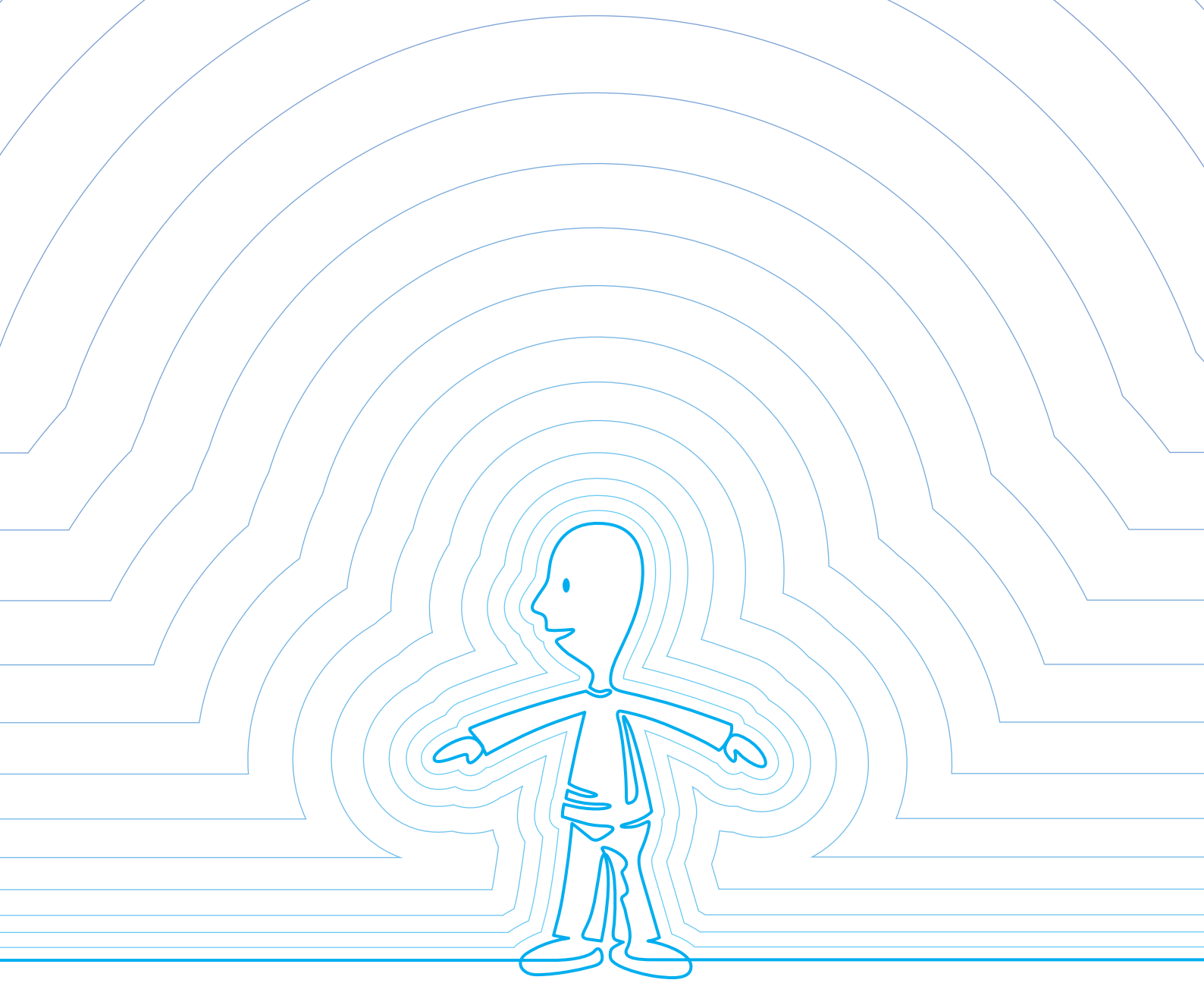


HARC

Human Augmentation Research Center

AIST

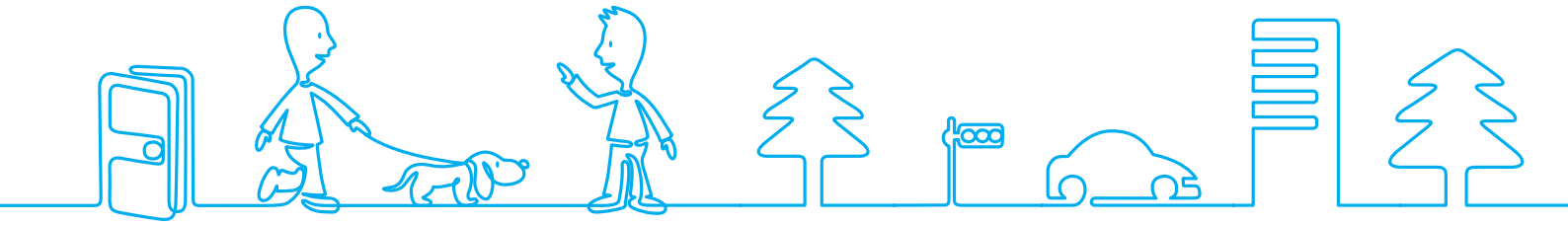
Human augmentation is a system close to human to enable human to live more actively. With a broad sense, microscopes and telescopes are a part of human augmentation technologies, whereas Human Augmentation Research Center (HARC) focuses on a wearable and/or invisible system based on information-communication technologies and robotic technologies. Using human augmentation system, human functions are enhanced and empowered temporarily. Moreover, we aim for researches to augment biological human functions through a long period use of the system. HARC challenges to launch a new industry based on human augmentation technologies towards "Society 5.0."

Namely, the mission of HARC is to develop human augmentation technologies for maintenance and enhancement of human functions (physical, emotional and communicational functions), improvement quality of life, reduction of social costs and development of industries (knowledge intensive business services relevant to daily living). The following inter-disciplinary researchers joined to HARC to carry out the mission; flexible sensing technologies, robotics, biomechanics, ergonomics, psychology, service engineering and design.

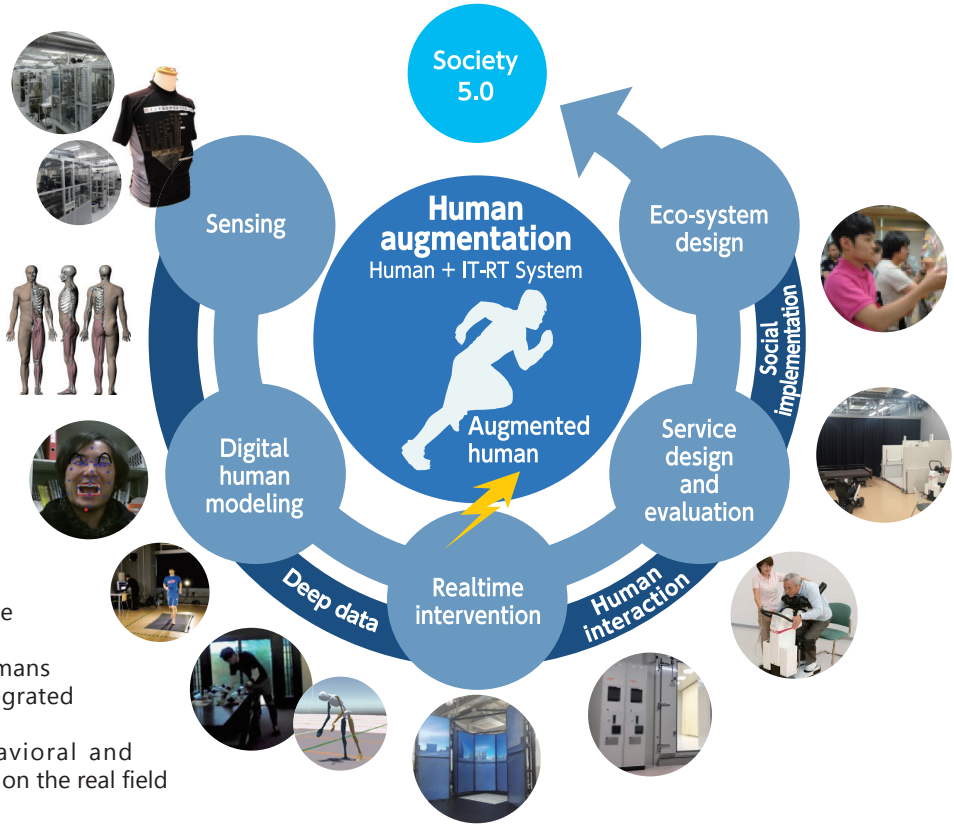
HARC is located at AIST Kashiwa Center (c/o Kashiwa II Campus, University of Tokyo). We cooperate closely with University of Tokyo, Chiba University and National Cancer Center Japan that are located in Kashiwanoha. Here, Kashiwanoha region is a newly developed town including residential areas and shopping malls. HARC is pushing through social implementation of new service businesses based on human augmentation technologies through enlisting cooperation with residents in Kashiwanoha and a real estate company that developed Kashiwanoha.

Director

MOCHIMARU Masaaki, Ph.D.



Core competence and strategy of HARC



Sensing

- Fabrication technologies for invisible sensors (Flexible hybrid electronics)
- Production technologies of unconscious sensors (Thermal damageless process and textile device production)
- Indoor positioning technology for humans and vehicles without GPS signals (integrated positioning technology based on xDR)
- VR technology for measuring behavioral and biological data that is difficult to acquire on the real field (Virtual Human-Sensing technology)

Digital human modeling

- Understanding the effects of environments on human cognition and learning, and augmentation of these functions (Measurement methods of effect of environments on human mental activities, and technologies for enhancing human cognition and learning)
- Investigation of processes of feelings which occur in interacting with others such as trust, sympathizing or togetherness (Measurement and visualization methods of communication)
- Comprehensive analysis of human movement to understand the features (technologies to analyze human movement comprehensively to clarify various features)
- Development of the models to assess various human movement features (model development for assess various human movement features by using sensors)
- Management of AIST human movement database (management and utilization of database for intellectual creation)

Realtime intervention

- Wearable AR technologies for supporting work and on the job training（integrated positioning technology and XR based on xDR）
- VR technologies for pre-evaluation of improvement plan and skill training（motion capture and XR technologies）
- Tele-existense technologies for remote work（fusion of multi-modal user interface design and XR technologies）
- Assistive robots to promote independent living and to reduce the burden of caregivers (development, assessment, and standardization)
- Technologies to realize sensing and analysis of daily life using assistive robots as probes（IoT care robots）

Service design and evaluation

- Technologies for assessing various aspects of services (customer satisfaction, employee satisfaction, productivity or social value)
- Design methodologies for creating desirable services for customers and employees with advanced technologies
- KAIZEN simulation based on 3-D environment modeling and human behavior sensing（3-D shape modeling and agent based simulation）

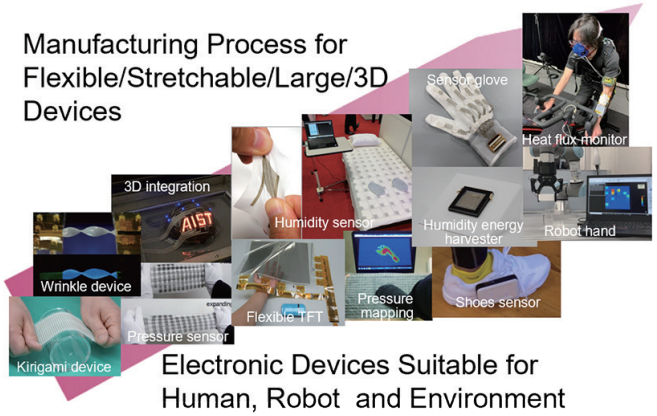
Eco-system design

- Technology for designing interactions between self, others and the environment
- Measurement / intervention / mind and behavior change / evaluation cycle methods and system implementation technologies for platforms that co-create new products and services
- Comprehensive design methodology for the innovation ecosystem

Smart Sensing Research Team

Team Leader : TAKEI Atsushi, Ph.D.

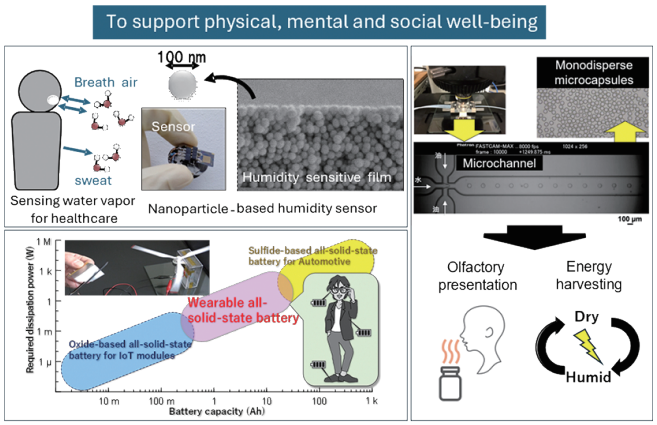
We are developing devices that collect data from people, things and environment that could not be obtained before and obtain information to create value. We aim to solve social issues with our developed devices and create new service markets. We are developing flexible/stretchable devices smoothly attachable on 3D shapes, technologies for measurement in large and non-planar area, and energy harvesting technologies for supplying power to the sensors. We are developing devices suitable and friendly for the people, things and environment without causing discomfort or making people aware of it for human augmentation.



Well-being Device Research Team

Team Leader : TAKEI Atsushi, Ph.D.

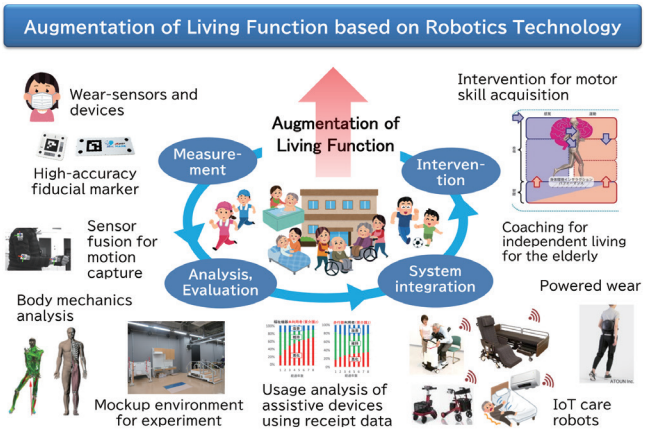
We are engaged in R&D of materials, processes, and devices form health/mental care, chemical and bio applications with the aim of realizing well-being. By combining nanomaterials, press molding, microfluidic, and MEMS technologies, we are promoting high-speed and high-performance micro/nanodevices in the field of biometrics. Particularly, we aim to realize all-solid-state batteries for wearable and IoT devices, olfactory presentation combined with microencapsulation technique, energy harvester combined with microchannel, and quick responsive humidity sensors for healthcare monitoring.



Assistive Robotics Research Team

Team Leader : TANAKA Hideyuki, Ph.D.

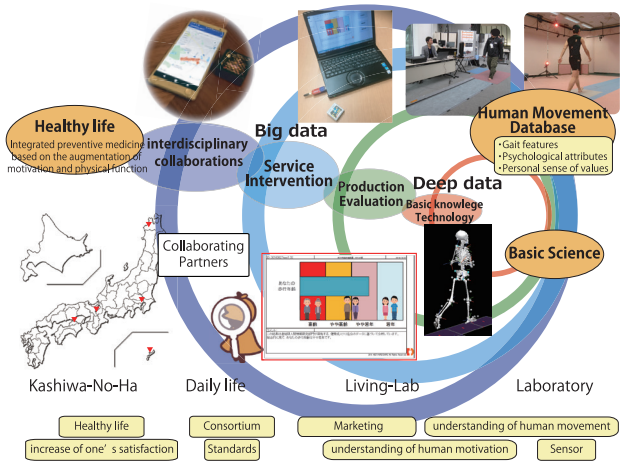
We develop assistive technologies including robots to support people in nursing care, production, and daily life, with the aim of augmenting people's life functions and improving their quality of life. We develop not only elemental technologies such as sensors, measurement, analysis, and intervention, but also assessment technologies of the safety and benefits required for dissemination. Through data collection and analysis in clinical experiment collaborating with manufacturers, care providers, and municipalities, we aim to promote the industrialization of robotics technologies to resolve social issues.



Exercise motivation and Physical function Augmentation Research Team

Team Leader : KOBAYASHI Yoshiyuki, Ph.D.

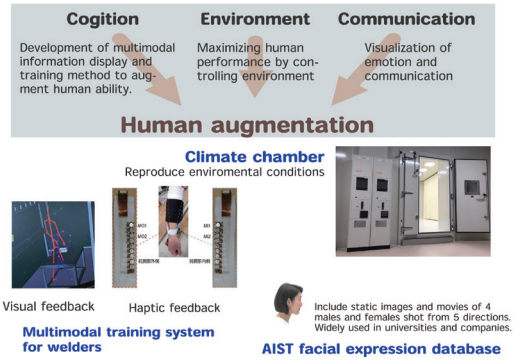
The goal of our research is to maximize one's health through the augmentation of motivation and physical function individualized on the basis of their daily activities and personal values. Our research activities range from the basic science focusing on a better understanding of human movement and psychological attributes associated with one's daily activities, to the applied science directed to the improvement of one's quality of daily living. Knowledge and technologies gained from our research activities are to be implemented in the Kashiwa-no-ha area and then nationwide for health promotion through interdisciplinary collaborations.



Cognition, Environment and Communication Research Team

Team Leader：UMEMURA Hiroyuki, Ph.D.

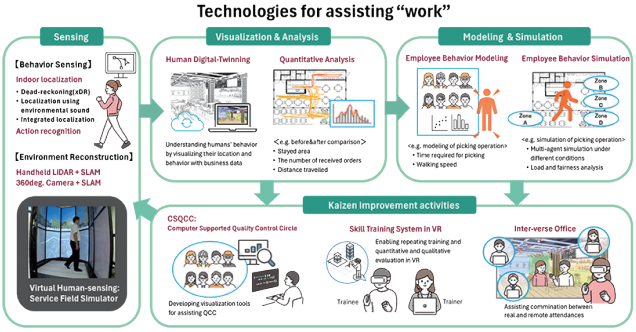
Cognition, Environment and Communication Research Team aims to augment not only abilities of individuals, such as perception or recognition, but also abilities required to communicate and cooperate with others. For the purpose, we are conducting research for understanding the process of human cognition, emotion, and communication through psychological methods, for understanding effects of environment for these processes, and for measuring these processes with techniques developed in biological psychology and/or computer vision technologies. Moreover, we are trying to apply these results to the developments of human interface devices and computer applications, and to the establishment of environment control method.



Smart Work IoH Research Team

Team Leader：ICHIKARI Ryosuke, Ph.D.

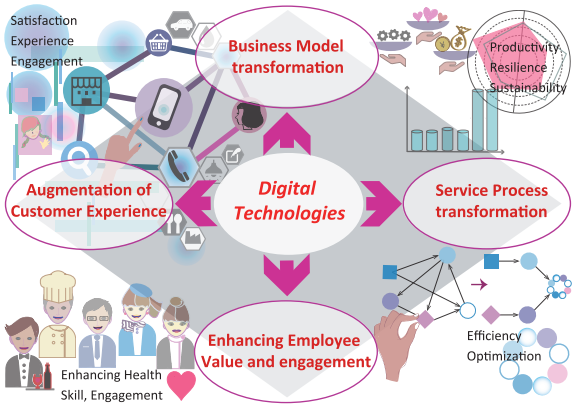
We are conducting research and development of human augmentation technology with the aim of enhancing the skills and motivation of people who are engaged in "work," an activity that contributes to the company where they work and the local community where they live, with a sense of fulfillment and purpose in life. In particular, we are developing and integrating technologies for measuring and estimating human behavior, digital models of human behavior based on measurement data, support services for improving the working environment and increasing productivity using simulation technology based on human behavior models, and skills training support technology using AR and VR technology, and industrializing them using service engineering. Through collaborative research with partner companies and universities, we are promoting on action research which applies these technologies to actual fields.



Service Value Augmentation Research Team

Team Leader：WATANABE Kentaro, Ph.D.

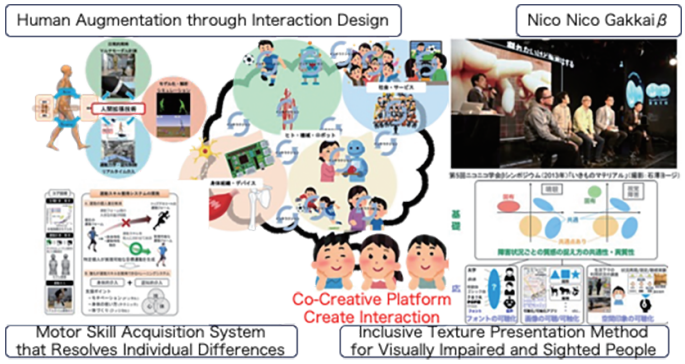
Service Engineering aims to realize service ecosystem through observation, analysis, design, and application of services based on actual data. The value of service should be evaluated from various perspectives, such as quality, customer satisfaction, employee satisfaction, efficiency, profitability, and social value. It is also importnat to extend the value of the entire service system, including humans, through the utilization of digital technologies. Therefore. we integrate methodologies from different disciplines including engineering, psychology, economics and design research to support the realization of service productivity improvement, integration of service and manufacturing, mechanism design of service platform, and creation of participatory services for residents using Living Lab research.



Co-Creative Platform Research Team

Team Leader：MURAI Akihiko, Ph.D.

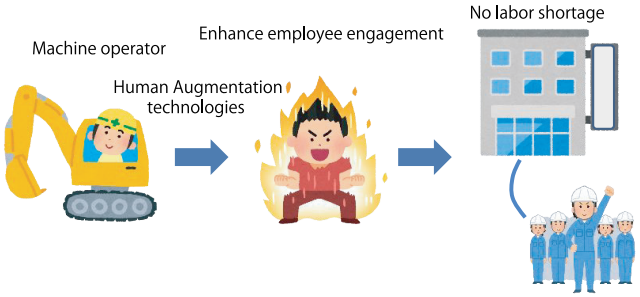
Co-Creative Platform Research Team aim to realize a vibrant society by augmenting human motor, sensory, cognitive, and social capabilities. Everyday, humans interact with various objects in various situation, with various modalities, granularity, and frequency, and they result in their performance. Design of these interactions would realize the human augmentations. We consider the place where this interaction takes place as a co-creative platform, and conduct research on the design and system implementation of interaction environments that co-create new thing and events in order to realize the fostering of this co-creative platform.



Komatsu-AIST Human Augmentation Cooperative Research Laboratory

Leader, Cooperative Research Laboratory:TAKAMATSU Nobumasa

This laboratory focuses on development of human augmentation technologies to enhance harmonization between human and construction equipment. The objective is to improve safety, to achieve well-being, to enhance employee engagement of machine operators through interaction between human and construction equipment. Moreover, we challenge to develop service technologies to support well-being management for client companies through visualization of health conditions and employee engagement in order to solve the serious labor shortage in the construction industry.

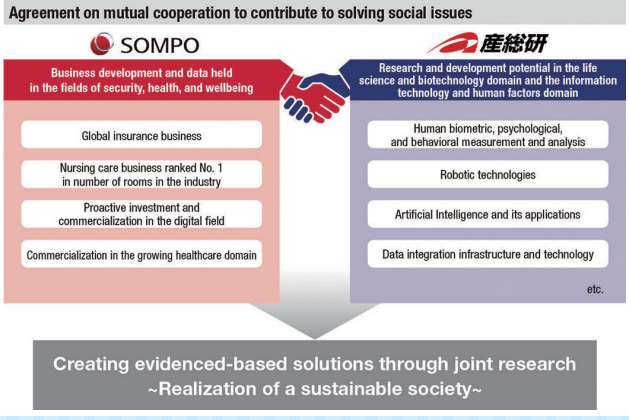


SOMPO-AIST RDP Cooperative Research Laboratory

Director, Cooperative Research Laboratory:KOJIMA Chika

By establishing the RDP Cooperative Research Lab within the department of information technology and human factors, we have been engaged in the research and development towards resolving social issues, including the low birthrate, aging population, and the New Normal.
We have started an initiative that leverages the strengths of both SOMPO Holdings, which owns a nursing care business, and AIST, which conducts a wide variety of research related to nursing care. We are working toward social implementation with the aim of building an ecosystem in which both the elderly and nursing care workers can be involved in the nursing care model and nursing care business with high quality, high efficiency, and high satisfaction.

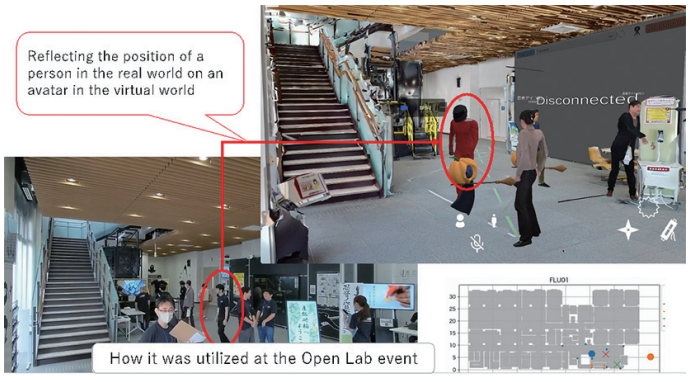
RDP: Real Data Platform



Research and Development of Interverse Technology to Augment Communication

OKUMA Takashi, Ph.D.

The project aims to simultaneously promote the well-being and economic development of people throughout society by creating new communication spaces that deeply connect the real and virtual worlds. In particular, we believe it is important to focus on technologies that extend people's communication and return the value created in the virtual world to the real world.
For example, we will investigate how technology can support activities that provide services in the real world by enabling people who want to work in a comfortable office and people who want to work remotely from the comfort of their homes to work as a team through communication in an office on the interverse.
In this way, by developing technologies to further enrich communication between participants in the space known as the Interverse, which combines the real and virtual worlds, constructing experimental systems that utilize such technologies, and working to resolve ethical, legal, and social issues, we aim to activate the relevant markets and produce socially We aim to produce useful results.

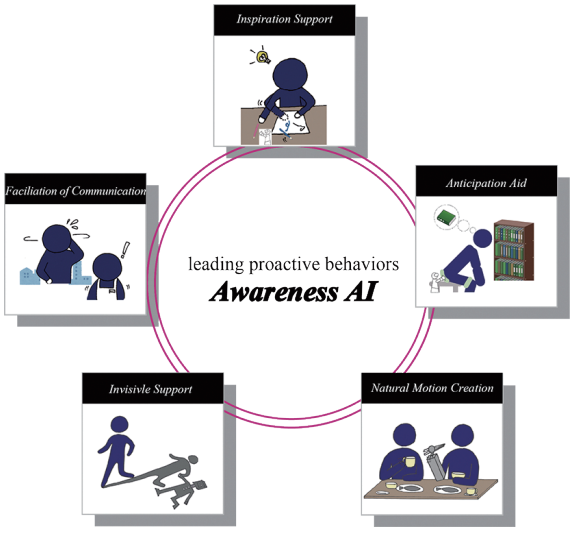


Moonshot R&D Goal 3 R&D Projects

Awareness AI Robot System for leading proactive behavior improvement

Co-Creative Platform Research Team
MURAI Akihiko, Ph.D.

It would be great if we could improve our health in our daily lives without having to go to a gym. Research to date has gradually revealed that various health problems originate in the actions we take in our daily lives. In our moonshot R&D project, we are developing an Awareness AI system that could detect such health problems in our daily lives and provide us with appropriate awareness using robot technology. For example, we dream a future in which a robot can detect the onset of muscle weakness while shopping for dinner at the supermarket, and suggest a menu that provides adequate nutrition for your current physical condition. We aim to implement this system as an unprecedented health diagnosis and intervention system.

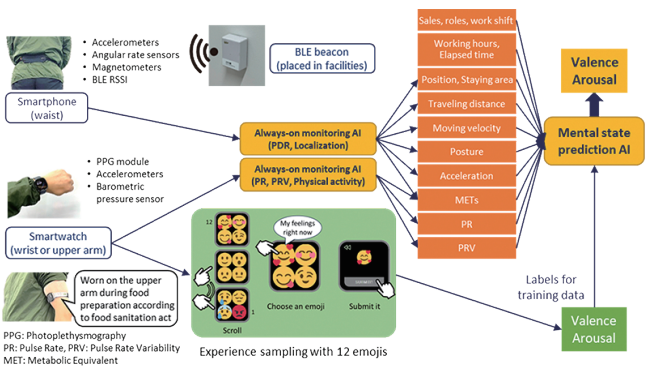


Multisensory XR-AI Technology Platform for Remote Healthcare

KURATA Takeshi, Ph.D.

The main objective of this research is to establish a "multi-sensory XR-AI technology platform" to alleviate spatio-temporal, economic, and cognitive constraints by enabling remote processes of healthcare services. The project is working on precise motion measurement using MR3 wear incorporating high-sensitivity and low-hysteresis strain sensors, remote haptic interaction using MR3 mannequins combined with hanger-reflex devices, self-efficacy enhancement using illusion in VR rehabilitation, reciprocal care to support motivation among multiple users, and prediction of mental state for always-on monitoring. We are conducting research and development for each of the following services: rehabilitation targeting the upper limbs and specific health guidance. In addition, we envision expanding applications to support services for health and productivity management (management that balances productivity and QoW) and human capital management.

This joint research (AIST, Kyoto University, The University of Tokyo, Seiko Epson Corporation, eveRehab, Inc.) is supported by a project, JPNP21004, commissioned by NEDO.



Always-on monitoring: Predicting daily physical and mental status

Human Augmentation Research Center

Organization

Director	MOCHIMARU Masaaki, Ph.D.
Deputy Director	KURATA Takeshi, Ph.D.
Deputy Director	TAKENAKA Takeshi, Ph.D.
Principal Research Manager	OKUMA Takashi, Ph.D.
Career Researcher	USHIJIMA Hirobumi, Dr.

Smart Sensing Research Team
Team Leader ● TAKEI Atsushi, Ph.D.

Well-being Device Research Team
Team Leader ● TAKEI Atsushi, Ph.D.

Assistive Robotics Research Team
Team Leader ● TANAKA Hideyuki, Ph.D.

Exercise Motivation and Physical Function Augmentation Research Team
Team Leader ● KOBAYASHI Yoshiyuki, Ph.D.

Cognition, Environment and Communication Research Team
Team Leader ● UMEMURA Hiroyuki, Ph.D.

Smart Work IoH Research Team
Team Leader ● ICHIKARI Ryosuke, Ph.D.

Service Value Augmentation Research Team
Team Leader ● WATANABE Kentaro, Ph.D.

Co-Creative Platform Research Team
Team Leader ● MURAI Akihiko, Ph.D.

Komatsu-AIST Human Augmentation Cooperative Research Laboratory
Leader, Cooperative Research Laboratory ● TAKAMATSU Nobumasa

Visiting HARC

AIST Kashiwa

c/o Kashiwa II Campus, University of Tokyo, 6-2-3
Kashiwanoha, Kashiwa, Chiba 277-0882 Japan
Phone: +81-4-7132-8861

Satellite Lab.

AIST Tsukuba

1-1-1 Umezono, Tsukuba, Ibaraki 305-8560 Japan

AIST Tsukuba Central 2

1-1-1 Umezono, Tsukuba, Ibaraki 305-8568 Japan

AIST Tsukuba Central 6

1-1-1 Higashi, Tsukuba, Ibaraki 305-8566 Japan

AIST Tokyo Waterfront

2-3-26 Aomi, Koto, Tokyo 135-0064 Japan

KOIL TERRACE

Room 405/406, Chuo 141 Block 1, 226-44 Wakashiba,
Kashiwa, Chiba 277-0871 Japan

URL : https://unit.aist.go.jp/harc/en/index.html
E-MAIL : harc-liaison-ml@aist.go.jp

Consortium

Consortium for Human Locomotion Assessment Technology
(Contact : KOBAYASHI Yoshiyuki)

URL : http://aist.tokyo/chlat/
E-MAIL : chlat-ml@aist.go.jp
TEL : +81-4-7132-8861

Consortium for Servitization of Manufacturing
(Contact : WATANABE Kentaro)

URL : https://unit.aist.go.jp/harc/servitization-conso/consortium_index.html
E-MAIL : conso-servitization-sec-ml@aist.go.jp

FIoT Consortium
(Contact : USHIJIMA Hirobumi)

URL : https://www.ssrc-fiot.jp/
E-MAIL : fiot-official-ml@aist.go.jp

Design Association of Augmented Experience (DAAX)
(Contact : OHYAMA Junji)

URL : https://unit.aist.go.jp/harc/daax/d_cns_index.html
E-MAIL : M-contact-daax-ml@aist.go.jp

2405A