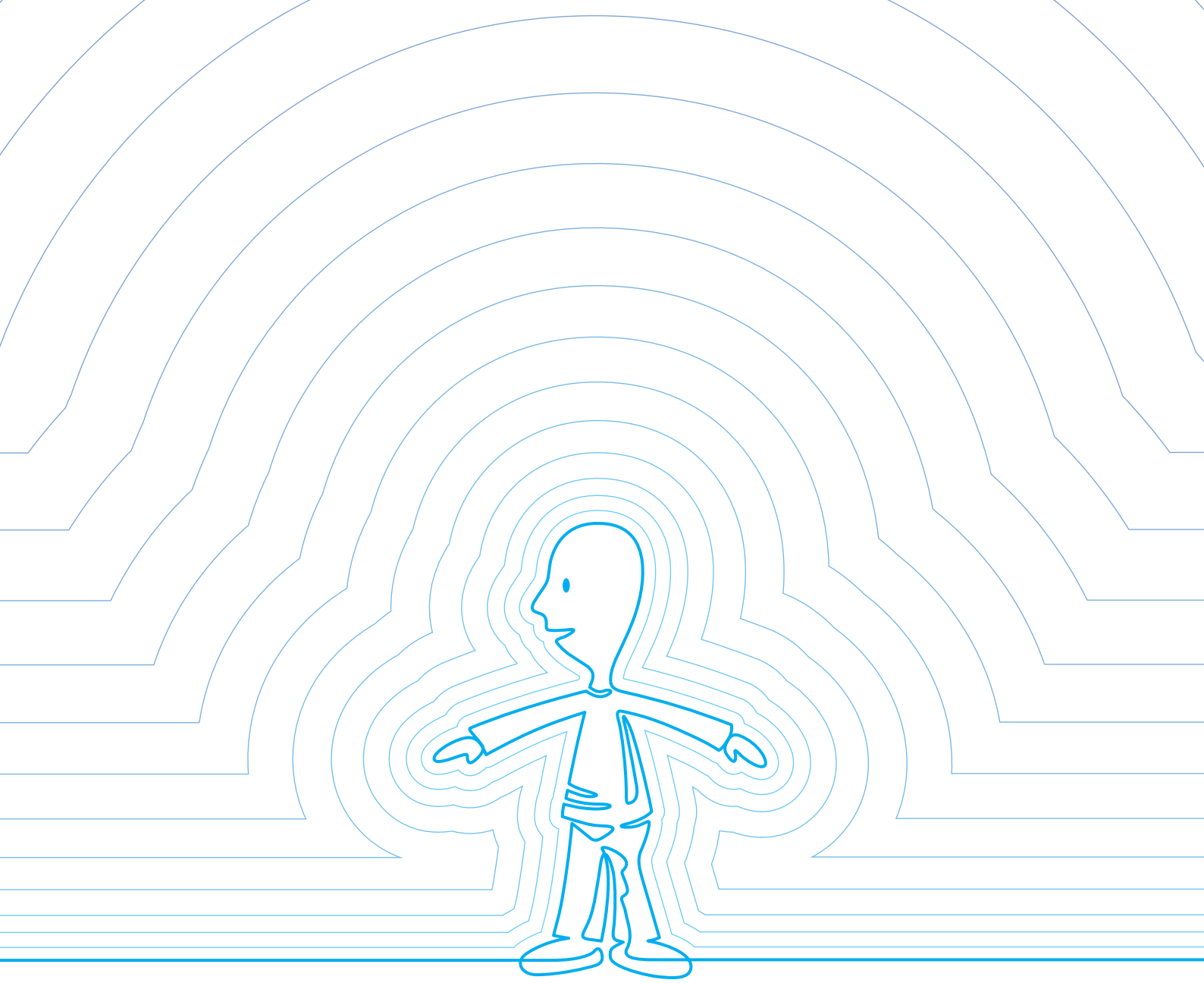


HARC

Human Augmentation Research Center

AIST

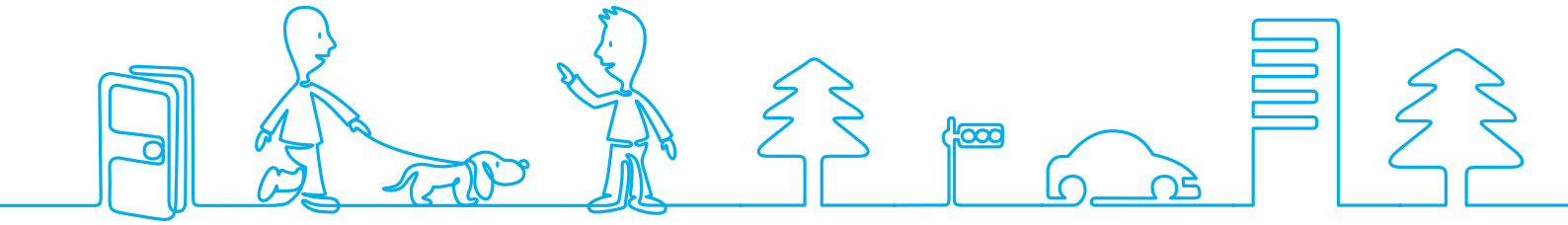
Human augmentation is a system close to human to enable human to live more actively. With a broad sense, microscopes and telescopes are a part of human augmentation technologies, whereas Human Augmentation Research Center (HARC) focuses on a wearable and/or invisible system based on information-communication 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.

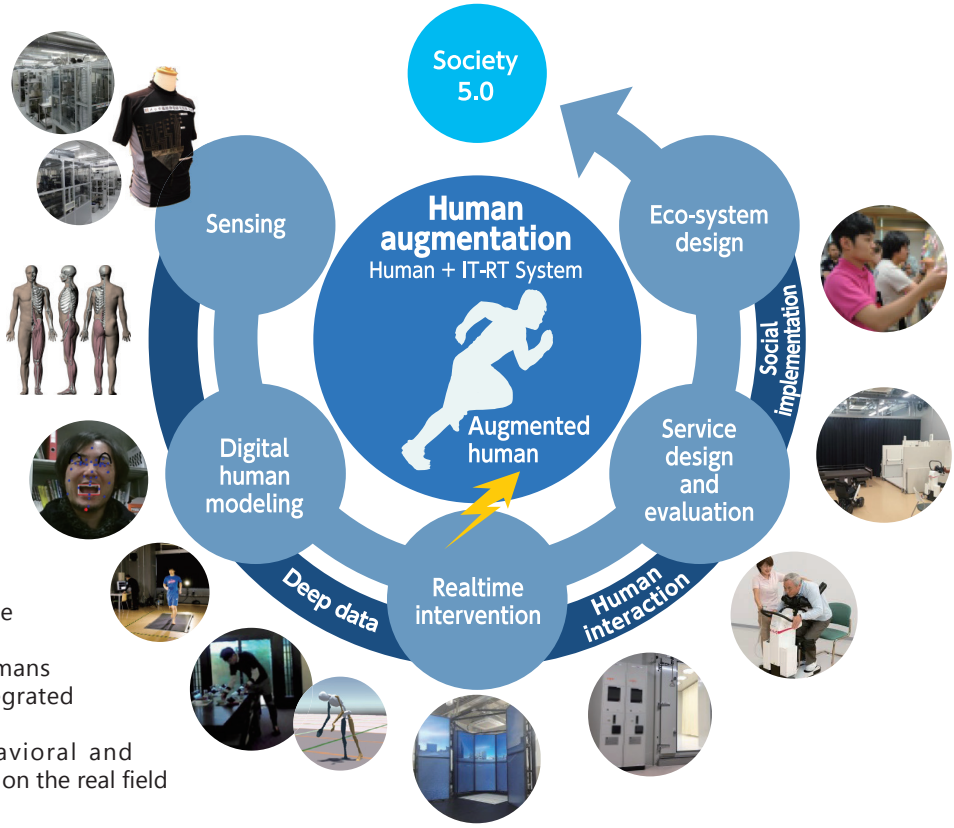
HARC is located at AIST Kashiwa Center (c/o Kashiwa II Campus, University of Tokyo). We cooperate closely with University of Tokyo, Chiba University and National Cancer Center Japan that are located in Kashiwanoha. Here, Kashiwanoha region is a newly developed town including residential areas and shopping 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）

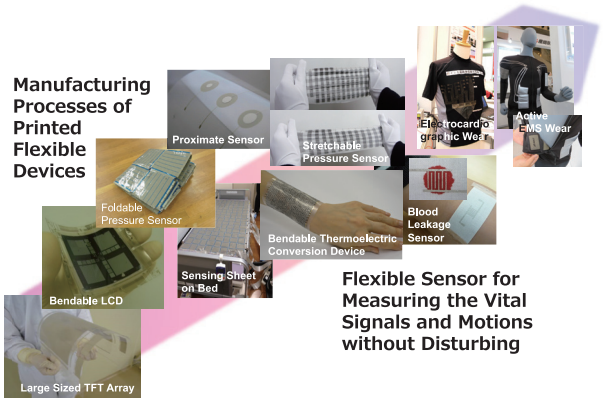
Eco-system design

- 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：KANAZAWA Shusuke, Ph.D.

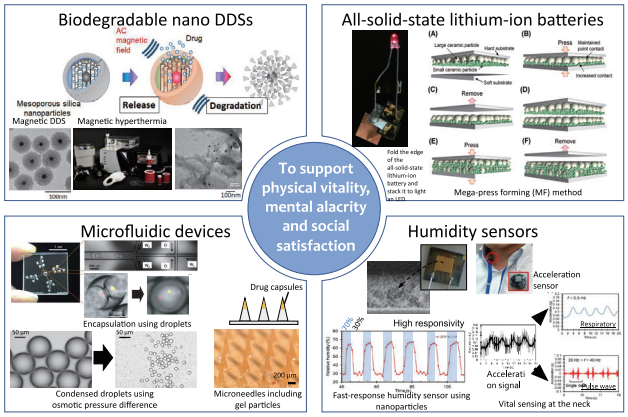
We are developing electronic devices relating to flexible hybrid electronics, which are combined with printed electronics and MEMS, for establishment of human augmentation systems by ambient vital sensing and low loading environmental sensing. Developing the novel input/output devices that the physical and mental stimulation systems work together with multimodal flexible sensing systems on wearable and textile devices, society 5.0 will be realised. To establish smart textiles and wearable devices, utilising functional materials, essentials of high precision printing processes, and design of device fabrication should be investigated.



Well-being Device Research Team

Team Leader：MEKARU Harutaka, Ph.D.

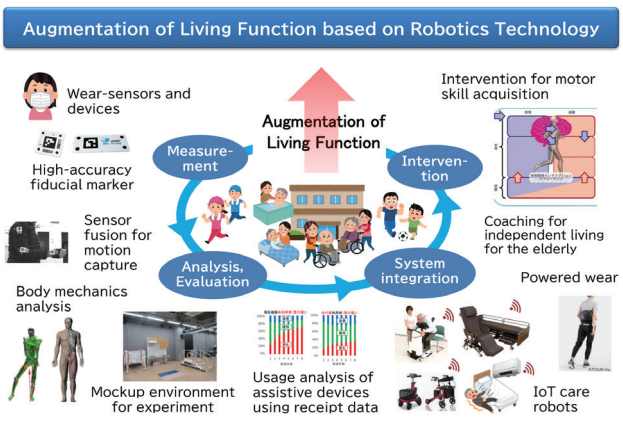
We are engaged in R&D of materials, processes, and devices for medical, health/mental care, chemical and bio applications with the aim of realizing well-being. By combining nanomaterials, press molding, microfluidic, and MEMS technologies, we are promoting high-speed, high-performance micro/nanodevices in the fields of biometrics and precision medicine. Particularly, we aim to realize minimally invasive medical treatment by in-vivo remote control, all-solid-state batteries for wearable and IoT devices, multi-functional microneedles combined with multilayered emulsion, and quick responsive humidity sensors for healthcare monitoring.



Assistive Robotics Research Team

Team Leader：TANAKA Hideyuki, Ph.D.

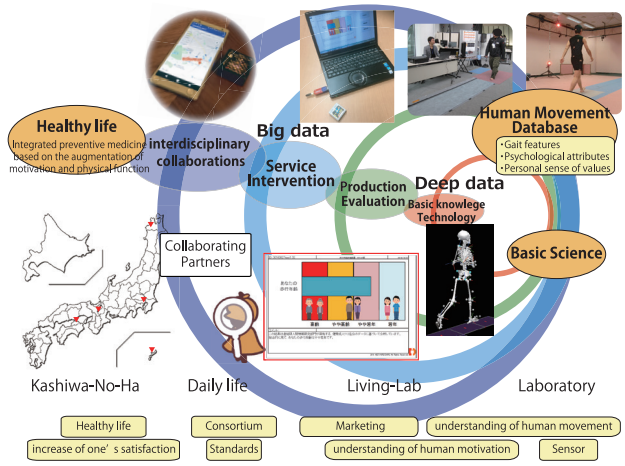
We develop assistive technologies including robots to support people in nursing care, production, and daily life, with the aim of augmenting people's life functions and improving their quality of life. We develop not only elemental technologies such as sensors, measurement, analysis, and intervention, 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.

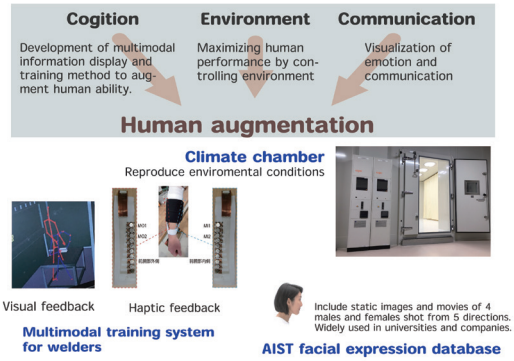
The goal of our research is to maximize one's health through the augmentation of motivation and physical function individualized on the basis of their daily activities and personal values. Our research activities range from the basic science focusing on a better understanding of human movement and psychological 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.

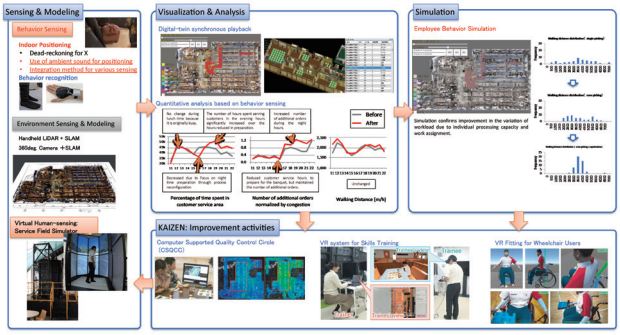
Cognition, Environment and Communication Research Team aims to augment not only abilities of individuals, such as perception or recognition, but also abilities required to communicate and cooperate with others. For the purpose, we are conducting research for understanding the process of human cognition, 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：OKUMA Takashi, Ph.D.

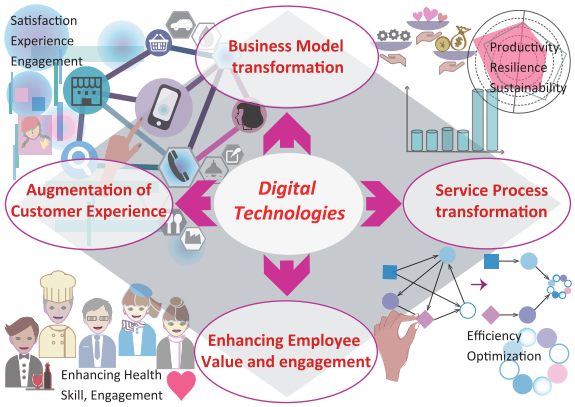
We are conducting research and development of human augmentation technology with the aim of enhancing the skills and motivation of people who are engaged in "work," an activity that contributes to the company where they work and the local community where they live, with a sense of fulfillment and purpose 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 corroborative research with private companies, we are promoting on action research which applies these technologies to actual fields.



Service Value Augmentation Research Team

Team Leader：WATANABE Kentaro, Ph.D.

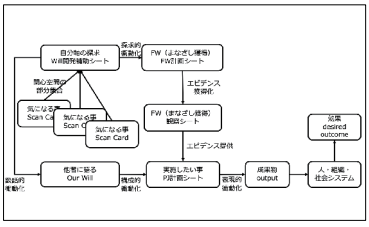
Service Engineering aims to realize service ecosystem through observation, analysis, design, and application of services based on actual data. The value of service should be evaluated from various perspectives, such as quality, customer satisfaction, employee satisfaction, efficiency, profitability, 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.

Our purpose is to co-creative a society where more people can improve creativity and can demonstrate diverse abilities. We are challenging the design of interaction platform that co- creates, research on measurement, intervention, mind and behavior change and evaluation method. By action research, we are developing curriculum of post-design thinking education (AIST Design School) and a citizen-participatory research and development.



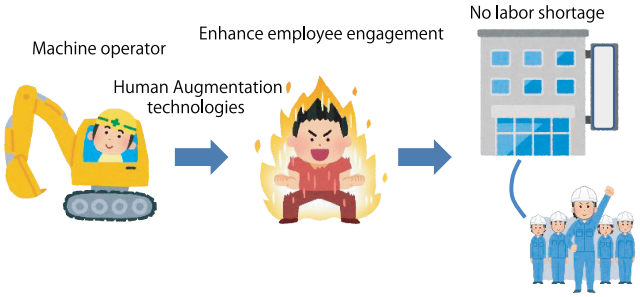
curriculum of post-design thinking education

design workshop

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.

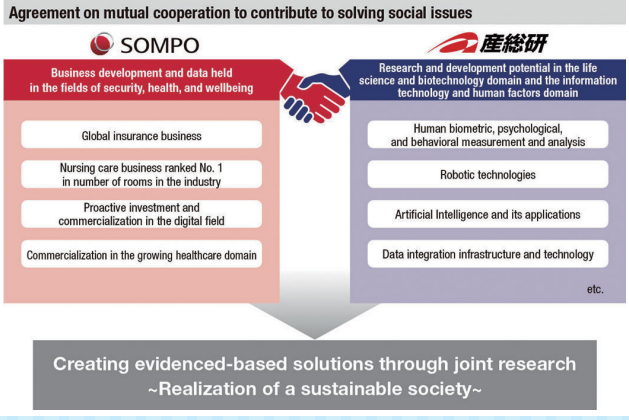


SOMPO-AIST RDP Cooperative Research Laboratory

Director, Cooperative Research Laboratory:IRITANI Hiroyuki

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.

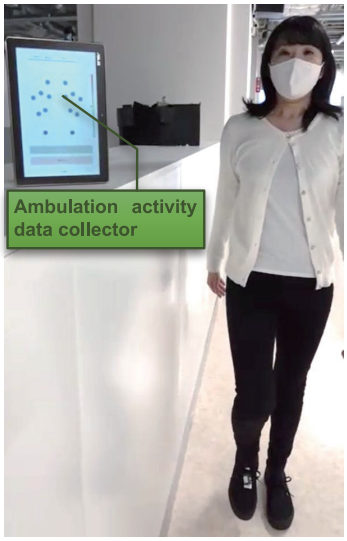
RDP: Real Data Platform



Plantar pressure measuring devices powered by all-solid-state batteries for wearable

SUZUKI Muneyasu, Ph.D. and NAKAJIMA Kanako, Ph.D.

Demand for plantar pressure measuring devices has increased with the rise in popularity of wearables because impairment of ambulation leads not only to fall accidents in the elderly people but also to arthritis disorders such as backaches induced by hallux valgus, calluses, or ingrown nails. Designing as a small and lightweight device to have comfortable daily lives refuses to mount a high-capacity lithium-ion battery and allows us not to collect sufficient data. We used our novel all-solid-state batteries of almost any shape beyond hazard, which discharge even if they were folded, cut, pushed, or hit, to prototype an insole device integrating pressure sensors, a wireless communication device and the battery in order to improve overall usability.



Developing VR-based Service Skills Training System for Restaurant

Smart-work IoH Research Team
OTSUKI Mai, Ph.D.

We are developing a system for the restaurant service, which is forecasted to face a serious labor shortage. Waitrons need to quickly notice and prioritize tasks that occur here and there in the restaurant. In conventional on-the-job training (OJT), instructors difficult to understand trainees' decision-making process. In VR, trainees can repeatedly experience various scenarios, and all situations can be recorded. Instructors can review them from various angles, and trainees can reflect on his/her own behavior. Moreover, using the various data from the training, we are studying quantitative evaluation methods for customer service.

Collaboration with citizens

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

HARC collaborates with local citizens to explore desirable approaches for research and implementation of human augmentation. One of our activities is the "citizen advisor" program as a citizen-researcher collaboration scheme to consider local issues and potentials of emerging technologies. In this program, we organize virtual gatherings to share challenges on daily life and work under COVID-19 and to receive feedback on our research activities. Some citizen advisors also participated in a regional event "Yachallenge 2020" which aims to nurture innovation culture. As another activity, we are developing a virtual lab tour program with an avatar robot in collaboration with citizen advisors and Kashiwa-no-ha high school.

Human Augmentation Research Center

Organization

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

Smart Sensing Research Team
Team Leader ● KANAZAWA Shusuke, Ph.D.

Well-being Device Research Team
Team Leader ● MEKARU Harutaka, 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 ● OKUMA Takashi, 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

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Consortium

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FIoT Consortium
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Design Association of Augmented Experience (DAAX)
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