2025

SUMMARY

2025 JST-MIRAI PROGRAM

Japan Science and Technology Agency

未来社会創造事業

Japan Science and Technology Agency

JST-Mirai Program

About JST-MIRAI

The JST-Mirai Program (hereinafter, Program) aims to promote high-risk but high-return research and development (R&D) that leads to social and economic impact. For that purpose, this Program helps develop proof-of-concept (POC), so that investors and industry may judge practical application feasibility. In this Program, the project sets technologically challenging goals based on basic research results and turns innovative ideas into commercial and social values for the future society.

|| Two Project Approaches

The JST-Mirai Program consists of two different project approaches: "Small-start Type" and "Large-scale Type."

"Small-start Type"

In this type, project begins with feasibility study at a relatively low budget (small start) and then is scaled up to full R&D project through the stage-gate evaluation. Projects are called for based on the "prioritized theme" set by JST according to R&D mission areas set by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). During the feasibility study, the project explores the social and economic potential of the ideas toward a full R&D project. Then, stage-gate evaluations are conducted) to determine the transition from feasibility study to full R&D project.

Feasibility Studies	R&D period: 2.5～4.5 years R&D costs (direct costs): 35～60 million JPY/project
Full-scale R&D	R&D period: Up to 5 years R&D costs (direct costs): 380～570 million JPY/project

●Needs of Industry and Society
●S&T Trends investigated by JST

MEXT
Mission Areas based on the S&T Innovation Basic Plan

JST
Prioritized Themes
Call for proposal research projects

Feasibility Studies

Full-scale R&D Projects

"Large-scale Type"

For the "Large-scale Type", MEXT identifies "Technology Themes" based on various analysis of science, technology and innovation policies. R&D project is selected according to the "technology theme" that may change existing technology systems and become platform technologies for the future.

R&D Project	R&D period: Up to 10 years R&D costs (direct costs): 2.7 billion JPY/project

MEXT
Technology Themes
to change current technology system and to be future basic technology

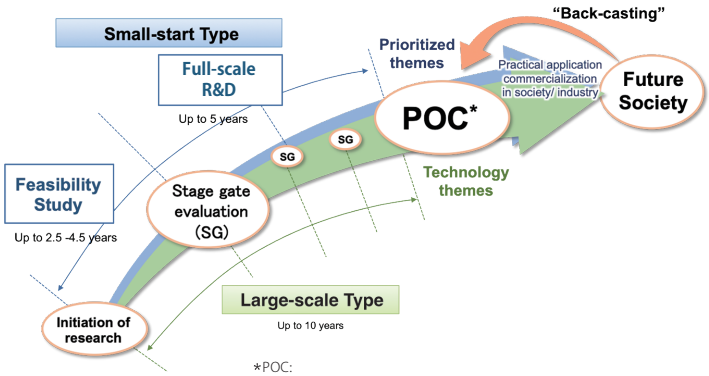
JST
Call for Proposals

R&D Projects

Scheme of the Program

●Maximizing the results

In the JST-Mirai Program, the R&D project may conduct basic research to solve issues raised during the project period, revise the teams (e.g., adding new R&D institutions), incorporate new technologies and findings, respond to changes of social and economic needs, spin out the results of some R&D, collaborate with other organizations and take ELSI (Ethical, Legal and Social Issues) into consideration. PO (Program Officer) reviews progresses in detail for maximizing the results of the R&D projects.



*POC:
Proof of concept where practical application feasibility may be properly judged by investors and industry

●Conducting stage-gate evaluation

The JST-Mirai Program conducts a "stage-gate evaluation" during the R&D period to determine whether the R&D project could continue or not based on the viability of reaching the POC. Research papers and patents are considered as parts of evidence for verification at the stage-gate evaluation.

Management System

Program Director Committee

Program Director
WATANABE Katsuaki

ABE Koichi

IKUHARA Yuichi

EMURA Katsumi

KOTANI Motoko

JST-Mirai R&D Management Committee

Small-start Type [Advanced Intelligent Information Society] Area	PO **MAEDA Eisaku** Chairman/ Professor, Tokyo Denki University
Small-start Type [New Social Challenges] Area	PO **TAKAHASHI Keiko** Senior Researcher/ Professor, Integrated Institute for Regulatory Science, Research Organization for Nano & Life Innovation, Waseda University
Small-start Type [Society Optimized for Diversity] Area	PO **WAGA Iwao** Senior Fellow, NEC Solution Innovators, Ltd.
Small-start Type [Super Smart Society] Area	PO **MAEDA Akira** Former Corporate Chief Engineer, Information & Communication Technology Business Division, Hitachi Ltd.
Small-start Type [Sustainable Society] Area	PO **KUNIEDA Hideyo** Director, Aichi Synchrotron Radiation Center, Aichi Science and Technology Foundation
Small-start Type [Safe and Secure Society] Area	PO **TANAKA Ken-ichi** Former Senior Engineer, Corporate Research and Development Group, Mitsubishi Electric Corporation
Small-start Type [Common Platform Technology] Area	PO **OSAKABE Nobuyuki** Executive Advisor, Core Technology & Solutions Business Group, Hitachi High-Tech Corporation
Large-scale Type	PO **OISHI Yoshihiro** Research Fellow, Mitsubishi Research Institute, Inc.

Innovative GX Technology Promotion Committee

Small-start Type [Low Carbon Society] Area	PO **KONDO Akihiko** President, Founder, and Representative Director, Bacchus Bio innnovation Co., Ltd. / Professor Emeritus, Kobe University

* Since FY2023, the "Low Carbon Society" mission area has been managed in an integrative manner with ALCA-Next. Projects starting full-scale research in FY2024 or later are promoted under ALCA-Next.

◆"Advanced Intelligent Information Society" mission area

MAEDA Eisaku
Program Officer

Chairman/ Professor,
Tokyo Denki University

Overview

In recent years, the rapidly evolving digitalization, data coordination and its utilization has created a new reality in which people, organizations, logistics--in reality, almost everything--are constantly connected on a global level and mutually influence one another. In this mission area, we aim to realize a next-generation information society that enables creation of new values and immediate response to uncertain and discontinuous changes through collection of diverse and reliable data in the real world and connection with various things to them.

Prioritized Themes

- Human-centric Digital Twins Services Utilizing AI, Big Data and IoT (from FY 2022)
- Human centric digital twins services (from FY 2021)

◆"New Social Challenges" mission area

TAKAHASHI Keiko
Program Officer

Research Organization for
Nano & Life Innovation,
Waseda University

Overview

Japan faces a number of issues, including public health crises such as the new COVID-19 infection, unforeseen disasters, declining birthrate and aging population, climate change, rural-urban issues, food and resource problems, aging infrastructure, and the risk of natural disasters. Besides, there is demand for appropriate responses to the changes in Japan's security environment, and the need to increase the resilience of our land and social functions. In this mission area, we aim to solve such emerging social problems.

Prioritized Themes

- Sustainable and resilient social system for healthy nature (from FY 2022)
  (Setting key concepts as "novel creation of environment" and "maintenance of life and living organisms and utilization of biological resources," respecting to "Food, Water, and Environment" and "Consumption and Production" while considering their relationship with "Decarbonation and Energy" and "Climate change, Disaster, and Infrastructure.")
- Sustainable and resilient social system for healthy nature (from FY 2021)
  (Focusing on "building a social system prepared for a drastically changing environment and increasingly severe natural disasters," while considering the effects of relationship between urban and rural areas and public health in "Climate change" and "Disasters.")

◆"Society Optimized for Diversity" mission area

WAGA Iwao
Program Officer

Senior Fellow,
NEC Solution
Innovators, Ltd.

Overview

In the future, people's life is expected to be changed intrinsically. The modes of behavior and action such as transportation, business practices, and lifestyle habits will be specifically released from the constraints of physical space and time, and thus transformed. In addition, human resources that have not been able to play active parts in the past will be released from restrictions, and the social diversity will be improved. In this mission area, we aim to realize a society in which merchandises and services are optimized for various users.

Prioritized Themes

- Assistance and evaluation for enhancing human relationships (from FY 2022)
- Reproducible evaluation on our sequential states for social improvement (FY 2021 - FY 2023)

◆"Super Smart Society (Society 5.0)" mission area

MAEDA Akira
Program Officer

Former Corporate Chief Engineer, Information & Communication Technology Business Division, Hitachi Ltd.

Overview

This research area is transdisciplinary, aiming to generate new value through the creation of industries and reformation of future society. Specifically, it includes spreading the utilization of networks and IoT not only to manufacturing industries but also to R&D in various other fields and strengthening base technologies (necessary for building a common platform through the effective utilization of IoT and base technologies that are a core of Japan's strength in creating new value, including advanced measurement technologies) for maintaining and strengthening the competitiveness of Japan as a super smart society. It also includes technologies related to space, such as satellite position measurement, satellite remote sensing, satellite communications, and satellite broadcasting.

Prioritized Themes

- Making full use of AI and simulation technologies across different fields for a human-centered society (from FY 2020)
- Innovative AI technologies for Sophisticated Integration of Cyber and Physical Services（FY 2019 - FY 2021）
- Modeling and AI that Connects the Cyber and Physical Worlds (from FY 2018)
- Establishment of a Service Platform that Enables Collaboration between Various Components and Creation of New Services (FY 2017 - FY 2021)

◆"Sustainable Society" mission area

KUNIEDA Hideyo
Program Officer

Director,
Aichi Synchrotron Radiation Center,
Aichi Science and Technology Foundation

Overview

This area focuses on technologically challenging targets to secure resources and food, aiming to realize a sustainable society in response to a super ageing and declining population. We aim to support a society of health and longevity by applying advanced technologies, developing social infrastructure for sustainable urban and local communities, and effectively and efficiently extending life-cycles of infrastructure. This will improve manufacturing and kotozukuri (story creation) competitiveness, preserve biodiversity, and so on. Research also includes marine technologies that contribute to the sustainable development and utilization of the ocean.

Prioritized Themes

- Breakthrough technologies to accelerate breeding and strain improvement in biological production for a sustainable society (from FY 2020)
- Enhancement of product durability and usability for resource-efficient society (from FY 2019)
- Creation of innovative food production technologies responding to future changes in climate and social demands (from FY 2018)
- Improving intellectual capability to enhance a "Societally Active life 2" for overcoming the reducing laborer force (FY 2017 - FY 2020)
- Innovation in manufacturing for new process of sustainable resource recycle (FY 2017 - FY 2023)

◆"Most Safe and Secure Society in the world" mission area

TANAKA Ken-ichi
Program Officer

Former Senior Engineer, Corporate Research and Development Group, Mitsubishi Electric Corporation

Overview

This area responds to natural disasters; secures food safety, living environment, industrial health, and cyber security; and responds to national security issues.

Prioritized Themes

- Realization of wellbeing by feedback based on psychological states evaluated by objective methods (FY 2020 - FY 2022)
- Self-management of health based on the action mechanism of daily behaviors such as food, exercise and sleep (FY 2019 - FY 2022)
- Realization of a safe, secure, and comfortable town free from hazardous substances hiding in the living environment (from FY 2018)
- Creation of "human service" industries (FY 2017 - FY 2023)
- Development of the crisis navigator for individuals (FY2017- FY2024)

Small-start Type

◆"Low Carbon Society" mission area

KONDO Akihiko
Program Officer

President, Founder, and
Representative Director,
Bacchus Bio innovation Co., Ltd. /
Professor Emeritus,
Kobe University

Overview

To realize a drastic reduction of GHG emissions by 2050, this area focuses on the stable securing of energy and on efficiency of energy use: energy saving technologies, higher efficiency of renewable energy, and stabilization of energy use through hydrogen or energy storage.

Prioritized Themes

- Realization of a low carbon society through game changing technologies (from FY 2017)

◆"Common Platform Technology, Facilities, and Equipment" mission area

OSAKABE Nobuyuki
Program Officer

Executive Advisor,
Core Techology &
Solutions Business Group,
Hitachi High-Tech Corporation

Overview

This is an area set to target common platform technology and cutting-edge research equipment that supports a wide variety of research activities. This area makes it possible to open up a new interdisciplinary field, support capabilities of basic science in Japan as a basis for generating world-leading research results, and contribute to creating sustainable science and technology innovation.

Prioritized Themes

- Realization of common platform technologies, facilities and equipment that create innovative knowledge and products (from FY 2018)

Large-scale Type

◆Large-scale Type

OISHI Yoshihiro
Program Officer

Research Fellow,
Mitsubishi Research Institute, Inc.

Overview

Technology themes are determined by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). For further details related to technology themes, please contact the Research and Development Infrastructure Division, Science and Technology Policy Bureau, MEXT.

Technology Themes

- Innovative microwave measurement techniques for a safe, secure, and smart society（from FY 2021）
- Innovative device technologies to achieve ultra-high level information processing in the age of trillion sensors (T Sensors) (from FY 2020)
- Innovative thermoelectric conversion technologies for stand-alone power supplies for sensors (from FY 2019)
- Ultrahigh precision time measurement technologies leading to a new time-business (from FY 2018)
- Development of innovative adhesion technologies for realizing Society 5.0 (from FY 2018)
- Innovative Hydrogen liquefaction technologies desired in future society (from FY 2018)
- Laser-plasma acceleration technologies leading to innovative downsizing and high energy of particle accelerators（from FY 2017）
- High-temperature superconducting wire joint technologies leading to innovative reduction of energy loss (from FY 2017)
- Quantum inertial sensor technologies leading to innovative high precision and downsizing of self-localization units (FY 2017 -FY2023)

Programs (2025.4)

	"Small-start Type"		"Large-scale Type"
	Feasibility Studies	Full-scale R&D	
R&D period	2.5～4.5 years	Up to 5 years	Up to 10 years
R&D costs (direct costs)	35～60 million JPY/project	380～570 million JPY/project	2.7 billion JPY/ project

(Program budget of FY2025 : 7.7 billion JPY)

Number of Projects (2025.4)

R&D Mission Area		PO	Full-scale R&D	Feasibility Studies
"Small-start Type"	"Advanced Intelligent Information Society" mission area	MAEDA Eisaku	3	0
	"New Social Challenges" mission area	TAKAHASHI Keiko	2	0
	"Society Optimized for Diversity" mission area	WAGA Iwao	1	0
	"Super Smart Society (Society 5.0)" mission area	MAEDA Akira	2	0
	"Sustainable Society" mission area	KUNIEDA Hideyo	3	0
	"Most Safe and Secure Society in the world" mission area	TANAKA Ken-ichi	2	0
	"Low Carbon Society" mission area	KONDO Akihiko	4	11
	"Common Platform Technology, Facilities, and Equipment" mission area	OSAKABE Nobuyuki	9	0
"Large-scale Type"		OISHI Yoshihiro	8	

Research Activities (FY2023)

Paper	897
Patent	159
Press release	875
Prize	253

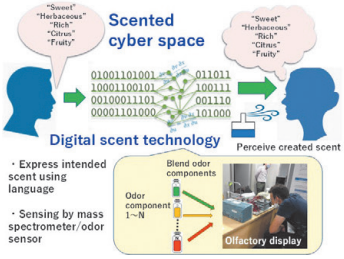
" Advanced Intelligent Information Society" mission area

Prioritized Theme Human-centric Digital Twins Services Utilizing AI, Big Data and IoT

Building Digital Scent Technology Based on Odor Reproduction

https://www.jst.go.jp/mirai/en/program/next-info/JPMJMI25H1.html (2025.04-)

NAKAMOTO Takamichi
Project Leader
Specially Appointed Professor,
Institute of Integrated Research,
Institute of Science Tokyo



Although scents cannot be treated as digital information at the current stage, it would be possible to express quite new sensory information if we could incorporate olfaction into information. Therefore, we will develop digital scent technology that can reproduce scents using a small number of odor components, and realize a scented cyberspace.
This research will make it possible to express information that could not be adequately conveyed only through audiovisual senses. In the exploratory research, we worked with companies to develop an olfactory display and content that can blend odor components to reproduce the scent in real time, and conducted numerous demonstrations. In the full-scale research, we will expand the range of scents that can be reproduced. Then, we will expand the scent reproduction technology and its applications, thereby carrying out the following tasks and building digital scent technology.
1: Reproducing scents using odor components and expanding the range of scents we can handle
2: AI that creates desired scents based on linguistic expressions
3: Establishment of scent presentation technology through olfactory display and content, followed by the verification of its effectiveness

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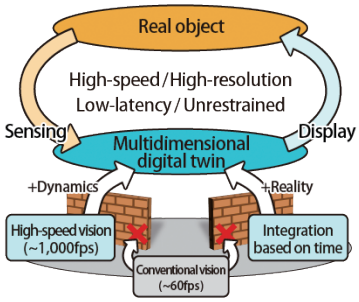
"Advanced Intelligent Information Society" mission area

Prioritized Theme Human centric digital twins services

Multidimensional digital twin sensing and reconstruction based on high-speed vision

https://www.jst.go.jp/mirai/en/program/next-info/JPMJMI24H1.html (2024.04-)

MIYASHITA Leo
Project Leader
Associate Professor,
Research Institute for Science and Technology,
Tokyo University of Science



Conventional information environments are constructed with sensor-display technologies based on an ability of human (30-60 fps), resulting in a spatio-temporal gaps in the real world, and dealing with a digital twin that lacks dynamics and reality under the limitations of latency and worn devices. This problem is a major obstacle in the creation of a comfortable next-generation information society for remote work, tele-surgery, and automated driving.

In this project, high-speed sensing based on 1,000fps vision, which is far faster than that of humans, and the development of optical systems, robots, and display handling the sensing technologies, will be integrated with spatial and various modal information based on the time axis, thereby creating an information environment that can handle multidimensional digital twins without spatio-temporal gaps. The technologies will be used as a platform multi-dimensional digital twins in real time to create various innovative services and businesses, and its effectiveness will be demonstrated mainly in the fields of factory automation, inspection, and media.

* PI during the feasibility study phase: President / Professor ISHIKAWA Masatoshi (Tokyo University of Science)

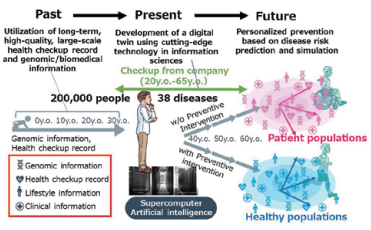
"Advanced Intelligent Information Society" mission area

Prioritized Theme Human centric digital twins services

Development of digital twin by integrating multi-layered biomedical information

https://www.jst.go.jp/mirai/en/program/next-info/JPMJMI24H2.html (2024.04-)

MURAKAMI Yoshinori
Project Leader
Project Professor,
Department of Molecular Biology
Institute of Advanced Medical Sciences, Nippon Medical School



Disease prevention is one of the key issues to promote human health and to maintain social vitality. The purpose of this project is to develop a new digital twin technology for predicting personalized risks of diseases and for simulating future health conditions of individuals by incorporating information of DNA polymorphisms and omics into that of long-term health checkup records.

In the feasibility study R&D project, we focused on unique health checkup systems of Japanese companies, constructed a cohort with DNA polymorphism information of 60,000 people, and successfully calculated and verified the disease risks (polygenic risk score:PRS) for prevention of several common diseases.

In the full-scale R&D project, its scope will be expanded to 38 diseases and 200,000 people. Moreover, by utilizing cutting-edge information science, more advanced and novel digital twin technology that includes not only genomic information but also omics and biophysical information will be developed and personalized approaches to disease prevention will be generated.

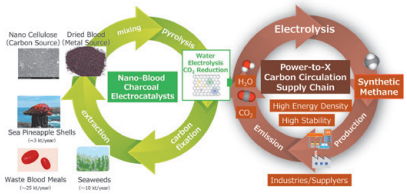
" New Social Challenges" mission area

Prioritized Theme Sustainable and resilient social system for healthy nature (FY2022-)

Realization of Resource / Energy Circulation Society and Establishment of Energy Independence through Power-to-X Using Biomass-Derived Electrocatalysts

https://www.jst.go.jp/mirai/en/program/social-challenge/JPMJMI25I1.html (2025.04-)

YABU Hiroshi
Project Leader
Professor,
Advanced Institute for Materials Research,
Tohoku University



Toward full utilization of renewable energy, Power-to-X (energy conversion and storage technology) is the serious bottleneck which is caused by catalyst with high cost and mineral resources restriction risk. This study aims to develop a catalyst for the direct synthesis of methane, a type of synthetic fuel, using nano blood-charcoal catalysts produced by pyrolyzing waste biomass materials such as cellulose derived from sea pineapple shells, dried blood meals, and seaweeds. The catalyst's atomic and molecular structures will be optimized to achieve performance that surpasses conventional catalysts. In addition, electrodes and cell stacks incorporating this catalyst will be developed to demonstrate synthetic methane production in an electrolyzer system. Furthermore, by establishing an integrated supply chain—from the collection of waste biomass to catalyst synthesis, the development and manufacturing of electrodes and electrolyzer systems, and the distribution of synthetic methane—this project aims to realize a resource- and energy-circulating society that enables both energy self-sufficiency and decarbonization in Japan through the expansion and full utilization of renewable energy.

"New Social Challenges" mission area

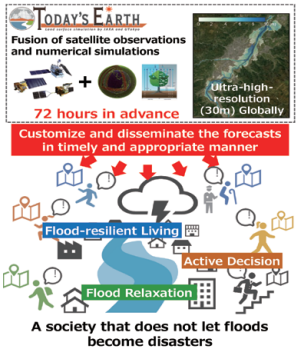
Prioritized Theme Sustainable and resilient social system for healthy nature (FY2021-)

Implementation of long-term flood prediction by integrating satellite observation and model simulation: Realization of a society that does not let floods become disasters

https://www.jst.go.jp/mirai/en/program/social-challenge/JPMJMI24I1.html (2024.04-)

YOSHIMURA Kei
Project Leader
Professor,
Institute of Industrial Science,
The University of Tokyo

First, we aim to establish an unprecedented global, ultra-high-resolution flood forecasting system (approximately 30 m resolution in Japan and 90 m resolution in other areas) that can be used more than 72 hours in advance. This will be done by making full use of data assimilation of various observation information and knowledge, including not only local observations and satellite data but also SNS data. Second, an information fusion infrastructure will be established to customize and disseminate the forecasts. It provides timely and apzpropriate early flood warning information necessary for individual evacuation actions, evacuation assistance by local governments, and damage prevention and mitigation measures. Third, the project will formulate flood control plans that incorporate flood forecast information, which has not been fully utilized in the past, and contribute to the formulation of medium- to long-term flood control and land planning by the national and local governments and business continuity planning by companies. Through the above, we will contribute to the realization of a "society that does not let floods become disasters," where floods are relaxed, and everyone can actively make decisions and take action to prevent disasters.



" Society Optimized for Diversity" mission area

Prioritized Theme Assistance and evaluation for enhancing human relationships

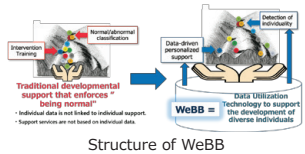
Development of Data Utilization Technology to Support the Individuality and Well-being of Diverse Children

https://www.jst.go.jp/mirai/en/program/society4diversity/JPMJMI25J1.html (2025.04-)

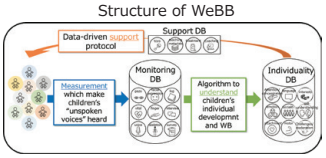
SENJU Atsushi
Project Leader
Professor,
Research Center for Child Mental Development,
Hamamatsu University School of Medicine

UNICEF reported that Japan ranked among the bottom for children's mental well-being. The Japanese educational and child support sectors have long been struggling with staff shortage and a lack of sufficient expertise, making it extremely difficult to adequately support the development of diverse children.

Our project will address this national challenge with the development of the Well-Being Base (WeBB), a platform of data utilization technologies designed to monitor, identify and support the individual child's unique developmental and well-being needs. The WeBB consists of three main components: (1) multi-sensing technology, which elucidates children's development and well-being needs, even some of those needs children themselves may not be aware of, (2) higher-order data integration algorithms, which automatically evaluate and estimate children's individuality and well-being in real-time, and (3) a suite of child support protocols, which provides tailored support to meet children's individualized developmental and well-being needs.



Structure of WeBB



"Super Smart Society (Society 5.0)" mission area

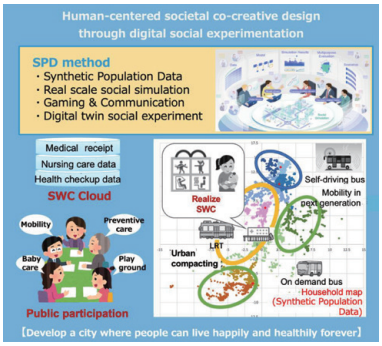
Prioritized Theme Making full use of AI and simulation technologies across different fields for a human-centered society

Development of digital social experimentation platform technology to enable human-centered societal co-creative design

https://www.jst.go.jp/mirai/en/program/super-smart/JPMJMI23B1.html (2023.04-)

KAIHARA Toshiya
Project Leader
Professor,
Faculty of Information Science and Technology,
Osaka Institute of Technology

This research and development project aims to develop SPD (Societal Prototyping Design) fundamental technology that uses real-scale models of society and its residents. By using SPD, we aim to visualize mid- to long-term social scenarios from various perspectives and to realize social policy making with a high degree of acceptance.
We establish a human-centered social co-creation design method that enables diverse stakeholders to be involved in urban and social policy making as if it were their own based on visualization.
In collaboration with the SWC Research Group of Chiefs of Cities (SWC: Smart Wellness City), in which the chiefs of 131 cities, towns, and villages across Japan participate, the goal of this project is to solve social issues to realize SWC policies and urban development with SPD fundamental technology.



"Super Smart Society (Society 5.0)" mission area

Prioritized Theme Modeling and AI that Connects the Cyber and Physical Worlds

Development of Smart Robot for Revolution of Industry

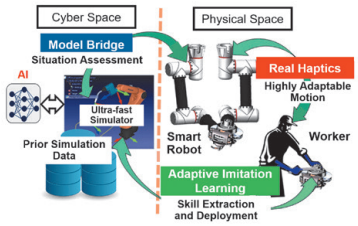
https://www.jst.go.jp/mirai/en/program/super-smart/JPMJMI21B1.html (2021.05-)

OHNISHI Kouhei
Project Leader
Project Professor,
Shin-Kawasaki Frontier Research & Education Collaborative Square,
Keio University

If the skills contained in the motion of experienced worker can be extracted and transferred to a robot, the scope of automation can be expanded to include atypical tasks (i.e., tasks that flexibly adapt to changes in the characteristics of an object) that are impossible with existing industrial robot. In order to achieve the above goals, the issues that need to be resolved are as follows.

1. The robot could acquire the skills of each experienced worker (learning skills).
2. Utilizing the expertise of experienced workers contained in the acquired skills to enable the robot to perform flexible movements adapted to the work object (using skills).
3. Evolving the robot ability to respond to all situations, including the unexpected and unknown (evolving skills).

The above issues can be solved by making robots smarter through advanced integration of real haptics and AI technologies. The project will bring some key technologies in the manufacturing process appeared in smart society.



The goal of smart robotics.

＊ This project is launched by integrating the following feasibility studies;
"GAN-based Robot Modeling and Its Application to Autonomous Manufacturing" (MORIMOTO Jun), "Building a fast optimization technique for simulation based on machine learning" (YAMAZAKI Keisuke) and "Smart Robot Evolved by Learning Human Skill" (OHNISHI Kouhei)

"Sustainable Society" mission area

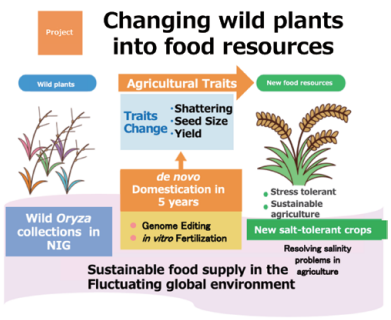
Prioritized Theme Breakthrough technologies to accelerate breeding and strain improvement in biological production for a sustainable society

Pioneering new food resources from wild plants for sustainable food supply under fluctuating environment caused by global warming

https://www.jst.go.jp/mirai/en/program/sustainable/JPMJMI23C1.html (2023.04-)

SATO Yutaka
Project Leader
Professor,
National Institute of Genetics,
Research Organization of Information and Systems

This research aims to create novel stress-tolerant crops that can withstand various stresses at levels not achieved by conventional crop breeding by imparting characteristics of agricultural crops (non-shattering, seed enlargement, and increased yield) to wild plants (weeds). We mainly use wild *Oryza* with high-stress tolerance as the primary research target. In this project, wild *Oryza* species, which are difficult to utilize through conventional breeding, will be genome-edited by a unique gene transfer technology to control the shattering and grain size. We aim to thereby provide advantageous traits as an agricultural crop to the species and make it into an agricultural resource. Furthermore, by the *in vitro* fertilization of egg and sperm cells, we aim to develop new food resources by creating new rice varieties that have both the superior traits of wild species and the characteristics of cultivated rice species, which are genetically distant and cannot be crossed with each other. In the coming term, salt-tolerant wild *Oryza* will be domesticated by our original technology to produce new crops to cope with the salt damage due to climate change.



＊ This project is launched by integrating the following feasibility studies; "New genomic breeding using cybrid plants between the three most important crops" (OKAMOTO Takashi) and "Pioneering new food resources from wild crop progenitors" (SATO Yutaka)

"Sustainable Society" mission area

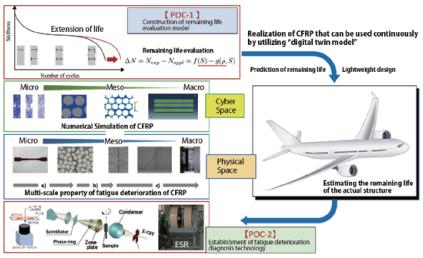
Prioritized Theme Enhancement of product durability and usability for resource-efficient society

Elucidation of fatigue deterioration mechanism and establishment of evaluation method to estimate the remaining life of CFRP laminates

https://www.jst.go.jp/mirai/en/program/sustainable/JPMJMI22C1.html (2022.04-)

ARAI Masahiro
Project Leader
Professor,
Department of Aerospace Engineering,
Graduate School of Engineering,
Nagoya University

CFRP is expected to be significantly lighter in airplanes and automobiles, and as a result, it is expected to be a material that can effectively reduce carbon dioxide emissions. To reduce CO_2 emissions by extending the service life of the aircraft, it is important to evaluate the damage and remaining life of these devices during long-term use. In this study, we will elucidate the mechanism of damage occurrence and progression of the CFRPs, and construct a model of damage and destruction. By establishing CFRP fatigue deterioration diagnosis technology and combining it with a fatigue/fracture evaluation model, highly accurate remaining life evaluation will be realized. By effectively combining the fatigue/fracture model and physical property evaluation methods such as entropy, electron spin, and thermal conductivity, the damage progress of CFRP and its remaining life are appropriately evaluated, and finally the total life of the CFRP structures is doubled in the present approach.



＊ This project is launched by integrating the following feasibility studies;
"Quantification of Lifetime for Thermoplastic CFRP Based on Entropy Damage" (KOYANAGI Jun) , "Realization of non-destructive observation techniques of defects & cracks triggering fatigue and degradation" (KIMURA Masao), "Evaluation of Microscale Degradation based on High Sensitivity Measurement of Thermal Wave Propagation Behavior" (NAGANO Hosei), "Operando micro-measurement analysis method for CFRP composite degradation and a model for remaining life estimation" (MARUMOTO Kazuhiro) and "Development of material design and evaluation system improving long-term reliability of CFRP laminates" (ARAI Masahiro)

"Sustainable Society" mission area

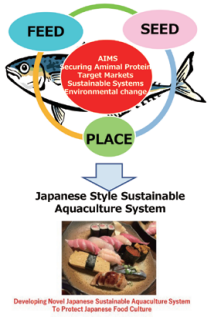
Prioritized Theme Creation of innovative food production technologies responding to future changes in climate and social demands

Development of Next Generation Sustainable Aquaculture System

https://www.jst.go.jp/mirai/en/program/sustainable/JPMJMI21C1.html (2021.06-)

NAKAYAMA Ichiro
Project Leader
President of the Fisheries Research and Education Agency

We develop a next generation aquaculture system that integrates novel "food" "seeds" and "places" research.
We conduct researches on novel "feed", "seed", and "place" for sustainable aquaculture; fish-free feed, short-term seed development, and aquaculture system with environment adaptability. We integrate the outputs of research to a new aquaculture system applicable to various environments and fish species in Japan to support Japan's rich food culture.
The research will lead to the sustainable supply of the world's high-quality protein sources and the maintenance and conservation of marine resources.



＊ This project is launched by integrating the following feasibility studies;
"Development of resources-recycling aquaculture feeds inspired from features of the ecosystem" (OGAWA Jun) and "Next-generation fish breeding by combination of developmental biotechnology and genomic selection" (YOSHIZAKI Goro)

"Most Safe and Secure Society in the world" mission area

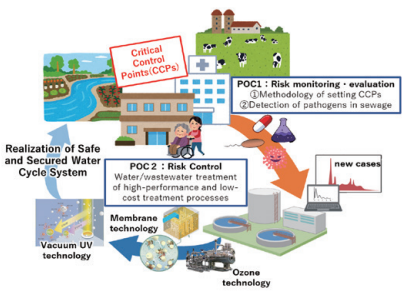
Pri oritized Theme Realization of a safe, secure, and comfortable town free from hazardous substances hiding in the living environment

Realization of Safe and Secured Water Cycle System Supporting Healthy Society and People

https://www.jst.go.jp/mirai/en/program/safe-secure/JPMJMI22D1.html (2022.04-)

TANAKA Hiroaki
Project Leader
Specially Appointed Professor, Faculty of Engineering, Shinshu University/Professor Emeritus, Kyoto University

Water is an inevitable resources in daily lives, and is recycled among human and social activities, and the water environment. Origins and whole pictures of the human health risk factors including hazardous chemicals, pathogenic bacteria and viruses, antibiotic resistance, etc. relevant to water is not disclosed well. Therefore, our present water infrastructures cannot bring human risk zero in all water applications. This project aims at identification of critical control points on such human health risk factors, risk evaluation to lower the human health risk to reasonably acceptable levels, development of high-performance and low- cost water treatment system, and development of wastewater-based epidemiology for social implementation, which is introduced to water infrastructures to realize safe and secured water application.



＊ This project is launched by integrating the following feasibility studies;
"Novel VUV/MBR for Production of Water with Reliable Quality" (MATSUI Yoshihiko) and "Reduction of Bio-Risk at Critical Control Points by High-Standard Water Treatment" (TANAKA Hiroaki)

"Most Safe and Secure Society in the world" mission area

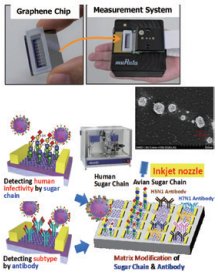
Prioritized Theme Realization of a safe, secure, and comfortable town free from hazardous substances hiding in the living environment

Realization of a pandemic-free society by graphene FET sensors with quickly detectable human infectious viruses

https://www.jst.go.jp/mirai/en/program/safe-secure/JPMJMI22D2.html (2022.04-)

MATSUMOTO Kazuhiko
Project Leader
Specially Appointed Professor, The Institute of Scientific and Industrial Research, Osaka University

In order to quickly identify the type of human infective virus to improve the lifesaving rate, we realize a highly sensitive on site detection system that can instantly and immediately determine multiple types of viruses. Graphene field-effect transistors with ultra-sensitive characteristics are integrated and arrayed, and using a bio-inkjet printer, individual transistors are modified with multiple types of antibodies and sugar chains to which viruses selectively bind. Using these technologies, we will build an on site system that can determine the type of virus, its subtype, and human infectivity within a few tens of minutes just after collecting the virus sample. In order to dramatically improve the infection protection rate in society, we will develop a simple detection system that can detect viruses directly from saliva with high sensitivity so that anyone can easily detect viruses at home every day, and create a safe living space. Furthermore, we will develop a basic technology that can detect the presence or absence of a virus in the living space from the exhaled breath or the atmosphere.
With these results, it becomes possible to immediately measure the presence and type of human infectious virus, determine its risk as soon as possible, and prevent a pandemic due to the spread of infection.



"Low Carbon Society" mission area

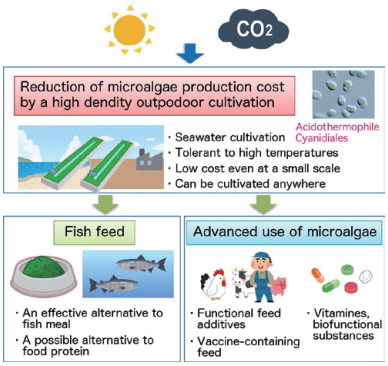
Prioritized Theme Realization of a low carbon society through game changing technologies

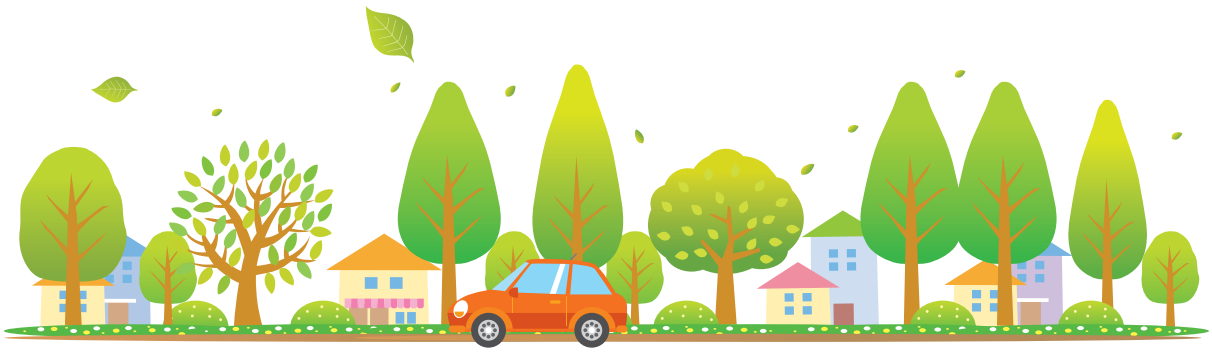
Innovation of microalgal cultivation and utility systems using acidic water

https://www.jst.go.jp/mirai/en/program/lowcarbon/JPMJMI22E1.html (2022.04-)

MIYAGISHIMA Shin-ya
Project Leader
Professor, National Institute of Genetics

Microalgae are expected to be a new green industry that does not compete with agricultural products. However, the production cost is high due to contamination of other microorganisms and the low culture density. As a result, and their use is limited to expensive supplements. In addition, the shortage of fresh water on a global scale limits the scale of microalgal cultivation. Moreover, genetic modification has not been established in microalgal industry.
In this research and development project, by using sulfuric hot spring microalgae Cyanidiales, we will develop a procedure for outdoor microalgal cultivation in acidified seawater to a high density which leads to an reduction of production cost. The algae produced will be used as fish feed. In addition, we will establish a genome editing technology for Cyanidiales for producing biofunctional substances.
Through this development, we aim to expand the scale of use of microalgae, reduce CO_2 (32 million tons / year / world), and contribute to stable food production and improving human and animal health.





"Low Carbon Society" mission area

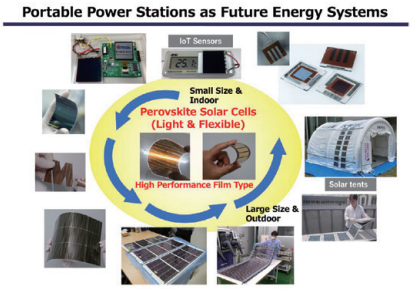
Prioritized Theme Realization of a low carbon society through game changing technologies

Pb-free Perovskite Solar Cells Consisting of Sn

https://www.jst.go.jp/mirai/en/program/lowcarbon/JPMJMI22E2.html

(2022.04-)

WAKAMIYA Atsushi
Project Leader
Professor, Institute for Chemical Research, Kyoto University



We will develop high performance of Sn-based perovskite solar cells using environmentally friendly, Pb-free materials, which could be commercialized at large scale.
It has become clear that the efficiency of Sn-based perovskite solar cells is held back by the large density of trap sites present in the perovskite absorbers. The origin of these trap sites, which act as recombination centers for the generated charge, are impurities and lattice defects arising from the facile oxidation of Sn(II)-containing materials.
In our exploratory research on this topic, we have improved the performance of Sn-based perovskite solar cells by focusing on the fabrication of high-quality perovskite semiconductor thin films. This included developing the necessary high-quality proprietary starting materials. These efforts have led to world-leading results.
In the proposed research, based on the results and knowledge gained to date, we will pursue the development of original materials focusing on elemental hybridization (alloying) to further optimize high-quality perovskite semiconductor thin films and devices. Through these efforts, we aim to achieve Sn-based perovskite solar cells with ultra-high performance (single-layer devices with >20% efficiency, tandem devices with >30% efficiency) and high durability (>20 years).

＊ PI during the feasibility study phase: Program-Specific Professor HAYASE Shuzi (The University of Electro-communications)

"Low Carbon Society" mission area

Prioritized Theme Realization of a low carbon society through game changing technologies

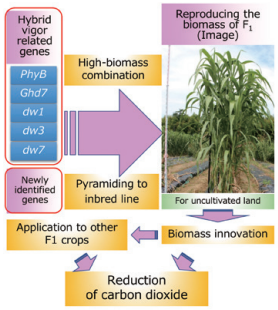
Biomass innovation by elucidating the principle of hybrid vigor

https://www.jst.go.jp/mirai/en/program/lowcarbon/JPMJMI21E1.html

(2021.06-)

SAZUKA Takashi
Project Leader
Professor, Biosci. and Biotech. Center, Nagoya University

The purpose of this project is to breed the crops needed to realize the low-carbon society. From this perspective, we focus on high biomass sorghum. We utilize the five important genes that are necessary and sufficient for hybrid vigor of sorghum revealed in our previous study. By pyramiding these genes, new inbred varieties will be bred with almost the same biomass as F1 hybrids. We will also try to identify new important genes for the above purpose.
In addition, for the development of fermentation technology in biorefinery using sorghum, we will categorize by the juice ingredients of the varieties, and also evaluate the effect by microorganisms for the fermentation.



"Low Carbon Society" mission area

Prioritized Theme Realization of a low carbon society through game changing technologies

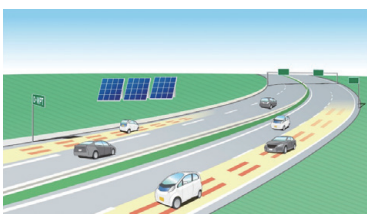
Future society opened by direct dynamic wireless power transfer to EV

https://www.jst.go.jp/mirai/en/program/lowcarbon/JPMJMI21E2.html

(2021.06-)

FUJIMOTO Hiroshi
Project Leader
Professor, Graduate School of Frontier Sciences, The University of Tokyo

- Problem of existing EV is shorter cruse-range and longer charging time.
- Solved by DWPT from road coils in part of highways. Realize smart EV community without plug-in charging.
- Early realization of a carbon-neutral society by DWPT EV



Demonstration test of smart EVs for the widespread of Dynamic Wireless Power Transfer.

" Common Platform Technology, Facilities, and Equipment" mission area

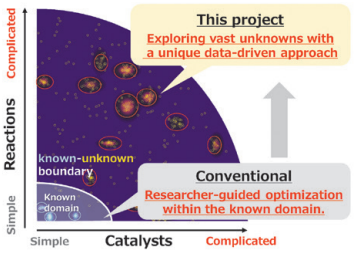
Prioritized Theme Realization of common platform technologies, facilities and equipment that create innovative knowledge and products

High-Dimensional Chemical Reaction Exploration Platform Transforming Material Discovery into Value Discovery

https://www.jst.go.jp/mirai/en/program/core/JPMJMI25G1.html (2025.04-)

TANIIKE Toshiaki
Project Leader
Professor,
Graduate School of Advanced Science and Technology,
Japan Advanced Institute of Science and Technology

The realization of a carbon-neutral society requires the innovation of catalytic technologies that synthesize fuels and chemicals from raw materials such as water, carbon dioxide, and biomass. This research aims to establish a "reaction exploration platform" that efficiently discovers new values from vast unknown spaces, replacing traditional catalyst development based on causal relationships. The reaction exploration platform is a technology that simultaneously discovers new reactions and catalysts by efficiently exploring unknown spaces. In traditional approaches, a specific reaction exists first, followed by the development of a catalyst for it. However, this research enables the exploration of both unknown reactions and catalysts through high-throughput experimentation and feature engineering, with exploration efficiency further enhanced by the introduction of autonomous techniques and optimized search algorithms.



" Common Platform Technology, Facilities, and Equipment" mission area

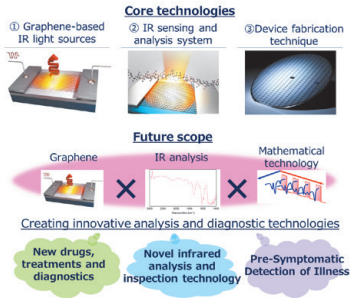
Prioritized Theme Realization of common platform technologies, facilities and equipment that create innovative knowledge and products

Developing IR sensing technology for innovative analysis and diagnostics based on graphene light emitters

https://www.jst.go.jp/mirai/en/program/core/JPMJMI25G2.html (2025.04-)

MAKI Hideyuki
Project Leader
Professor,
Faculty of Science and Technology,
Keio University

We will create a new healthcare, medical, and lifestyle paradigm by realizing a high-spatial resolution and high-speed infrared spectroscopic and microscopic device using a graphene light emitter, and by creating innovative analysis and diagnostic technologies. Infrared spectroscopy has been used in a variety of fields as a technology for identifying molecules, chemical analysis of food and other products, and environmental measurement. However, there is a growing need for higher resolution local analysis and more sensitive analysis to solve these issues. In this research, we will use the ultra-compact, high-speed thermal light emitters based on graphene for the application of a high-spatial resolution and high-speed infrared spectroscopic and microscopic analysis system, which can realize the marker-less and single-cell bioimaging. We will also improve the performance of the underlying graphene light source chip and develop mathematical techniques necessary for the advanced analysis. We will also promoting the development of applications that make the most of the features of the graphene light source chip.



"Common Platform Technology, Facilities, and Equipment" mission area

Prioritized Theme Realization of common platform technologies, facilities and equipment that create innovative knowledge and products

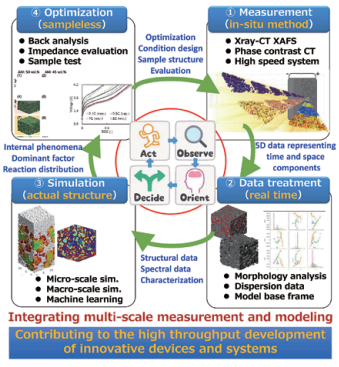
High-throughput Platform for Device Development by Fusion of Multi-scale Measurement and Modeling

https://www.jst.go.jp/mirai/en/program/core/JPMJMI24G1.html (2024.04-)

INOUE Gen
Project Leader
Professor,
Graduate School of Engineering
Department of Chemical Engineering,
Kyushu University

The objective of this project is to establish a high-throughput platform for device development by integrating multi-scale measurement and modeling. In the first stage, we attempt to understand the internal phenomena of all solid-state batteries by using cutting-edge measurement technology, data treatment technology, multi-physics simulations, and an automatic optimization method. We then realize a technology that can analyze batteries by decomposing their three-dimensional distribution and resistance components using kinetic-non steady mathematical modeling of electrochemical reactions and mass transport. Our findings offer insight into the relationship between internal phenomena and cell performance, stability, and durability, and present a design for an optimal device system. Another objective is to develop technologies that provide design guidelines for enhancing a variety of devices and systems by estimating their internal phenomena. These technologies can reduce the lead time for final product development.

＊ This project is launched by integrating the following feasibility studies;
"Development of a 3D multiscale and multimodal operando chemical analysis platform"(AMEZAWA Koji), "Development of Multi-scale Digital Feedback Loop by Integrating Non-destructive Measurement, Space-Time Inverse Analysis and Modeling"(INOUE Gen)



Common Platform Technology, Facilities, and Equipment" mission area

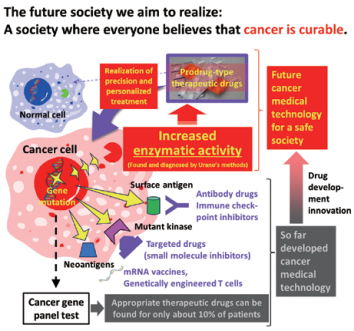
Prioritized Theme Realization of common platform technologies, facilities and equipment that create innovative knowledge and products

Creation of small molecule-based precision cancer theranostics medical technology by diagnosing and utilizing enzyme "activity"

https://www.jst.go.jp/mirai/en/program/core/JPMJMI24G2.html (2024.04-)

URANO Yasuteru
Project Leader
Professor, Graduate School of Pharmaceutical Sciences and Graduate School of Medicine, The University of Tokyo

Personalized medicine, in which the genetic mutation of each patient's cancer cells is identified and the most appropriate therapeutic drug is administered based on this information, has been gaining popularity in recent years. However, at present, only about 10% of patients are found to have a therapeutic drug, and there is still an overwhelming shortage of therapeutic drugs. Against this backdrop, the PI has succeeded in establishing an intraoperative rapid visualization technique for tiny cancer using original fluorescence probes. This technique is based on enzymatic activities of cancer cells, and this approach (the Urano's method) can be used to diagnose the enzyme activity characteristics of each patient, as well as to rapidly develop prodrug-type therapeutic agents. This research aims to establish a new personalized and precise cancer treatment technology for the majority of cancer patients for whom no effective treatment options were available in the past, and to realize a safe society where everyone believes that cancer is a curable disease.

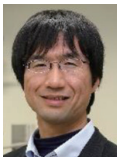


"Common Platform Technology, Facilities, and Equipment" mission area

Prioritized Theme Realization of common platform technologies, facilities and equipment that create innovative knowledge and products

Establishment of customizable optical sensing and creation of advanced use of optical information that brings new value to society and daily life

https://www.jst.go.jp/mirai/en/program/core/JPMJMI23G1.html (2023.04-)

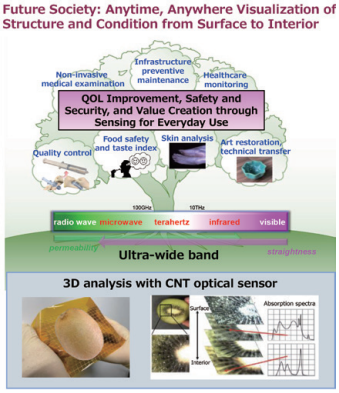


KAWANO Yukio
Project Leader
Professor, Faculty of Science and Engineering, Chuo University

Internal visualization of any object is essential for understanding the state of the object. X-ray CT, for example, is used to more accurately measure internal conditions, but the equipment is expensive and large, making in-situ observations impractical. This research is aimed at developing the following technologies based on the ultra-wide band sensing method:

1. Improvement of sensor sensitivity to enable accurate measurement of objects susceptible to optical damage with very low light irradiation.
2. Image sharpening under low light irradiation to enable damage-free measurement
3. Internal image reconstruction to enable non-destructive and non-invasive identification of internal structures

As for applied research, we will verify the effectiveness of this technology for analysis of food, skin, and works of art, which have been difficult to measure in a nondestructive manner.
After this project, we will widely disseminate this technology as a visualization tool for everyday use, and contribute to improving quality of life, realizing a safe and secure society, and creating new value.



"Common Platform Technology, Facilities, and Equipment" mission area

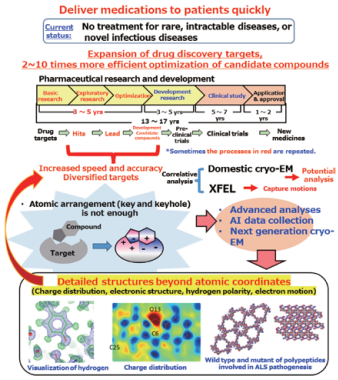
Prioritized Theme Realization of common platform technologies, facilities and equipment that create innovative knowledge and products

Innovation of drug discovery through visualization of structures beyond atomic coordinates

https://www.jst.go.jp/mirai/en/program/core/JPMJMI23G2.html (2023.04-)

YONEKURA Koji
Project Leader
Group director, RIKEN SPring-8 Center

We aim to overcome the limits of conventional measurement by developing advanced technologies in cryo-electron microscopy and also using X-ray free electron laser (XFEL). Our goal is high spatio-temporal resolution and rapid analysis of organic compounds and proteins, even at small quantities. This will enable us to elucidate "unseen" physical properties and phenomena, so-called "structures beyond atomic coordinates", such as charge distribution, electronic structure, chemical bond polarity, protonation of functional groups, and electron motion. Its application will promote drug discovery for the treatment of new infectious diseases and intractable diseases. The technology can also be applied to the development of new materials, energy, the environment, and life science. In addition, we will develop a next-generation cryo-electron microscope to expand the global market share and establish a base for the analysis. Thus, the project is expected to contribute to the improvement of productivity in research and development sites as a common basic technology.



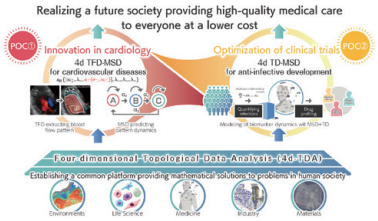
"Common Platform Technology, Facilities, and Equipment" mission area

Prioritized Theme Realization of common platform technologies, facilities and equipment that create innovative knowledge and products

Four-Dimensional Topological Data Analysis for Future Medical Care

https://www.jst.go.jp/mirai/en/program/core/JPMJMI22G1.html (2022.04-)

SAKAJO Takashi
Project Leader
Professor, Graduate School of Science Division of Mathematics, Kyoto University



We shall establish a new methodology of data analysis, called "Four-dimensional topological data analysis (4d-TDA)", tracking the time evolution of geometric structures in various data with mathematically rigorously. In particular, applying 4d-TDA to issues in the fields of medicine and drug development, we shall contribute to a realization of a future society providing high-quality medical care to everyone at a lower cost.
4d-TDA consists of topological flow data analysis (TFDA) and persistent homology (PH) combined with data-driven mathematical modeling.
Our research objectives are:

- Creating a new classification for cardiovascular diseases based on blood flow structures in the heart; developing a software applicable to clinical diagnosis with echocardiography and MRI.
- Designing conditions for effective clinical trials, which reduces the time and the number of participants, for antiviral drugs against infectious disease such as COVID-19 by predicting dynamics of biomarkers.
- Establishing a common platform that provides mathematical solutions to many problems in human society.

＊ This project is launched by integrating the following feasibility studies;
"Quantitative approach for genome evolution dynamics based on multiscale mathematical mode" (IWAMI Shingo) and "Comprehensive R&D Platform for Topological Data Analysis" (SAKAJO Takashi)

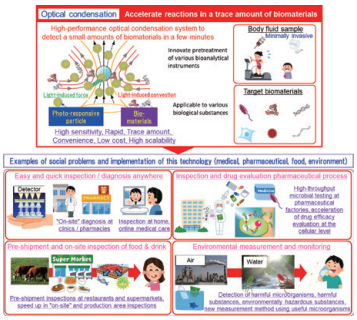
"Common Platform Technology, Facilities, and Equipment" mission area

Prioritized Theme Realization of common platform technologies, facilities and equipment that create innovative knowledge and products

Development of Minimally Invasive High-throughput Optical Condensation System

https://www.jst.go.jp/mirai/en/program/core/JPMJMI21G1.html (2021.06-)

IIDA Takuya
Project Leader
Professor, Graduate School of Science / Director, Research Institute for LAC-SYS, Osaka Metropolitan University



We will develop a system accelerating biochemical reactions by "optical condensation" of a very small amount of biological samples (protein, DNA, microbe, cell, etc.) with maintaining their functions at the aimed position, and innovate the fields of preventive medicine, food inspection, and environmental measurement.
Utilizing the synergistic effect of light-induced force and light-induced convection, we clarify a principle for "optical condensation" of biological materials for the acceleration of their reactions, and develop extremely rapid and highly sensitive detection method. Particularly, we will clarify mechanisms of intermolecular interaction under optical condensation, and establish a high-throughput measurement technology for an ultra-early diagnostic method in the medical field. Furthermore, by developing a multipurpose optical condensation system, we will expand applications to the detection of microorganisms and environmentally hazardous substances, and provide innovations in food inspection and environmental measurement.

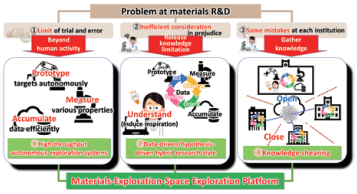
"Common Platform Technology, Facilities, and Equipment" mission area

Prioritized Theme Realization of common platform technologies, facilities and equipment that create innovative knowledge and products

Materials Exploration Platform; Expanding Search Space by high-throughput technology

https://www.jst.go.jp/mirai/en/program/core/JPMJMI21G2.html (2021.06-)

NAGATO Keisuke
Project Leader
Professor.
Graduate School of Engineering, The University of Tokyo



In order to improve efficiency of material research and development, we build a new material search method "Materials Exploration Platform", utilizing experience which is Japan's strengths.
POCs are following three for KPI of 1,000-times throughput on battery materials synthesis;
① High-throughput autonomous exploration systems;
- "Prototype": autonomous experiment system
- "Measure": automatic crystal structure analysis
- "Accumulate": properties prediction system

② Data-driven/hypothesis-driven hybrid research style;
"Understand (induce inspiration based on experience)" is connected to "P" ➡ "M" ➡ "A" by machine learning.
③ Knowledge shearing;
Knowledge obtained from data, inspirating researchers, is shared with R&D institution, R&D company, and measuring instrument manufacturers for future materials R&D ecosystem.

＊ This project is launched by integrating the following feasibility studies;
"Multiscale Multimodal Materials Structure Analysis System" (ONO Kanta), "Development of Materials Design Workflow and Data Library for "Materials Foundry"" (CHIKYOW Toyohiro), "Materials Robotics: A new research style for materials science" (HITOSUGI Taro) and "Data-driven Process Informatics for higher-throughput researches on powder film-formation process" (NAGATO Keisuke)

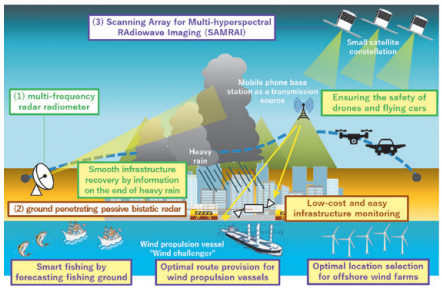
Technology theme Innovative microwave measurement techniques for a safe, secure, and smart society

Research and Development of Microwave Radar and Radiometer using Ultra Wide Band Antenna and Digital Technologies

https://www.jst.go.jp/mirai/en/program/large-scale-type/theme09.html (2021.11-)

TOMII Naoya
Program Manager
Project Manager,
Space Technology Directorate I,
Japan Aerospace Exploration Agency

We have defined an ultra-wideband antenna with upper to lower limit frequency ratio of 30 times or more and digital technologies (ultra-high-speed AD conversion, etc.) as the fundamental technologies. Innovative microwave measurement systems that apply the fundamental technologies can realize below two features, which were difficult with conventional systems, in a small size and at low cost with a small number of parts: (a) hyperspectral measurement of microwave signals, (b) simultaneous measurement of the amount of various objects in the same space by sharing the observation field over a wide band. In this research and development, we first solve the technical issues for acquiring the fundamental technologies, and apply them to three innovative microwave measurement systems to demonstrate the technical availability: (1) multi-frequency radar radiometer, (2) ground penetrating passive bistatic radar, and (3) Scanning Array for Multi-hyperspectral RAdiowave Imaging (SAMRAI). We then utilize each system to solve various problems in modern society such as infrastructure monitoring, smart fishing, and carbon neutral to demonstrate the availability of businesses that will realize the safe, secure and smart future society.



Technology theme Innovative device technologies to achieve ultra-high level information processing in the age of trillion sensors (TSensors)

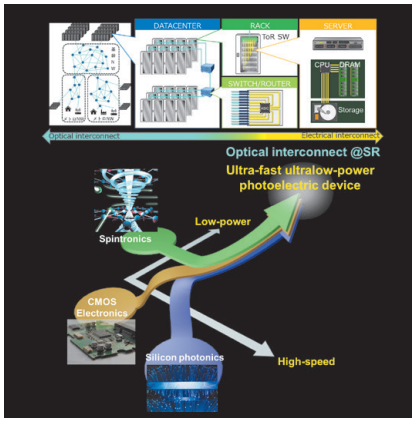
Innovation of Photoelectric Technologies using Spintronics

https://www.jst.go.jp/mirai/en/program/large-scale-type/theme08.html (2020.11-)

NAKATSUJI Satoru
Program Manager
Director.
Trans-scale Quantum Science Institute,
The University of Tokyo

Information and communication technology plays a critical role in realizing Society 5.0. The development of high-speed, wide-bandwidth, and low-power devices is all the more urgent to achieve sustainable information processing systems.

In high-end information processing systems such as switches and routers in large-scale data centers, I/O bottleneck has become a central challenge, awaiting the creation of ultra-fast and ultra-low power photoelectric devices. Specifically, the long electrical interconnects and the integration-limit of CMOS circuits hinder the simultaneous realization of high-speed performance and low-power consumption. To overcome this difficulty, we develop innovative photoelectric technologies, intermediating electrical signals and optical signals by spintronics to achieve a highly functional I/O device.



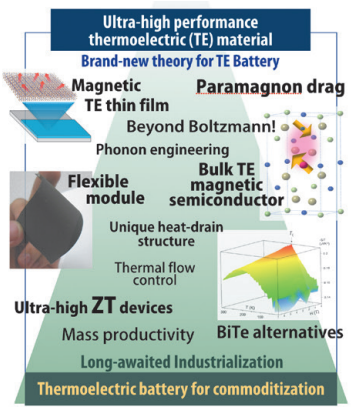
Technology theme Innovative thermoelectric conversion technologies for stand-alone power supplies for sensors

Utilizing magnetism to develop high performance thermoelectric materials and devices

https://www.jst.go.jp/mirai/en/program/large-scale-type/theme07.html (2019.11-)

MORI Takao
Program Manager
Group Leader,
Research Center for Materials Nanoarchitectonics(MANA),
National Institute for Materials Science

In future Society 5.0, sensors will gather myriad data analyzed by AI to create new value. Thermoelectric modules are promising to supply power to innumerable sensors by directly converting ubiquitous thermal energy in the environment to electricity. In order to achieve the 200 year old dream of thermoelectric power generation application, we are challenging with new approaches. Utilizing magnetism, such as magnetic interactions and spin fluctuations, we have been able to realize significant thermoelectric enhancement. Together with thin film effects, we aim to break through beyond the traditional confines, and realize ultra-high performance thermoelectric materials. As another critical strategy we have focused on methods for module production, which are industry and mass production compatible, i.e. semiconductor thin film devices and flexible hybrid sheets. With the world's leading thermoelectric team, we aim to lead the way and create a new industry and market, utilizing thermoelectric power generation for energy harvesting to power ubiquitous IoT sensors and devices for future society.

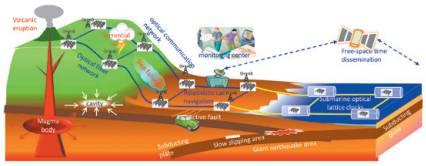


Technology theme Ultrahigh precision time measurement technologies leading to a new time-business

Space-time information platform with a cloud of optical lattice clocks

https://www.jst.go.jp/mirai/en/program/large-scale-type/theme04.html (2018.11-)

KATORI Hidetoshi
Program Manager
Professor,
Graduate School of Engineering,
The University of Tokyo
/ Team Director, RIKEN Center for Advanced Photonics



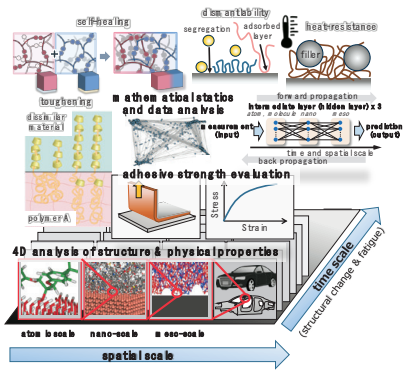
The optical lattice clock, taken as a ridiculous idea in 2001, has come true and changed the game for building highly precise and stable atomic clocks. In this project, we will develop a space-time information platform by networking "optical lattice clocks", which improve the uncertainty of atomic clocks used in GNSS (Global Navigation Satellite System) by three orders of magnitude. Such a platform will benefit future high-capacity network systems, navigation, and other services.
Since the dawn of history, mankind has elaborated technologies for timekeeping and developed applications to fully use time resources. These technologies have triggered a paradigm-shift in communication and information technologies. In order to facilitate a new breakthrough in industrial and academic fields introduced by highly-precise clocks, we will develop transportable and compact "optical lattice clocks" that allow remote maintenance and unattended operation.
By networking them via phase-stabilized fibers, we will demonstrate clocks' application to relativistic geodesy and establish a space-time information platform that will substitute GNSS.

Technology theme Development of innovative adhesion technologies for realizing Society 5.0

Innovative Adhesion Technology Based on 4-dimensional Multi-scale Analysis of Interfaces

https://www.jst.go.jp/mirai/en/program/large-scale-type/theme05.html (2018.11-)

TANAKA Keiji
Program Manager
Distinguished Professor,
Department of Applied Chemistry,
Kyushu University



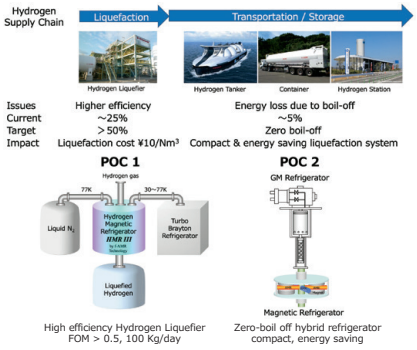
The objective of this project is to introduce an innovative state-of-the-art adhesion technology based on an *in-situ* 4-D multi-scale analyses of adhered interfaces, in conjunction with molecular-level manipulation and fabrication of polymers. This collaborative work involves strong collaboration between the academe and the industry rooted from establishing fundamental science at interfaces to manufacturing of components for mobilities utilizing the envisioned adhesion technology. This project could also lead significant developments in the areas of sensors and devices, electronics, social infrastructure, and manufacturing, envisioned to accelerate the realization of Society 5.0 by linking these achieved goals to social economic structure transformation.

Technology theme Innovative Hydrogen liquefaction technologies desired in future society

Development of advanced hydrogen liquefaction system by using magnetic refrigeration technology

https://www.jst.go.jp/mirai/en/program/large-scale-type/theme06.html (2018.11-)

NISHIMIYA Nobuyuki
Program Manager
Visiting Researcher,
National Institute for Materials Science



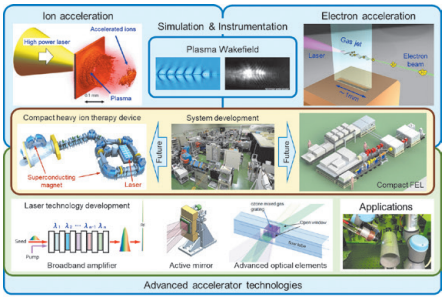
The supply chain of hydrogen, liquefaction cost may occupy 1/3 of total supply price, therefore, developing a high efficient hydrogen liquefier is one of the most important technology issues for incoming hydrogen society. Magnetic refrigeration using the magneto-caloric effect has potential to realize liquefaction efficiency higher than 50%, and also to be environmentally friendly and cost effective. A hybrid refrigeration cycle consisting of precooling cycle and magnetic active regenerator cycle has been proposed and estimated to achieve a liquefaction capacity of 100 kg/day with FOM = 0.5. Our new project is committed to develop ① such a high efficient hydrogen liquefier and also, ② compact and energy saving re-condensation refrigerator to realize zero boil-off in the liquid hydrogen storage.

Technology theme Laser-plasma acceleration technologies leading to innovative downsizing and high energy of particle accelerators

Development and demonstration of laser-driven quantum beam accelerators

https://www.jst.go.jp/mirai/en/program/large-scale-type/theme01.html (2017.11-)

SANO Yuji
Program Manager
Specially Appointed Professor,
SANKEN, The University of Osaka



Particle accelerators are used in a wide range of fields over academic, industrial, and medical purposes. However, the huge size of the system and the expensive construction cost have blocked their broader use. In this project, we aim to achieve significant downsizing of particle accelerators and reducing the cost through development and exploitation of laser plasma acceleration technology which enhances the acceleration gradient by several orders of magnitude compared with conventional accelerators. Broad contribution to social implementation in the following areas is expected.

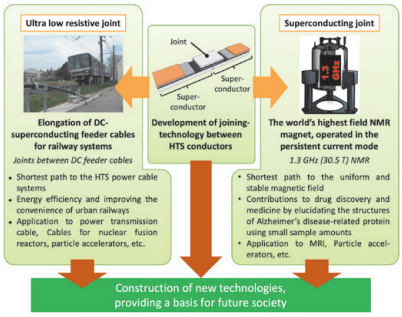
- Development of small electron accelerators will drastically improve accessibilities to synchrotron and FEL light sources as infrastructure, significantly promoting a wide range of scientific and industrial applications.
- Development of small ion accelerators will reduce the cost for construction / operation of medical-purpose accelerators such as cancer therapy and promote the deployment to existing hospitals. It is expected to extend the span of life while keeping high QoL and reduce medical expenses.
- Development of stabile high-power compact lasers enables widespread distribution of new domestic lasers to the global market, and contribute to laser-related industries.

Technology theme High-temperature superconducting wire joint technologies leading to innovative reduction of energy loss

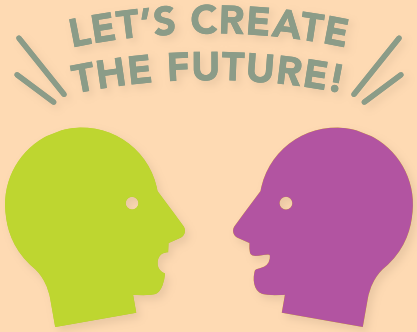
Social implementation of super-high field NMRs and DC superconducting cables for railway systems, through advancement of joint-technology between hightemperature superconducting wires

https://www.jst.go.jp/mirai/en/program/large-scale-type/theme02.html (2017.11-)

ONO Michitaka
Program Manager
Research Administrator,
RIKEN Center for
Integrative Medical Sciences



Low temperature superconductors require liquid helium, while only generating a magnetic field less than 24 T. For full-fledged commercialization, high temperature superconducting (HTS) conductors are preferred as they are cooled by liquid nitrogen, generating a much higher magnetic field. However, the drawback of the HTS conductor is its availability only in short lengths of a single conductor, such as 500 m. This necessitates many joints being installed in the superconducting apparatus, resulting in difficult manufacturing process and a complicated operatingprocedure. Hence, we have commenced a new project, comprising two R&D items: (a) development of superconducting-joints (10 - 13 Ω) between HTS conductors, which are installed in the world's highest field persistent current mode 1.3 GHz (30.5 T) NMR; the joining performance is evaluated based on NMR spectra: (b) development of ultra-low resistive joints(10 - 7～10 - 8 Ω) between DC superconducting feeder cables, > 100 mm in diameter, for railway systems, which are evaluated by the operational test of a train in the Railway Technical Research Institute.



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Our world faces unprecedented global challenges — such as climate change, energy crises, and emerging infectious diseases — that demand innovative solutions. JST will rise to these challenges through " Science and Technology, " as a national research and development agency that plays a central role in implementing Japan's science, technology, and innovation policy. We support fundamental research and startups to create new value, develop R&D strategies, foster the next generation of talent, disseminate vital information, and manage the Japan University Fund. Like a compass guiding ships through turbulent waters, JST will chart the way towards a vibrant and secure future by empowering science through a multifaceted approach.

Japan Science and Technology Agency (JST)
Department of R&D for Future Creation

Web : https://www.jst.go.jp/mirai/en/
X : https://x.com/JST_mirai
TEL : +81-3-6272-4004
E-mail : kaikaku_mirai@jst.go.jp

Web

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