with the members of our Centers.

DS Centers and Project

Data Sharing Support Groups

- Database Center for Life Science: Promoting developments of open science and database integrations in life science fields.
- Polar Environment Data Science Center: Promoting various research collaboration with a synthetic database and analysis-support-tools for long-term variation of polar environment in global earth system.
- Center for Social Data Structuring: Building a platform for managing social data, including social survey data, public opinion data, official micro data and social big data, for providing empirical data that solve various social issues.
- Center for Open Data in the Humanities: Sharing data for and from humanities to develop novel approaches for data science-driven humanities, or digital humanities, on an integrated platform that goes beyond organizational and disciplinary barriers.
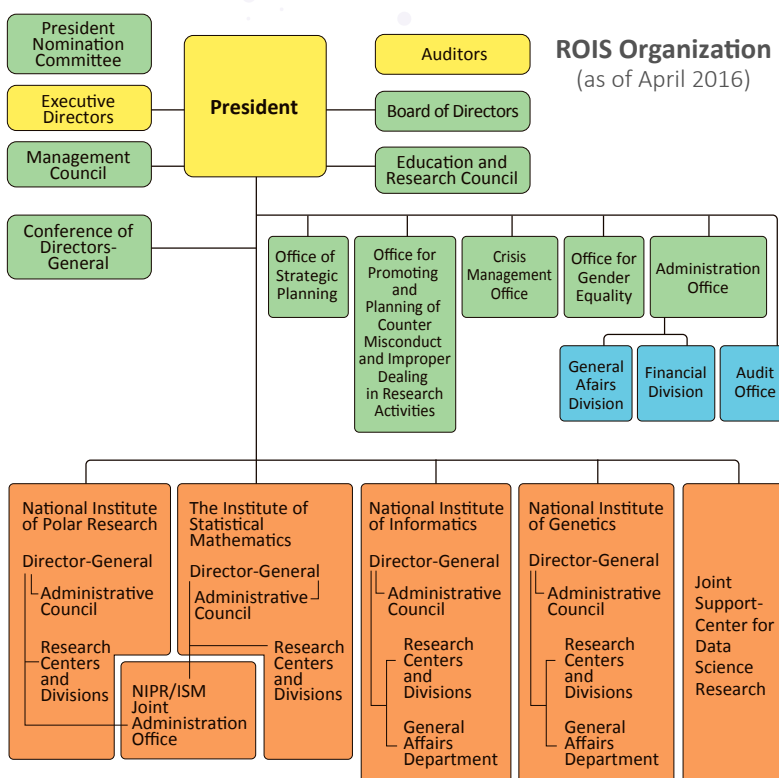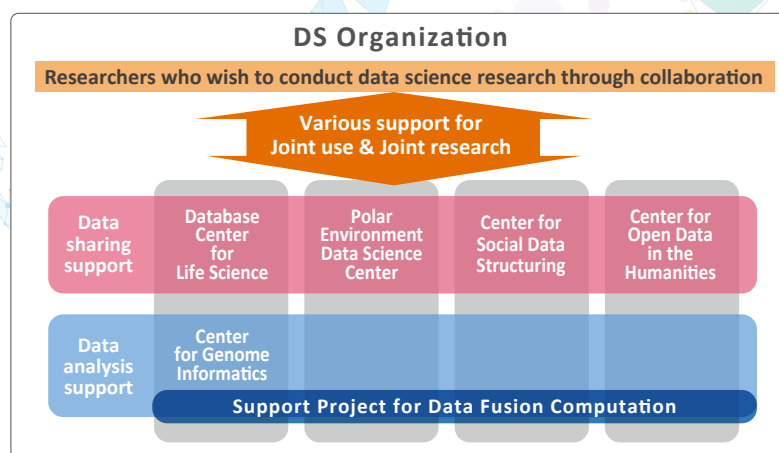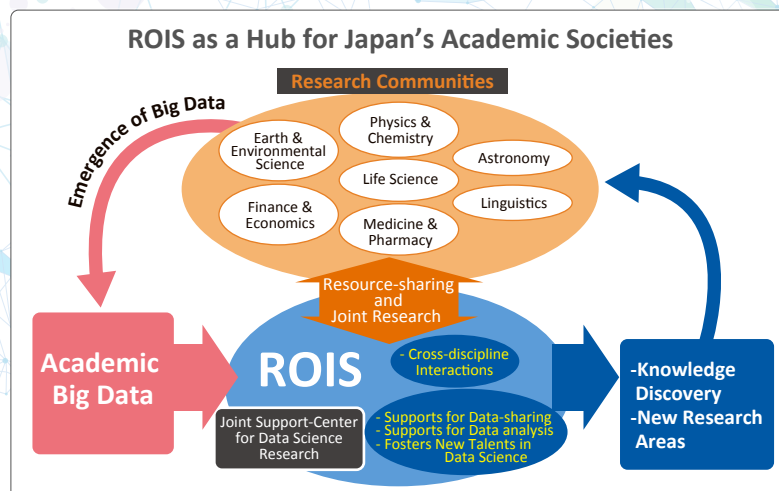
Data Analysis Support Groups

- Center for Genome Informatics: Supporting computational analysis of genomic/proteomic data (e.g. next-generation sequencing data) based on the state-of-the-art bioinformatics artifices.
- Support Project for Data Fusion Computation: Supporting simulation and modeling studies based on statistical methodologies such as data assimilation and statistical emulation, aiming at solving practical problems in science and industry.

⬡ Postgraduate Education

The research institutes provide critical support for The Graduate University for Advanced Studies (SOKENDAI) by bringing together cutting-edge research and education to foster the next generations of skilled workers.

Students in SOKENDAI, The Graduate University for Advanced Studies (as of May 2016)

Schools	Departments	Parent institutes	Total	Number of Foreigner
School of Multidisciplinary Sciences	Polar Science	NIPR	20	0
	Informatics	NII	82	52
	Statistical Sciene	ISM	26	2
School of Life Sciences	Genetics	NIG	37	11
		Total	165	65

ROIS as a Hub for Japan's Academic Societies

DS Organization

ROIS Organization (as of April 2016)

NiPR National Institute of Polar Research

The Antarctic and the Arctic each encompass an area with a unique natural system. The NIPR promotes joint projects aiming to advance comprehensive, cutting-edge earth system science that connects all relevant sciences, including earth science, environmental science, solar-terrestrial science, earth and planetary sciences. The Institute supports such projects by offering analysis and modeling of data and samples from field monitoring activities that it conducts. The NIPR, which has observing stations in the Antarctic and the Arctic, is also the chief operating organization for the Arctic Challenge for Sustainability Project.

- We identified the "Prolonged Aurora" phenomena[1] from 800 years ago through the NIRP's analysis of classical statistics. The research involved carbon isotope measurement and the examination of '*Meigetsuki*' and 'Soushi,' Japanese and Chinese historical written materials respectively, which led to our discovery of the emergent pattern of serial giant magnetic storms.
- We elucidated the climate instability over the past 720,000 years[2]. This is the culmination of the analysis of data from the Deep Ice Coring Project at our Antarctica Dome Fuji Station and climate simulations.
- We launched the '*Polar Data Journal*,' becoming Japan's first academic institution to publish a data journal.
- The CO_2 concentration in the atmosphere exceeds[3] 400 ppm[4] at the Showa Station.
- The Antarctic sea ice area shrunk to the smallest size on record[5].

*1: Joint research with the National Institute of Japanese Literature, Kyoto University and others.
*2: Joint research with 31 institutions and 64 researchers, including Tokyo University and the Japan Agency for Marine-Earth Science and Technology.
*3: Joint research with Tohoku University.
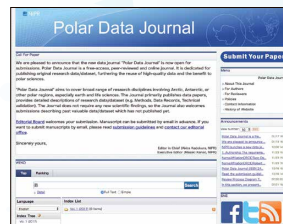*4: 1ppm equals to 0.0001%
*5: Based on monitoring data from "Shizuku" the water cycle change monitoring satellite that belongs to the Japan Aerospace Exploration Agency.
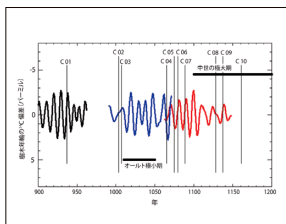
Changes in solar activity that are reconstructed from tree rings
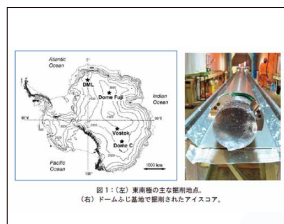
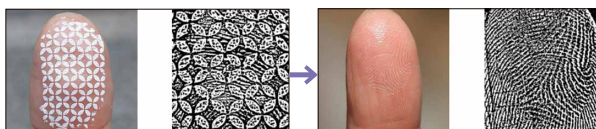Important ice-coring sites in the eastern Antarctic and an ice core taken at the Dome Fuji Station

Polar Data Journal Website (http://pdr.repo.nii.ac.jp/)

A member of the 57th Antarctic Observation Wintering Party measuring CO_2 concentration levels inside the observation building at the Showa Station
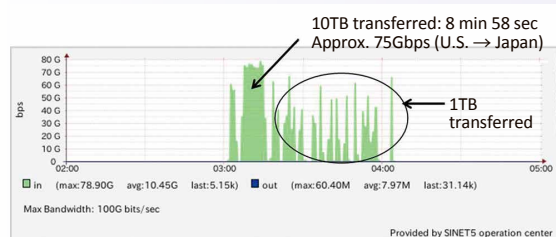
NII National Institute of Informatics

NII promotes research in all areas of informatics – from theoretical computer science to such cutting-edge topics as artificial intelligence, big data, IoT (Internet of Things) and cybersecurity – to build the way for "future value creation" in this new study field as Japan's only academic informatics research center. In addition to building and operating academic information infrastructures and networks, such as SINET5, NII offers academic content and services to maximize the flow of information. NII aslo focuses on collaboration with universities, research institutions and corporations both inside Japan and overseas.

- Unveiling of biometricJammer at CeBIT 2017:A method for preventing photographic capture of fingerprint information that neither inhibits fingerprint sensor authentication nor causes any visual discomfort, which is the first in the world to bedeveloped.
- Development of speaker adaptation technology for statistical parametric speech synthesis:Our technology allows automatic synthesis of natural speech from a few minutes of voice data, and it has been used to assist people with voice impairment.
- Successful long-distance data transfer at the world record speed:We achieved the server-to-server transfer speed of 150Gbps, the highest speed ever recorded, in our joint experiment with the NICT (National Institute of Information and Communications Technology) for Japan-U.S. data transfer.
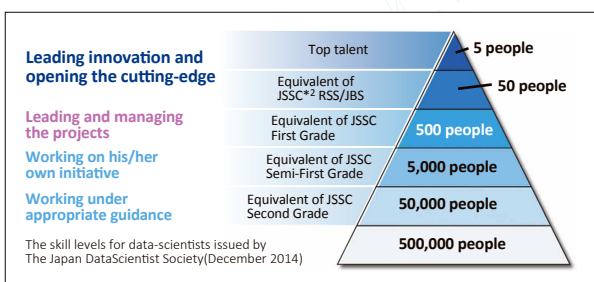

The new and improved technique uses a fingerprint pattern that resembles an actual one (right) in place of the geometric pattern used in the conventional technique (left). (The right photo shows image thresholding of fingerprints for feature point extraction. The fingerprints are unrecognizable in both photos.)

10TB transferred: 8 min 58 sec
Approx. 75Gbps (U.S. → Japan)
1TB transferred
Max Bandwidth: 100G bits/sec
Provided by SINET5 operation center

Experiment result (Bandwidth usage, Observation Point 4-SINET5: Tokyo-Los Angeles) Source: SINET5 NOC

Overviews of the four institutes that are on the cutting-edge of polar science, informatics, statistical mathematics and genetics with some highlights of their recent research work

The Institute of Statistical Mathematics

Statistical mathematics refers to a science aimed at extracting meaningful information from statistics in order to gain and develop knowledge that is useful for decision-making. As Japan's only research institute focused on statistical mathematics, the ISM conducts both basic and cutting-edge research and works to accelerate solutions to academic, societal and industrial problems through an undertaking known as NOE (Network Of Excellence) and by training new generation of data analytics talents. The NOE is a program that promotes collaborations among the academic world, the industry and the public-at-large in an organized manner.

- Development of New Talents in Data Science: We invite data-scientists to work with us on various cutting-edge projects according to their skill sets and abilities.
- Extraction of Supernova from Massive Astronomical Data: We successfully identified about 100 supernova after collecting massive observation data with the use of the Subaru Telescope and performing super-high speed analysis by taking advantage of machine learning. [1]
- Establishment of Akaike Memorial Lecture Award: Co-established by the ISM and the Japan Statistical Society to advance research and develop young researchers in the field, the award is presented to individuals who like Dr. Akaike, stood out as being ahead of their time, exercising an international influence over a wide range of fields in the statistical sciences and applied fields. We held the memorial lecture by the first awardee, Prof. C.F. Jeff Wu of Georgia Institute of Technology.

[1]: JST-CREST "Statistical Computational Cosmology with Big Astronomical Imaging Data"

Leading innovation and opening the cutting-edge
- Top talent — 5 people
- Equivalent of JSSC[2] RSS/JBS — 50 people

Leading and managing the projects
- Equivalent of JSSC First Grade — 500 people

Working on his/her own initiative
- Equivalent of JSSC Semi-First Grade — 5,000 people

Working under appropriate guidance
- Equivalent of JSSC Second Grade — 50,000 people
- 500,000 people

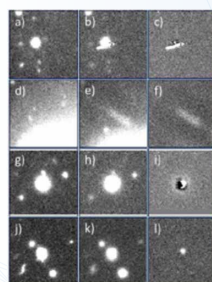The skill levels for data-scientists issued by The Japan DataScientist Society(December 2014)

Annual target number of training for each skill level (Based on the report from the ROIS round-table meeting of industry-government-academia published in 2015)

[2]: JSSC (Japan Statistical Society Certification)
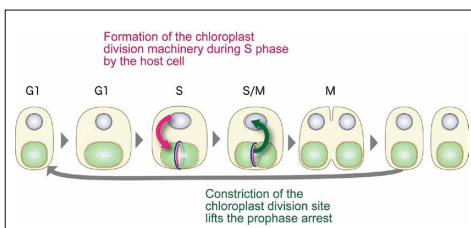
The observation images by Subaru Telescope

Awarding of the commemorative plaque to Prof. Wu (right)from Prof. T. Higuchi, Director-General of ISM(left)

National Institute of Genetics

Life is a complex system generated by interactions between genetic information engraved in the genome and the internal/external environments of the body. In order to decode this system, NIG conducts cutting-edge research on cell function, development and differentiation, evolution and diversity, and genome information among other topics. As an international hub for life science research, NIG operates three research infrastructure projects: BioResource Project, Advanced Genomics Project, and DNA Data Bank of Japan (DDBJ) Project. In addition, NIG's Center for Frontier Research provides budding researchers with independent positions and opportunities to develop new frontiers in life sciences.
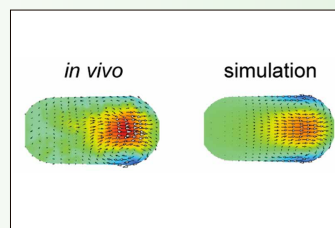
- Regulation of Cell Cycle Progression by Chloroplast Division: The Miyagishima Group found that constriction of the chloroplast division site is required for prophase to metaphase transition of the host cell, thereby synchronizing the division of the cell and the chloroplast.
- The First Determination of the Nuclear Genome Sequence of the Jomon People: The Saitou group determined partial nuclear genome sequences from the 3,000-year-old teeth of the Jomon people excavated from Sanganji Shell Mound, Fukushima.
- Estimation of Intracellular Forces Using Data Assimilation: The Kimura group developed a computational method for estimating the localization and amplitude of the forces generating cytoplasmic streaming.

A chloroplast division ring is formed in the S phase. The constriction of the ring permits the cell to enter metaphase.
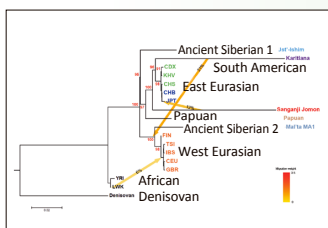
Phylogenic tree of Jomon and other populations. The values in red indicate credibility level of the tree branches while the arrows indicate miscegenation.

Cytoplasmic flow predicted from forces estimated by data assimilation (right) agrees well with the actual flow observed in the cell (left).

Resource Sharing and Joint Research to Meet the Needs of Universities
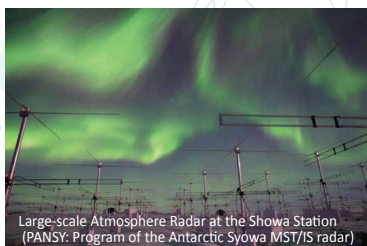
Large-scale Atmosphere Radar at the Showa Station
(PANSY: Program of the Antarctic Syowa MST/IS radar)

Ny-Ålesund Research Station (79 degrees north latitude)

⬡ Research Collaborations for Antarctic Observation

Showa Station marked its 60th anniversary in January 2017. A total of 3,283 researchers have participated in the research expeditions operated out of Showa Station over the years. The 57th expedition conducted in 2015 alone had 535 researchers from 78 national, national, prefectural and private universities taking part in 67 different assignments.

## ⬡ Resource-sharing in the Artic Region

An Arctic atmospheric aerosol observation (University of Tokyo, Nagoya University and Fukuoka University), an atmospheric observation involving the use of a cloud radar (Chiba University) and various other joint research projects are taking place at the Ny-Ålesund Research Station in Sweden's Svalbard Islands.

二次イオン質量分析計SHRIMP

⬡ Alternative: Facilities and Equipment for Analysis of Polar Science Sample Data

The Ice Core Research Center at the NIPR provides assistance for ice-coring and makes coring equipment available. The Institute also offers ice cores harvested at the Antarctic Dome Fuji station and analytic data of the samples. In addition, the NIPR provides samples of meteorites, rocks and minerals to researchers and analyses conducted on the samples with the use of a secondary mass ion spectrometer (SHRIMP) through the Polar Science Resource Center. The NIPR is the only institution in Japan that uses large-scale computing machine system for polar science and calibrates an optical instrument that uses a large scale integrating sphere.

National Institute of Polar Research

NiPR

NII

National Institute of Informatics
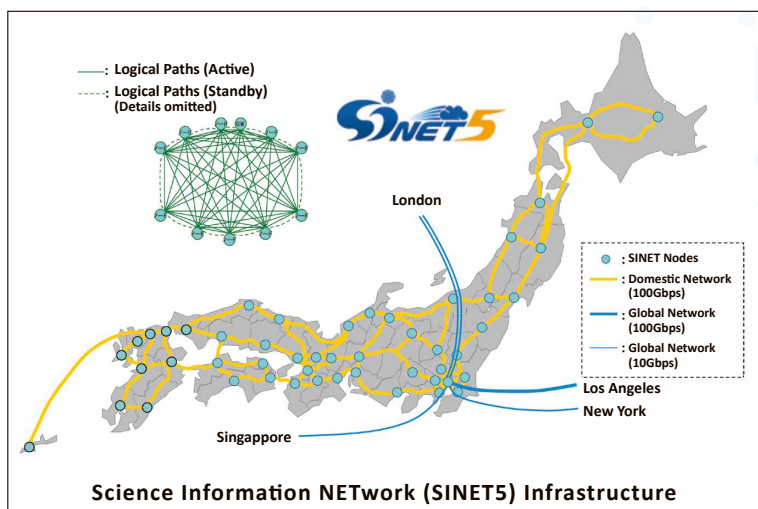
Science Information NETwork (SINET5) Infrastructure

⬡ Science Information NETwork (SINET5)

As an inter-university research institute, NII coordinates with academic institutions and the research community. For starters, it built and now operates the Science Information NETwork (SINET5), the world's most-advanced, high-speed network linked to domestic and international sites. Furthermore, the Institute takes advantage of this super high-speed and highly functional network to build a cloud infrastructure, develop security systems, make academic contents available and promote open science.

⬡ Information Security System Snfrastructure through Inter-university Collaborations

NII works with national university corporations and other institutions to build systems for the SINET for monitoring, detecting and analyzing cyber-attacks. The Institute also shares information with affiliated agencies both inside and outside Japan Need provides necessary information to national universities and other institutions according to the severity and urgency of the attack risks. In addition, NII holds training sessions for security managers to help them gain advanced skills for dealing with cyber-attacks so national universities and other academic institutions will have better systems in place to respond to incidents and emergency situations arising from attacks.

⬡ Research Data Infrastructure for Open Science

Universities and research institutions are increasingly interested in sharing their research data in order to promote open science. Upgrading data storage and promoting better data usage are extremely important to these academic institutions, and NII supports their endeavors by developing research data infrastructures.
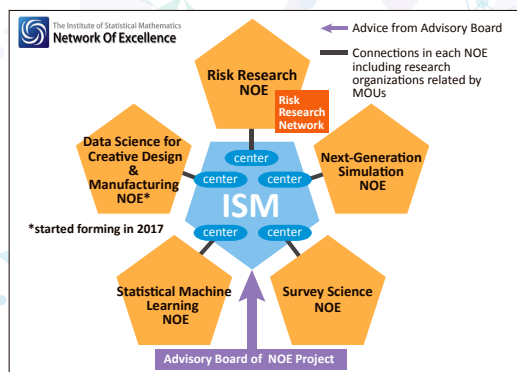
We take advantage of the academic research bases as well as global partnerships to make a wide range of research and educational support programs available to universities.

◈ NOE (Network Of Excellence) Project

Related by MOUs with 10 domestic research organizations and 20 abroad research organizations*[1], the ISM forms NOEs (Network Of Excellence) and serves as hubs for development of interdisciplinary research for solution of complicated problems required modern society.

◈ Supercomputer "AIC"

The ISM provides a supercomputer environment consisting of three supercomputers: "Data Assimilation Supercomputer A," which is a shared-memory supercomputer that boasts the highest performance in the world*[2]; "Statistical Mathematics Supercomputer I," which is a distributed-memory supercomputer designed for resource-sharing; and "Shared Cloud Computing System C," which comes with a wide range of apps for different purposes. The Institute also uses an academic literature database to provide universities with "academic literature data analysis" that can be used as the guidance in determining institutional research methodologies. The ISM provides an advanced computational environment and information resources, including periodicals and literature collections related to statistics, mathematics, computing machine science and informatic science.

◈ Project for Fostering and Promoting Statistical Thinking

The ISM strives to foster skilled data-scientists to meet the demand of the era of big-data through various programs operated by the School of Statistical Thinking, which are mostly geared toward young talents. Such programs include "Research Collaboration Start-up," which advises universities, companies and government agencies and "Data Science Research Plaza," which accepts researchers from companies.

*1: As of July 2017
*2: Graph500 (As of November 2015)

The Institute of Statistical Mathematics

National Institute of Genetics

https://shigen.nig.ac.jp/mouse/researchSupportingUnit/

◈ Genetic Modification & Model Organism Resources

The Mouse Research Supporting Unit assists in the production of genetically modified mice using advanced genome engineering techniques. The Genetic Resource Center develops, preserves, and distributes strains of various model organisms, including those of zebrafish, *Drosophila melanogaster* and rice. The center also provides a bioresource database containing information on 6.5 million genetic strains.

◈ NIG Supercomputers

NIG provides supercomputers optimized for bio-application such as genome analysis and annotation. Currently, 250 research institutions and 3,000 users take advantage of NIG's supercomputers.

Next-Generation DNA Sequencers

◈ Genome Sequencing, Archiving, and Analysis

The Advanced Genomics Center offers the latest sequencing technology and genomic research tools to the research community. To date, the Center has produced genome information on more than 450 organisms. DDBJ Center is a worldwide center for DNA data archiving and has more than 240 million sequences registered in its database.

Science Report WebSite

The ROIS publishes an online magazine, Science Report, to inform the audience overseas about Japan's latest academic research activities and achievements. Science Report focuses on a specific research topic for six months at a time with monthly feature articles introducing different aspects of the field. The magazine is intended to provide insights into some of the major ongoing research projects and how the country uses the Team Japan approach to bring together all the expertise and resources it has to offer to advance studies in certain areas. The site offers links to the news releases and publications of various universities and other academic institutions from across Japan.

https://sr.rois.ac.jp/en/

Akaike Guest House

The ISM opened Akaike Guest House in June 2010 in the suburban city of Tachikawa in Tokyo to offer researchers visiting from out of the region/country a place to stay that has easy access to their research sites. The facility was named after the late Dr. Hirotugu Akaike, a renowned statistician, to pay tribute to his wide-reaching and influential achievements in the field of Statistical Science. We hope Dr. Akaike is watching us over as we strive to advance science and try to carry on his legacy.

http://www.ism.ac.jp/akaikememorial/guesthouse-e.html

Activities for Gender Equality

The ROIS has the Office for Gender Equality set up at each of its research centers to promote a fair and equal work environment where both men and women researchers can thrive and access the support they need. As part of the initiative, the ROIS also publishes on its website a directory of female researchers who can be found through the ROIS researchmap search engine.

Women Researchers of Japan Website
http://women.rois.ac.jp/

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❸ National Institute of Informatics
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❹ The Institute of Statistical Mathematics
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❺ National Institute of Genetics
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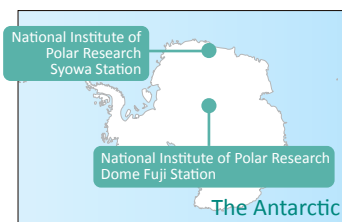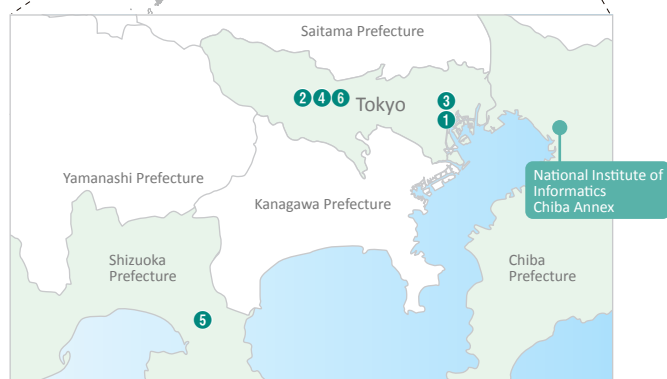https://www.nig.ac.jp/nig/

❻ Joint Support-Center for Data Science Research(DS)
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Chiba Prefecture
❺

The Arctic
National Institute of Polar Research Ny-Ålesund Research Station

National Institute of Polar Research Syowa Station
National Institute of Polar Research Dome Fuji Station
The Antarctic

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