Research area in Strategic Objective

・*Technology infrastructure for the post-COVID society built by "Convergence of Knowledge"*

・*Information carriers and innovative devices*

・*Fundamental technologies for next-generation IoT (Internet of Things) to create a future smart society*

・*Creation of innovative core technologies by merging material technology, device technology, and nano-system optimization technology toward the realization of information devices with ultra-low power consumption and multiple functions*

・*Advanced interaction technologies within networked intelligent information environment*

・*Elucidation of basic principles for innovative energy conversion, and synthesis of new materials, development of new energy harvesting devices, and other core technologies, that will contribute to the high-efficiency conversion of ambient microenergy into electricity and their new advanced applications*

Hardware in Future for Resilience of Real Space

Research Supervisor: Shuji Tanaka

(Professor, Graduate School of Engineering Department of Robotics, Tohoku University)

Overview

"Society 5.0," proposed in the 5th Science and Technology Basic Plan, is a concept that aims to create a sustainable and resilient "human-centered society" via a fusion of cyberspace and real space. It relies on science, technology, and its innovative power to overcome the difficult situations and imminent social problems that we face. A necessitous problem coming up recently is the spread of COVID-19, and it has become necessary to strengthen our abilities to deal with social disturbance caused by infectious diseases and disasters. At the same time, it is urgent for us to realize carbon neutrality. Those situations have request us to upgrade this concept to a resilient "Society 5.x."

As is stated above, "Society 5.0" is to be realized through a fusion of the cyberspace and the real space. In recent years, the focus has been on digital technology and AI technology, and research, development, and the education of researchers and engineers connected to the cyberspace have been enhanced. However, it goes without saying that in order to meet long-term social goals, we need to strengthen research and education related to the real space in the same way. Thus, this research area supports young researchers with advanced and challenging ideas related to real technologies—more specifically, "things" such as hardware, devices, and modules—that will make up the resilient society in the future.

When promoting research, we aim to train researchers who can drive cutting-edge research for the future, and to create wide-ranging human networks that will lead to future collaboration. So, we emphasize the perspective of researcher education and create chances where young researchers from different fields can interact and inspire each other.

Research Supervisor's Policy on Call for Application, Selection, and Management of the Research Area

1. Background

Thanks to the remarkable development of information-processing technology, the cyberspace is expanding even further. On the other hand, we exist in the real space, and it is where the problems that we must address occur, including infectious diseases, disasters, environmental deterioration, and poverty. Therefore, we must develop hardware such as communication devices, human interface input devices and sensors that gather data from the real space, and actuators, controllers and display/output devices that interact with the real space in parallel with the development of information-processing technologies in the cyberspace. Moreover, processers and memories for information processing and energy sources to drive hardware are "things" in the real space, and their production lines also exist in the real space.

These hardware technologies are created through the synthesis of a variety of technologies, including mechanical, control, electric, electronic, chemical, and material technologies. In addition, we must understand the society, especially trends in industry, in order to envisage what kind of hardware to research. The knowledge of economics, humanities and sociology, the law, and other subjects may also be necessary. Therefore, hardware researchers need to learn a wide range of subjects, which is the reason that we aim to develop young researchers with the long-term vision. To accomplish this purpose, it should be important to encourage young researchers to have a concrete image of an excellent and original idea of hardware and to drive their own research to realize their ideas. This kind of research style must be an effective way for young researchers to improve their skills and sense as hardware researchers.

Thus, in this research area of ACT-X, a program that aims to establish individual researchers, we support and mentor young researchers who have concrete ideas relating to hardware and the confidence that the hardware will be necessary for a resilient society in the future, and who have an enthusiasm to realize those ideas with their own hands. We hope that this program will create revolutionary hardware technologies that will become the seeds of future innovation.

2. Direction of the themes called for in this research area

Research themes must be related to “things” in the real space that composes the resilient “Society 5.x” and connect with the cyberspace. In other words, a broad range of hardware is considered, if proponents themselves believe that the hardware will be needed or useful for a resilient society in the future. Among this wide-ranging concept of hardware, we are focused mainly on hardware referred to as devices and modules that have strong connections to the cyberspace, but we also welcome excellent research proposals related to systems, manufacturing technology and materials. Examples of keywords include sensors, actuators, semiconductor devices, biodevices, optical devices, passive devices, display devices, communication devices, and power devices, but eligibility for application is not limited to these keywords. The application of materials (incl. bio-materials) to hardware is also within the scope. On the other hand, research on theoretical physics and analysis of materials or research with a focus of interest on life sciences do not well fit the direction of themes expected in this research area, even though it is related to a “thing.”

We believe that it is important for hardware researchers to have a hands-on experience of “things,” especially when they are young. Therefore, please make plans so that a substantial part of the research does not consist of the design, analysis, control, or use of hardware only. For example, you should reconsider such research plan as you outsource the manufacturing of a key component of hardware, and you just use already-existing hardware. We also welcome research proposals from researchers in fields other than engineering, for example, researchers in art, industrial design, and social science. We are looking forward to receiving research proposals with a mania of manufacturing.

3. Research area management policy

This research area supports and promotes exchange between young researchers in order to form connections between researchers in different fields, which will become important in the future. Additionally, a perceptiveness to know what kind of hardware technologies will be necessary in the world, especially in industry; the ability to envision a path from research to actual use; a sense for functional beauty; and a business sense are all important for hardware researchers. So this ACT-X area will be operated as you can receive advices from industrial design and economic specialists and discuss from many different perspectives.

ACT-X expects that young researchers will boldly carry out their research, and makes allowances for the risk of failure that comes with the outcome of a challenge. On the other hand, the budget scale for individual research projects is limited, so rather than spending a large portion of the budget for equipment purchase, or researching only using your won equipment, you should pursue a higher quality of manufacturing by making effective use of shared facilities in each research institution, Nanotechnology Platform (Material Advanced Research Infrastructure) etc. We believe that by working with their own hands in these shared facilities, researchers will learn a lot from experienced technicians.

As ACT-X is a program that aims to establish individual young researchers, we encourage people to apply for PRESTO if there is a research area for which they can make a proposal, even if they are in the middle of carrying out ACT-X research (if they are selected, they can switch programs via early graduation). In addition, should a researcher gain beneficial outcomes, we will freely give advice so that these can be developed through joint research with a company.

4. Research period and research funds

The call for applications for the 2021 academic year offers a research period of two years and six months. Standard research costs are 1.5–2 million yen per year, a total of 4.5–6 million yen (excluding indirect costs) for a single project. If you need more than a total of 6 million yen for research costs, please state the reason clearly on your application (max. 10 million yen). Although a budget within the above standard was submitted, an additional budget can be considered in case of need by Research Supervisor according to the progress of research.

Those selected will be evaluated on the progress towards their goal two years after their research begins; at this time, any research projects that are expected to lead to even greater results with support for continued research will be given additional aid (around several million yen at most) for a maximum of one year as an acceleration phase. Approximately 20–30 projects will be selected.*

*It is possible that the number of selected projects will change according to budget status and the research budget of said projects, among other issues.

5. Points to note when applying

The resilient “Society 5.x” has the broad target of hardware that exists in the real space and is connected to the cyberspace. Please express your proposed or targeted hardware as specifically as possible, and explain its usefulness, novelty, and its challenging point persuasively. In conjunction with such explanation, please clearly state how you are planning to manufacture it. Additionally, please thoroughly assert the core of your plan and your strengths to realize this hardware. We expect research proposals from academia, motivated, company-affiliated researchers with visions that will solve problems in industry, and interdisciplinary researchers.