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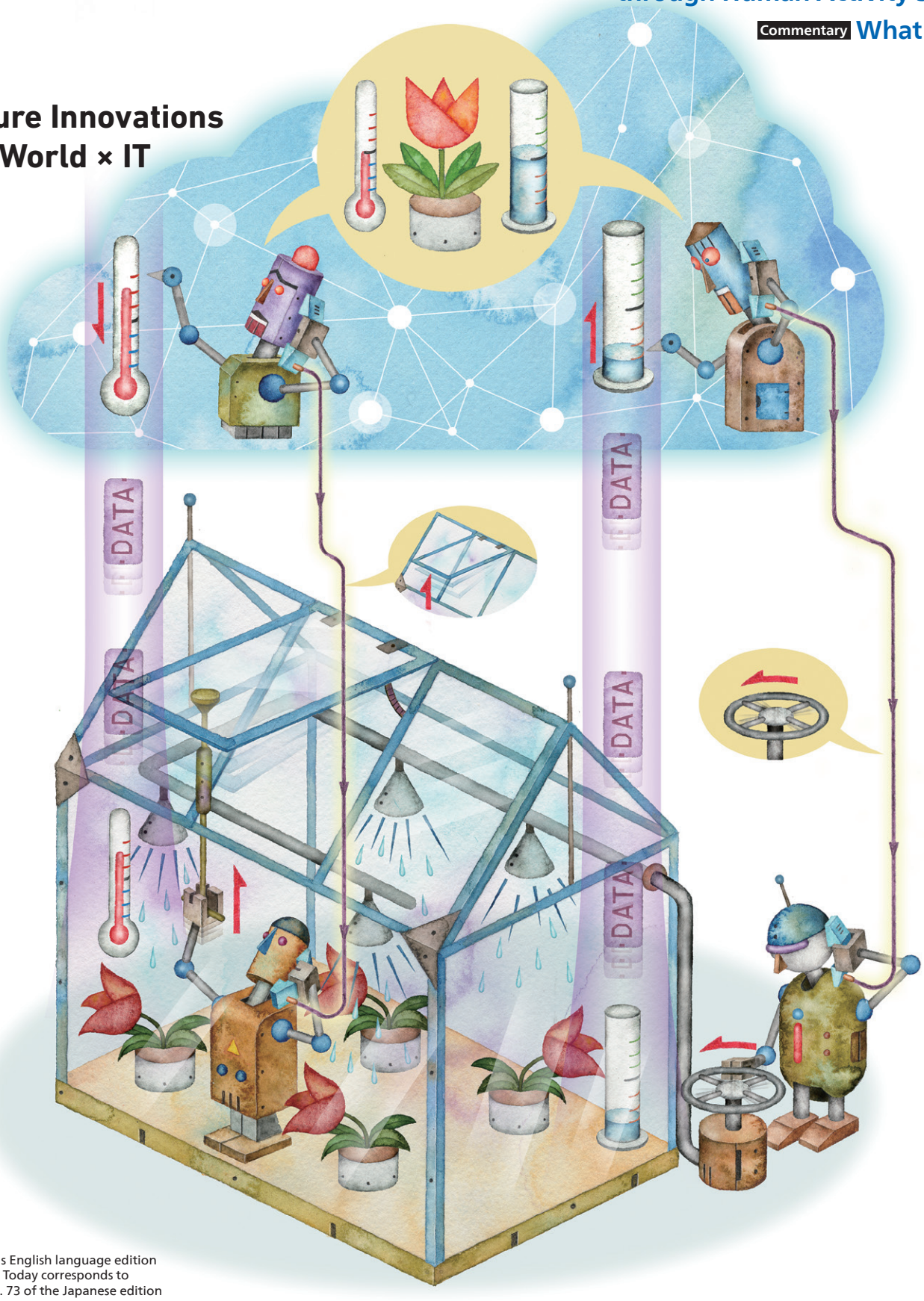

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Aiming for Japan to Build a CPS Platform

Jun Adachi (Deputy Director General, National Institute of Informatics)
Interviewer: Waichi Sekiguchi (Senior Staff Writer, Nikkei Inc.)

The National Institute of Informatics (NII) is working together with Hokkaido University, Osaka University, and Kyushu University on the "Cyber-Physical Integrated IT Infrastructure Project to Optimize Social Systems and Services," a project started for the promotion of R&D for national issues and funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). In particular, this project researches cyber-physical systems (CPS) aimed at resolving a variety of social challenges, such as energy conservation and disaster prevention, by integrating cyberspace and the real (physical) world. Deputy Director General Jun Adachi serves as the project's representative, and I asked him about the results and future outlook of the project.

Jun Adachi

Sekiguchi: CPS is not a very familiar term.
Adachi: It is a term that the U.S. President's Council of Advisors on Science and Technology (PCAST) started using in 2007. It represents the idea of controlling various devices and systems by linking cyberspace and the real world. We carried out a feasibility study about six years ago looking at whether we could make practical use of this idea, and as a result, we obtained a budget from MEXT and this project began five years ago.
Sekiguchi: What kind of work has been done?
Adachi: Hokkaido University, Osaka University, Kyushu University, and NII have collaboratively carried out several demonstration experiments. At Hokkaido University, researchers collected a variety of data from sensors and drive recorders that they attached to cars, and by combining these data with traffic and weather information, they investigated the causes of traffic congestion due to snow in the city of Sapporo and researched snow clearing measures. At Osaka University and Kyushu University, researchers used sensors to detect people's movements and carried out experiments to determine what could be done to optimize energy consumption inside a building or on a university campus.
Sekiguchi: What kinds of results have been obtained?
Adachi: In the case of the snow clearing experiment, the researchers found that traffic congestion was caused by roads becoming narrowed by the collapse of walls of snow stacked up along the sides. The key point of CPS is that by visualizing and simulating circumstances based on data, we are able to take immediate measures as events are occurring. Our experiments study issues involving people and society, and so we decided to call the systems "social CPS".
Sekiguchi: How will the experimental results be used?
Adachi: The aim of the research supported by MEXT was to build a platform capable of addressing social challenges using data. In terms of practical use, the city of Sapporo has shown an interest in the possibility of putting the snow clearing results to use in real public services.
Sekiguchi: What is the reason for the success of the demonstration experiments?
Adachi: The main reason is the availability

of diverse data resulting from technological innovations that have happened during the past five years—smartphones, for example. A variety of data can be obtained instantaneously from mobile devices, such as postings to social media and images or videos taken using the device's camera. In this context, there are two approaches in CPS research. One approach attempts to build new sensors capable of collecting data even more successfully. The second approach examines how the diverse information that we are currently able to acquire can be combined and fed back to solve problems. Our approach has been the latter of the two.

Sekiguchi: How is CPS research being conducted overseas?

Adachi: One example of application of CPS in the industrial sector is Industrie 4.0, an initiative promoted by the German government that aims to revolutionize the manufacturing industry. In the United States, demonstration experiments are being carried out at universities, such as the University of California, with an initiative taken by the National Science Foundation (NSF), but startup companies are playing an important role in applying the results in society. Recently, artificial intelligence (AI), the Internet of Things (IoT), and big data are hot topics, but these technologies are also closely connected to CPS. The IoT focuses on connecting devices using the Internet. The concept of big data is similar to CPS in that it involves processing and making use of data, but the point of CPS is processing and feeding back data obtained from the real world.

Sekiguchi: Research on AI, IoT, and big data is being promoted through programs such as the Cross-Ministerial Strategic Innovation Promotion Program (SIP) of the Cabinet Office's Council for Science, Technology and Innovation.

Adachi: SIP is attempting to find solutions regarding specific topics, such as operation and maintenance of social infrastructure and disaster prevention. The aim of our project is to provide a platform for analyzing and processing data for SIP. In fact, our team is involved in the analysis of data on bridge deterioration and so on carried out by SIP.

Sekiguchi: Are there any new challenges?

Adachi: I mentioned that technological innovations such as smartphones have been useful in the research; however, new challenges have become apparent regarding data collection. As users have become proficient in using the new technologies, they have become sensitive about privacy protection and security measures. Social media, such as Twitter, constitute a valuable source of information, but more people are removing their positional data when transmitting information. Sensing, such as facial recognition, is also gradually becoming more difficult. We employed drive recorders in the snow clearing experiment because we were aware of the limitations of collecting data from smartphones alone.

Sekiguchi: Judgment is also required when analyzing data, isn't it?

Adachi: Yes, that's right. Making new discoveries from data requires the ability to carry out modeling, and logical thinking and a background in IT are essential for this. Unfortunately, there is a shortage of people with these capabilities in Japan, and the development of suitable personnel is an urgent issue. The education system and social trends are also factors causing this shortage of human resources. Progressing to graduate school and taking a doctoral degree does not necessarily result in significantly higher earnings. A tendency for students to avoid the sciences begins at the stage of elementary and secondary education, and this has to change.

Sekiguchi: That's also why the number of startup companies in Japan is small, isn't it?

Adachi: Yes. People who are capable of making new discoveries and commercializing them are people who are able to think in an original way. They are people who devote themselves to what they are interested in without worrying about anyone around them, but it is difficult for people like that in Japan. This is where Japan differs from the U.S. and other countries. Therefore, I think research institutes must try to promote strong-minded, independent people whenever possible, and to take on people who are different.

Sekiguchi: Utilizing data also requires information linking and cooperation with private-sector companies, doesn't it?

Adachi: In Japan, the flow of people in industry–academia collaborations is in one direction, from private-sector companies to universities, and greater exchange of human resources is necessary. If private money and data were available, it would be possible to produce new research results. CPS research, in particular, deals with events in the real world, and so researchers must get out into the real world more.

Sekiguchi: How do you intend to build on your results?

Adachi: I think that the shape of the platform required for CPS is fairly complete, but in the time that remains, I would like us to further improve the level of completion. I want it to become a platform that can be applied to projects like the government's SIP and used by private-sector companies as well.

(Photography by Mariko Tosa)

A Word from the Interviewer

Most people will not grasp the meaning of CPS from the initials only. However, the Ministry of Economy, Trade and Industry (METI) in Japan is committed to popularizing CPS. This is because integrating cyberspace with the real world could increase the efficiency of R&D, demonstration experiments, and so on, and improve Japan's industrial competitiveness.

Digitization of manufacturing industries is progressing in the West with initiatives such as Industrie 4.0 in Germany and the Industrial Internet in the United States. In Japan's manufacturing industry too, digitization is a topic that cannot be avoided.

The U.S. company General Electric (GE) has built a cloud-based data analysis platform called Predix for this purpose and is inviting other companies to use the platform. In this context, there is a need to establish a platform for utilizing information beyond organizational walls in Japan as well.

Waichi Sekiguchi

Graduated from the Faculty of Law, Hitotsubashi University, in 1982 and joined Nikkei Inc. in the same year. Fulbright Fellow at Harvard University in 1988. Chief reporter for the English-language edition of the Nikkei in 1989. Washington correspondent in 1990–1994. After working as chief reporter covering electronics in the Industry Division, became a senior staff writer in 1996. Editorial writer for 15 years from 2000, primarily covering telecommunications. Visiting professor at three universities: Hosei University Graduate School since 2006, the Center for Global Communications (GLOCOM) at the International University of Japan since 2008, and the University of Tokyo Graduate School since 2015. Served as a news commentator for NHK World 2009–2012. Also works as a part-time instructor at Waseda University and Meiji University, and as a member of the Expert Panel on Evaluation of the Cabinet Office's Council for Science, Technology and Innovation. He has written books titled *Pioneers of the Personal Computer Industry* and *Savvy Search Techniques,* and co-authored *ICT Policies for the Emerging Information Society.*

Hokkaido University

Smart Snow Clearing Using CPS

Collecting information in real time from public transport and private cars

Yuzuru Tanaka

(Specially Appointed Professor, Graduate School of Information Science and Technology, Hokkaido University/Visiting Professor, National Institute of Informatics)

Hokkaido University is engaged in a project to use and verify the effectiveness of CPS platform technology in improving the efficiency and optimization of snow clearing in the city of Sapporo. We asked Professor Yuzuru Tanaka of the Graduate School of Information Science and Technology, Hokkaido University, about the aims of the research, difficulties associated with data collection, results obtained from the data, and the direction of future developments.

"An attempt to build a platform for various services provided at city level. A kind of 'operating system' for the city." This is how Tanaka sees the overall theme of the project—"social CPS". Sapporo was chosen as the site of the demonstration experiment with the aim of helping local communities, and because urban areas in Hokkaido face major problems concerning snow clearing.

The annual snowfall in Sapporo is roughly six meters, the highest snowfall of any large city (population greater than one million) in the world. This amount is far greater than the city with the second highest snowfall, which gets about three meters per year. "During winter, it is as though a minor disaster occurs every day."

The city of Sapporo allocates an annual budget of 15 billion yen just for snow clearing. Several years ago, when there was especially heavy snow, this cost ballooned to 22 billion yen. The aim of this project is to improve, optimize, and reduce the cost of this snow clearing work using social CPS.

The goal of snow clearing is to maintain without significantly decrease the socio-economic activities of the city when there is snowfall. Therefore, Tanaka decided to take minimization of influence on movement of cars, which is important for socio-economic activity, as an indicator when investigating the optimization of snow clearing work. The first stage involved creating a system capable of determining when the authorities should dispatch snow clearing vehicles based on evidence, rather than uniformly applying a standard or relying on the experience and intuition of city staff.

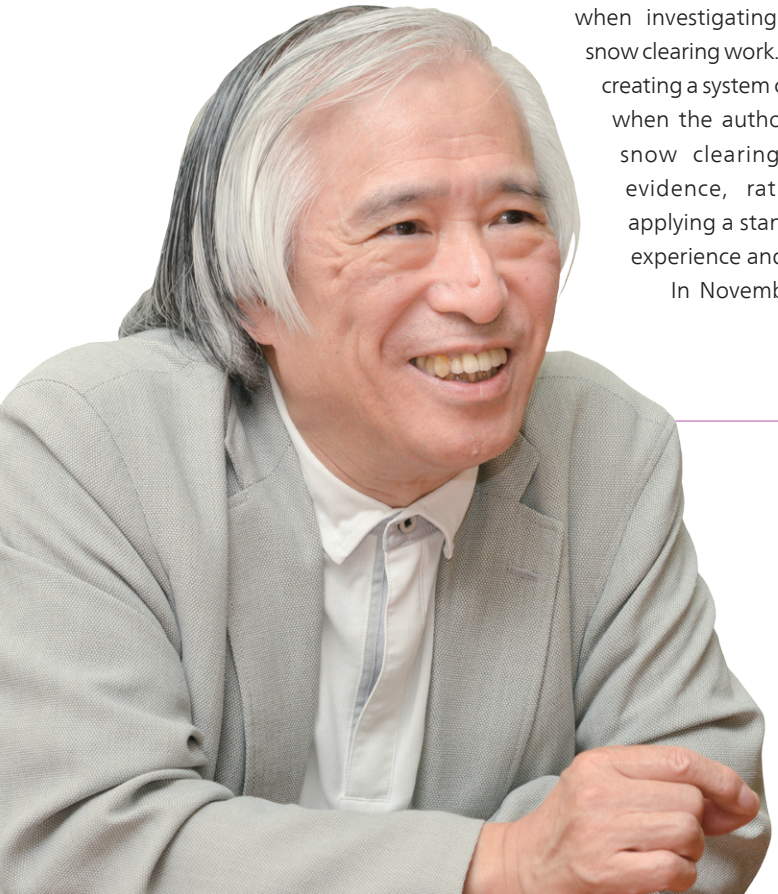
In November of last year, when heavy snow fell on Sapporo, the city authorities made the judgment that snow melts quickly at that time of year, and so decided against sending out the snowplows. However, for the first time in 62 years, more than 40 cm of snow fell in November. Civic life was disrupted, with bus services canceled and roads brought to a standstill, and the city authorities received many complaints.

"By combining historical and realtime data on weather, road conditions, and traffic flows, rather than relying on experience or intuition, it is possible to make decisions on a more quantitative basis. If we can reduce the inefficient dispatch of vehicles, it will lead to cost savings," says Tanaka.

Collecting weather and traffic data

Tanaka's team collects a wide range of data. This is because the data required differ according to the objective. "For example, when predicting the freezing of road surfaces, weather data such as change in air temperature from the previous day and the date of the most recent snow clearing are important."

Therefore, in collecting weather-related data, as well as the Japan Meteorological Agency's mesh information, the team uses



Yuzuru Tanaka

Completed a master's course in the Department of Electronic Science and Engineering, Kyoto University in 1974, and went on to receive his Doctor of Engineering degree in 1985 from the University of Tokyo. Before his present post, worked as a professor in the Department of Electrical Engineering, Hokkaido University; professor at the Graduate School of Information Science and Technology, Hokkaido University; director of the Meme Media Laboratory, Hokkaido University; and adjunct professor at the Graduate School of Informatics, Kyoto University. Visiting professor at the National Institute of Informatics since 2004. Research areas include database theory, database machines, and knowledge media.

weather sensor information (air temperature, humidity, atmospheric pressure, rainfall, etc.) and X-band MP radar data that capture rainfall and snowfall in real time.

With regard to traffic conditions, historical probe car data (data acquired from a traveling car fitted with sensors) for private cars were provided by a private-sector company. These include data on average speeds for each road and location where an anti-lock braking system (ABS) was activated. In addition, statistically processed, realtime driving data at five-minute intervals are provided by two taxi companies using Fujitsu's location data service SPATIOWL.

Traffic accident data for the past ten years were obtained from the Hokkaido Prefectural Police. Data including subway boarding/alighting records and complaints concerning snow clearing were also obtained.

The quality and quantity of the data that can be collected will determine the success or failure of this demonstration experiment. Therefore, Tanaka visited the city authorities, the Hokkaido Prefectural Police, and private-sector companies himself to request the provision of data.

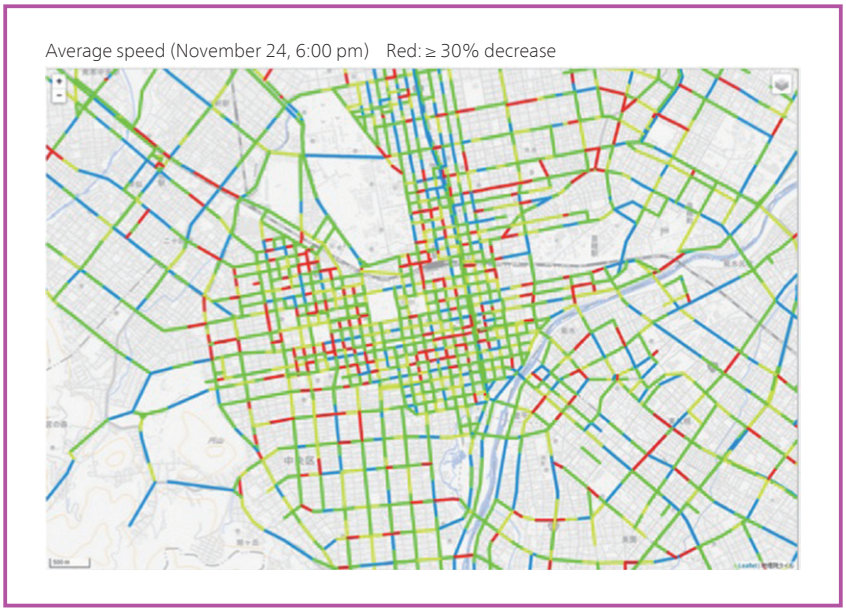


Figure1 **Rate of change from annual average at same time and day of the week on each road link**

Figure2 **Acquisition of 3D image of road periphery using laser range scanner mounted on a Chuo bus**

Collecting movement history using smartphone app

In addition, the research team has collected data unique to this project. First, smartphones equipped with an application that collects positional data were installed on 23 fixed-route buses in Sapporo to acquire information about Sapporo's public transportation. A laser range scanner was mounted onto the front of one of these buses in order to assess how narrow the roads were becoming due to snow. The scanner acquires the state of the snow on the road surface and on both sides of the road as 3D data.

"Snow clearing to widen roads is done using a snow blower to scrape up the tails of piles of snow at the sides of the roads and stack it on top. However, the snow stacked on the top of the pile will gradually collapse and fall to the bottom again, so this work must be repeated. In this regard, the 3D data are useful for improving the efficiency of the snow clearing."

Also, a crowdsourcing initiative to capture road conditions using surfaces rather than points was started this year. This initiative has made a drive recorder app developed by another project publicly available, and is making use of it to collect movement history data from citizen drivers with their consent.

When dealing with such varied data, the quality and format of the data also vary. Tanaka says, "Curation work such as processing, sorting, and piecing together the collected data is a lot of work."

For example, the probe car data on private cars and taxis provided by a private-sector company consist of statistical values showing average speeds on each road link. However, the data collected from citizen drivers via the app show the trajectories of each individual car. Because the formats of the data are completely different, the data have to be processed and consolidated according to the intended use.

Predicting snow clearing results

By analyzing these historical and realtime data, researchers became able to extract how much traffic flow was improved as a result of snow clearing the previous year. The city of Sapporo recognizes the technology as "a system for visualizing the results of snow clearing".

Tanaka intends to work on developing a more sophisticated analysis that will analyze the urgency of snow clearing and make it possible to dispatch snow clearing vehicles with priority given to, for example, places that affect regular bus service and places that tend to become traffic bottlenecks. Tanaka also wants to develop a function that can predict what will happen if certain actions are taken. Based on the real data obtained in last season's experiments, he hopes to develop this function in time for next winter.

(Interview/Report by Naoki Asakawa.
Photography by Yusuke Sato.)

Osaka University

Sensing Crowds Inside Buildings

Towards "human-centric" energy efficiency

Teruo Higashino

(Professor, Graduate School of Information Science and Technology,
Osaka University/Visiting Professor, National Institute of Informatics)

Osaka University is working on a project called "Human-Centric Energy Efficiency," which is attempting to increase the efficiency of energy use in buildings and commercial facilities and improve services by sensing people's movements. We asked Professor Teruo Higashino of the Graduate School of Information Science and Technology, Osaka University, about the project's efforts, as well as its results, challenges, and future prospects.

Office buildings and large commercial facilities consume large amounts of energy for ventilation and air conditioning. Thirty percent of the energy consumed by underground shopping centers is used for ventilation. This is because insufficient exhaust ventilation would result in increased concentration of the carbon dioxide that people exhale.

Building energy management systems (BEMS) have been attempted in the past to control air conditioning based on information from temperature sensors. However, there had been few means of accurately identifying the movements of the sources of heat and carbon dioxide emissions—people—and this had tended to result in wasted energy, for example, air conditioning running full blast in places where there are no people.

If "crowdsensing" measuring the numbers and movements of people were possible, it would be easy to improve ventilation efficiency by increasing ventilation when there were many people and reducing it when there were few people. This is the human-centric energy use efficiency devised by Higashino. "If we can implement crowdsensing, it will lead not only to better energy efficiency but also to improvements in services and disaster response, such as evacuation guidance after an earthquake," says Higashino.

Higashino is conducting a crowdsensing experiment at Grand Front Osaka, a shopping complex in Kita Ward, Osaka City, that opened in April 2013. The experiment primarily uses laser range scanners to track people's movements. With a detection angle of 270°, a detection distance of 30 m, and a measurement error of just several centimeters, these scanners are capable of tracing people's movements accurately.

Installing cameras is one method of capturing the flow of people. However, Higashino says, "Cameras are avoided in public spaces, so it is necessary to reduce energy using inconspicuous, low-cost sensors."

His aim is not just to improve energy use efficiency. His team has also installed several laser range scanners in a large office. In addition to optimizing the air conditioning, the scanners will allow them to understand how people move and communicate in a large office. They will also be able to capture actions such as entering the large office's conference room or heading towards the eating space.

Operators of large offices will be able to use these data to improve services by, for example, changing the office layout to encourage communication between users. "Improved energy use efficiency alone is not a big enough benefit for building owners or tenants. The technology will only be implemented in the real world if it provides added value useful for business."

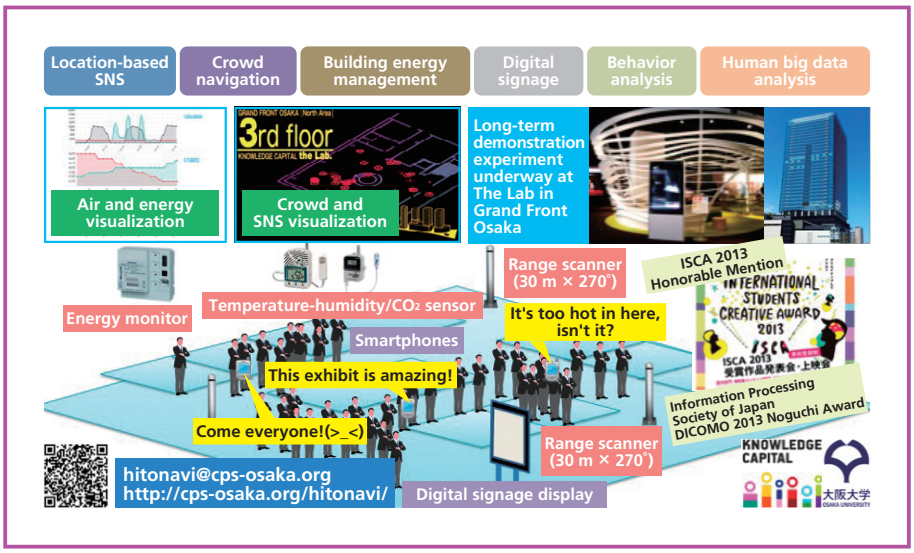


Figure1 HITONAVI (Advanced crowd tracking system using LRS)

Measuring congestion using smartphone sensors

Laser range scanners are not Higashino's only weapon. The smartphones that people carry around with them can also be powerful tools in crowdsensing, as they are equipped with multiple sensors. Higashino is conducting an experiment to estimate the level of congestion inside a building using smartphones.

When walking in a crowd, people slow down and they move left and right to avoid other people. By capturing this kind of movement using acceleration sensors in

smartphones, it is possible to estimate the level of congestion of a place.

Microphones are also useful for estimating levels of congestion. "The sounds created by a crowd, such as footsteps, are low-frequency sounds—2,000 Hz or below—and can be captured by microphones." By combining data from microphones and acceleration sensors, Higashino and his team can assess congestion level with an accuracy of 90% or better.

If the level of congestion measured using smartphones can be combined with smartphone positional information, it becomes possible to map congestion level distribution. GPS cannot be used indoors, but using information from Wi-Fi access points inside buildings, the positions of smartphones can be calculated with an accuracy of several meters. As long as most customers use the smartphone app, the state of congestion inside the building can be captured in real time.

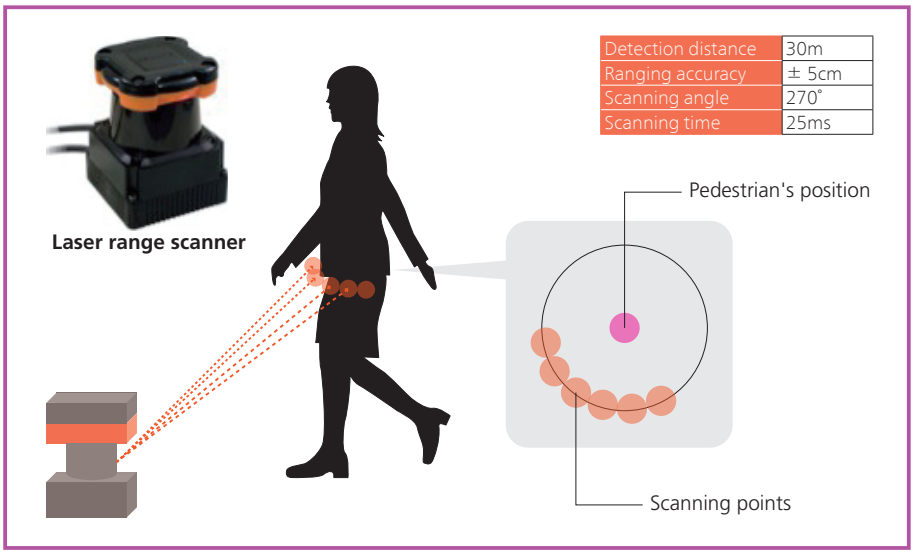


Figure2 Laser range scanner
Detects objects that have human shape and movement from laser beams reflected off pedestrians' bodies.

Combining lasers and smartphones

Furthermore, when position estimating technology using smartphones is combined with information from laser range scanners, it is possible to analyze the behavior of people on each floor in more detail.

For example, suppose that visitors to a showroom posted their impressions using a dedicated app. By using laser range scanners to track visitors and verify information on when they turned and when they stopped obtained from acceleration sensors and their approximate positions obtained from Wi-Fi access points, it would be possible to understand with a high degree of accuracy how the owners of the smartphones who posted messages moved within the showroom. "We would be able to estimate, for example, which booths they stopped at, what areas of the showroom they were interested in, and where they posted their impressions."

Towards "stickable" sensors

The immediate challenge in implementing crowdsensing in society is cost. A single laser range scanner costs several hundred thousand yen. This project also required the added expense of embedding the scanners inside cylindrical poles when installing them on floors inside the complex to prevent children from playing with them and knocking them over.

Higashino expects that sensors and the computers that control them will become smaller and thinner. "Carbon nanotube film sensors and tiny computers such as Raspberry Pi, for example, did not exist five or six years ago when this project started. With sensors and computers that can be stuck to walls or windows and powered by sunlight or indoor lighting, we will be able to obtain a great deal of information while keeping equipment and installation costs down."

(Interview/Report by Naoki Asakawa. Photography by Yusuke Sato.)

Teruo Higashino

Completed his Ph.D. degree at the Graduate School of Engineering Science, Osaka University in 1984 and remained at Osaka University as a faculty member. Since 2002, Higashino has been leading the Mobile Computing Laboratory, Graduate School of Information Science and Technology, Osaka University. His Research interests include mobile/ubiquitous computing, wireless networks, distributed computing systems, intelligent transport systems (ITS), and cyber-physical systems (CPS).

Kyushu University

Reducing Power Consumption through Human Activity Sensing

Visualization using cameras, IC cards, and smartphones

Rin-ichiro Taniguchi

(Professor, Graduate School of Information Science and Electrical Engineering, Kyushu University/Visiting Professor, National Institute of Informatics)

Kyushu University is conducting a project that monitors human activity, taking as its subjects twenty or so students enrolled in the laboratory of Professor Rin-ichiro Taniguchi, who specializes in computer vision. The project calculates the electricity consumption of individuals based on their activity patterns identified using various sensors and investigates efficient methods of saving power using the data. We asked Taniguchi about the potential of human activity sensing.

Energy saving at the level of the individual

When asked about the reason for starting the project, Taniguchi explains, "We want to examine the extent to which information technology can be useful in saving energy and reducing electricity costs."

There are various approaches to reducing energy consumption, including those that focus on improving the efficiency of energy use of entire towns or of individual building units. Taniguchi is focusing on the smallest possible unit, that of the individual human being.

"I thought that visualizing how small differences in people's daily activity patterns affect power consumption would lead to knowledge that could be used to save energy on the individual level."

Taniguchi combined three different technologies in order to survey the laboratory activities of the twenty or so students chosen as subjects for monitoring. These technologies were image analysis using indoor cameras, entrance and exit control using IC cards, and position estimation using the Wi-Fi feature of smartphones.

First, the project team installed fish-eye cameras on the ceiling of the laboratory, making it possible to track the movements of people in the rooms using image recognition technology. By combining the results of this image analysis with IC card entrance /exit control information, the team can continuously capture a certain person's activities, such as entering the room, sitting in a chair, using a computer, and entering the meeting space. In areas not covered by the cameras, their position is estimated using information from smartphone Wi-Fi access points.

"Privacy would have to be considered when implementing this technology in the real world, but in this research within the university, our aim was to discover the extent to which we could capture the activities of individuals, and measure and reduce their electricity consumption," says Taniguchi.

Smart power outlets capable of measuring electric current were installed in the lab in

Rin-ichiro Taniguchi

Completed a master's course in computer science at the Department of Computer Science and Communication Engineering, Graduate School of Engineering, Kyushu University in 1980, before going on to receive his Doctor of Engineering degree in 1986. After working as an assistant professor at the Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, became a professor at the Graduate School of Information Science and Electrical Engineering, Kyushu University in 1996. Served from 2011 as dean of the Graduate School of Information Science and Electrical Engineering and the Faculty of Information Science and Electrical Engineering (until FY2013), and has served as the director of the Research Institute for Information Technology, Kyushu University since 2014. Engaged in modeling of automatic image/video recognition and understanding, and its implementation using computer systems (computer vision).

order to estimate power consumption associated with people's activities. These outlets are used to measure the power consumption of computers, refrigerators, air conditioning, and personal lighting. Power consumed by computers is counted as the individual user's power consumption, power consumed by refrigerators is divided equally between users, and power consumed by air conditioning is divided proportionally according to time spent in the room.

Taniguchi's team has been able to reliably measure people's activities for the past year. "Capturing people's positions by integrating information from multiple cameras was more difficult than we had imagined," says Taniguchi. In human recognition using cameras, the room is taken as the background, and then the technology determines that there are people in areas that differ from the background. However, the background varies, for example, when the lights are on or off, and also changes greatly when the morning sun comes in through the windows. Incorporating these kinds of room-specific characteristics took a great deal of time. Seamlessly tracking people after identify them with multiple cameras was also difficult.

"The team included experts in sensing technology, networks, visualization, and machine learning, among others, and teamwork enabled the project to move forward."

Reducing peak power by changing behavior

Understanding the ways in which individuals use electricity reveals measures for reducing overall power consumption and costs. Specifically, while it is difficult to control total power consumption, it is comparatively easy to control peak power by, for example, staggering the use of electricity. Reducing peak power could make it possible for society as a whole to decrease its power facilities and allow organizations to cut their costs by changing their electricity plan.

Taniguchi has implemented two steps towards reducing peak power.

The first step involves conveying to individuals information such as, "Your power consumption is the third highest in the laboratory." He considers this to be easier to understand than simply telling them their total power consumption and thinks it could lead to changes in daily habits.

The second step is to have people actually change their daily habits. First, he proposes a shift in activities, such as coming to the lab 30 minutes earlier and leaving 30 minutes earlier, so as to reduce peak power.

However, unreasonable proposals that do not suit people's circumstances are impractical. Therefore, the question of how to design the proposed activities is an important one. For example, "Shifting working times by an hour and a half might be difficult, but 30 minutes may be acceptable."

An important goal of this project is to reduce electricity costs, but if the pursuit of this goal were to lead to a decrease in activities such as studies and research, it would be a case of misplaced priorities.

"Sleeping at home is the most energy saving activity, but that's pointless. The question is how to save power while maintaining our university activities. We expect to produce some results within this academic year, and I'm looking forward to seeing what they show."

With a more detailed understanding of people's patterns of activity and electricity consumption, Taniguchi will be able to make more precise proposals.

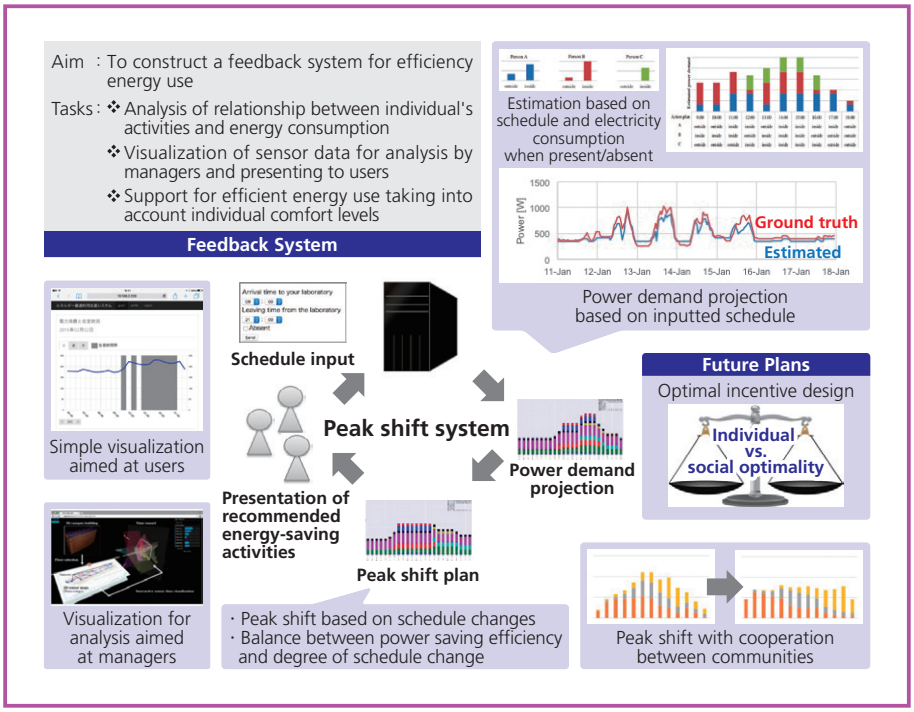


Figure Demonstration experiment of human-centric energy use on university campus

Applying activity sensing to agriculture

Taniguchi intends to continue researching human activity sensing even after the end of this project.

He is now carrying out a concurrent experiment on applying human activity sensing technology to agricultural IT. This technology uses beacon information to identify people's locations and recognizes specific movements such as "harvesting tomatoes with pruning shears" or "pulling out tomato leaves" using acceleration sensors in smartphones. By collecting this kind of data, his team will extract information on growing high-quality produce.

Past agricultural IT trials have required all of the agricultural tasks carried out to be input one by one using a computer or tablet. The ability to obtain activities automatically would significantly lower the hurdles to implementing agricultural IT.

In addition to energy conservation and agriculture, human activity sensing has the potential to be applied in various areas including medical care and nursing. Taniguchi intends to continue to investigate the possibilities it has to offer.

(Interview/Report by Naoki Asakawa. Photography by Yusuke Sato.)

Commentary

What is CPS?

Kazuo Imai (Project Professor, Research Strategy Office, National Institute of Informatics)

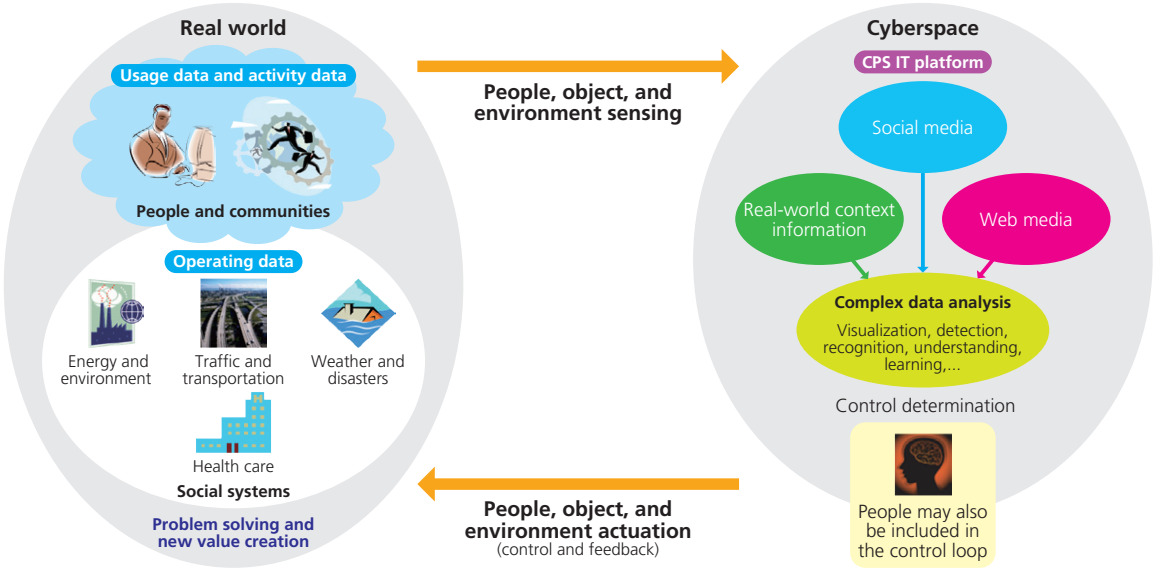


Figure1 **Structure of social CPS**

The concept of cyber-physical systems (CPS) has been discussed by research communities covering such areas as realtime systems, embedded systems, and sensor networks, in the United States and other countries for more than ten years. It materialized as a multidisciplinary research area through workshops by the U.S. National Science Foundation (NSF), and a report by the U.S. President's Council of Advisors on Science and Technology (PCAST) in 2007 proposed that it be addressed as a matter of highest priority in information and communications technology (ICT) research and development.

The basic elements of CPS are sensing (data) and computing (calculation and semantic understanding) with regard to the real world, and actuation (control and feedback) based on that. CPS can be defined as interrelated structures in which the real world (people, things, and environments) and ICT are closely connected and working in cooperation (Figure). CPS deals with the ever-changing real world, and so realtime performance is a particularly important requirement. At the same time, CPS is required to process huge amounts of data in order to handle various types of sensing data from the real world. Therefore, a major challenge is incorporating cloud computing and big data processing (which draws meaning from large amounts of data) without sacrificing realtime performance.

Focusing on the real-world sensing aspect of CPS, there are overlaps with the currently popular concept of the Internet of Things (IoT) and the previously commonly used term "ubiquitous computing". However, these are primarily concerned with the ubiquity of network connectivity for access to and exchange of data, and they should be thought of as slightly different to CPS, which aims to achieve feedback to the real world by analyzing information.

Involving systems that integrate or connect the real world and ICT, CPS is a multidisciplinary research area that extends over many fields, and it could be used in a wide range of applications: for example, automatic driving [transport systems], feeding back required actions from people's vital information using wearable or implanted medical devices [health care], optimizing power supply by sensing electricity consumption of users [energy], and optimizing manufacturing by monitoring operational status of machinery in factories [manufacturing].

NII is involved in the “Cyber-Physical Integrated IT Infrastructure Project to Optimize Social Systems and Services”, together with Hokkaido University, Osaka University, and Kyushu University. This project is conducting technology research on the basic elements of CPS, as well as demonstrating the effectiveness of CPS by working on supporting smart snow clearing in large cities and optimization of energy consumption in university campuses and urban public spaces. To solve these kinds of real-world social problems, not only machines but people as well must be subject to sensing and actuation, while being included in the CPS feedback control loop. Therefore, researchers are working on unique initiatives such as developing systems that navigate human behavior, and conveying the state of snow clearing in real time to support decision-making by the authorities.

News 1

SINET5 Opening Ceremony

The Science Information NETwork (SINET) built and operated by the National Institute of Informatics (NII) was upgraded to SINET5 in April of this year, and a formal opening ceremony was held on May 25. SINET5 provides ultrahigh-speed 100 Gbps lines throughout Japan, as well as a 100 Gbps connection to the US, and provides the first-ever 20 Gbps line between Japan and Europe. With improved reliability and functionality, SINET5 is essential infrastructure for the growth of Japan's academic community.

At the start of the opening ceremony, NII's Director General Masaru Kitsuregawa (top left photo) declared, "Nodes have been placed throughout Japan, and operation of the extremely powerful, full-mesh network has begun." He thanked the academic community for its enormous support in implementing the migration to SINET5. He also said that SINET5 could play an important role in facilitating the introduction of cloud computing and strengthening cybersecurity at universities and research institutions.

Participating in the opening ceremony (bottom photo) were Tsutomu Tomioka, Senior Vice Minister of Education, Culture, Sports, Science and Technology (top right photo), who has jurisdiction over SINET5; representatives of the academic community who supported migration to SINET5; and representatives of the telecommunications carriers who helped to build the network. As well as many heartwarming congratulatory speeches by guests of honor, speeches were made by members of research institutions, both internal and external, who are using SINET5 to carry out cutting-edge research.

Academic Information Infrastructure Open Forum 2016

Starting with the SINET5 Opening Ceremony, the Academic Information Infrastructure Open Forum 2016 was held for three days, ending on May 27. NII's far-reaching vision for future academic information infrastructure includes not only network infrastructure but also security and cloud environments, and academic content distribution platforms. The aim of this forum is to share with relevant parties a concrete image of education and research environments realized using SINET5 through a program covering six fields: network security, GakuNin, repositories, contents, learning analytics, and cloud computing. Sessions in all fields were held concurrently on the second day (May 26). Some of the sessions were so full that extra seating had to be brought in, and there were many enthusiastic lectures and lively discussions on the future of academic information infrastructure. Sessions in four fields were held on the final day as well.

News 2

Open House 2016

NII Open House 2016 was held on May 27 and 28 to inform the wider public about NII's research findings and activities.

Day 1 began with a welcome address and activity report by Director General Masaru Kitsuregawa. He spoke about the significance of SINET5, operation of which began in April, NII's contribution to open science, and NII's desire to boost innovation by providing data infrastructure that makes research data other than articles accessible. Sadaoki Furui, Professor Emeritus at Tokyo Institute of Technology and President of the Toyota Technological Institute at Chicago, gave a keynote speech titled "Prospects and Issues of AI and Autonomous Driving" in which he described the rapid advancement of artificial intelligence (AI) as a result of deep learning. From NII, Professor Hiroki Takakura of the Information Systems Architecture Science Research Division gave a keynote speech that discussed "Security Measures to Mitigate Damage Caused by Sophisticated Cyberattacks." Also held were "The Forefront of Information: Industrial–Government–Academic Exchange Seminar" and "Results Presentation of Grant-in-Aid for Scientific Research on Innovative Areas," which introduced hybrid quantum science—a new field established last fiscal year.

The main feature on Day 2 was “Running Fire of Research Presentation at NII” (top photo). Ten NII researchers had 7.5 minutes each to present 10 items of research—totaling 100 items of research. The lineup was enhanced this time by the inclusion of three veteran professors: Tomohiro Yoneda, Information Systems Architecture Science Research Division; Akihiko Takano, Digital Content and Media Sciences Research Division; and Noriko Kando, Information and Society Research Division. Day 2 was a Saturday, and so there were many activities aimed at young people, from elementary to senior high school students. In a panel session for school children titled "Programming Dojo: World-Changing Coding," three young assistant professors—Takuya Akiba (then, Principles of Informatics Research Division), Kazunori Sakamoto (Information Systems Architecture Science Research Division), and Kanae Tsushima (Information Systems Architecture Science Research Division)—talked about how encountering programming changed their lives and answered questions from children in the audience, chaired by Associate Professor Nobukazu Yoshioka (Information Systems Architecture Science Research Division). Assistant Professor Sakamoto also led the "Fun Programming Course: Let's Make a Teddy Bear Move" for elementary school children (bottom photo), in which children had a go at programming the movements of a teddy bear. In the "Informatics Workshop for Junior and High School Girls," Assistant Professor Tsushima gave guidance on game programming.

There were many visitors to the demo and poster exhibition areas on both days, and visitors were seen engaged in lively discussions with researchers. Guided tours of the poster exhibition were available for the first time, and these were well received, with each tour exceeding its allotted time.

Flash

SPARC Japan Seminar "Roads to Open Access"

Held on September 9. The first SPARC Japan Seminar 2016, an advocacy activity aimed at the development of infrastructure for international distribution of academic information. Following lectures by Shun Tsuchiya of the National Institution for Academic Degrees and Quality Enhancement of Higher Education (NIAD-QE), Koichi Ojiro of University of Tokyo Library System, and Masayuki Shoji of Waseda University Library, discussions were held on how to implement open access and the strategies that Japan should take.

ERATO Festival Season III

Held on August 9 and 10. Presentation of research findings of the JST ERATO Kawarabayashi Large Graph Project (Research Supervisor: Professor Kenichi Kawarabayashi, Principles of Informatics Research Division), which aims to develop high-speed algorithms capable of analyzing networks such as the Internet by regarding them as "large graphs". Announcement of papers accepted by top information-related conferences this year.

News 3 Start of this fiscal year's public lectures

Easy-to-understand explanations of cutting-edge informatics

The FY2016 Public Lectures titled "The Forefront of Informatics" have begun. This is a program of six lectures a year that explain cutting-edge research and topical issues in the field of informatics to the wider public in an easy-to-understand manner.

The first lecture was held on June 22. Assistant Professor Takuya Akiba of the Principles of Informatics Research Division (then) gave a lecture titled "Big Data Analysis of Relationships: The Science and Application of Social Networks," in which he explained graph theory and graph data analysis. Assistant Professor Akiba gave road/transport networks and social networks such as Facebook and Twitter as examples of graph data, and explained that, "Analysis of these data reveals that the distances between people in networks are surprisingly short. The majority of humanity is included within just five levels of your acquaintances' acquaintances' acquaintances..."

The second lecture was held on August 25, and Professor Masahiro Goshima of the Information Systems Architecture Science Research Division gave a lecture titled "How Do Computers Work? Mechanism of Computers—From Smartphones to Super Computers" (photograph). Professor Goshima explained how computers work in a comprehensible way by likening a computer to a restaurant and a program to a recipe. He introduced instruction set architecture such as x86 and ARM for writing commands for hardware by saying, "The chefs in this restaurant cannot cook without looking at a recipe. Therefore, the chefs cannot cook unless the recipe is written in a 'language' that they understand."

The third lecture will be held on October 20 (Thursday), when Assistant Professor Kanae Tsushima of the Information Systems Architecture Science Research Division will give a talk titled "How Can You Easily Write Correct Programs? Program Types and Debugging Techniques." For details and registration, go to the "Public Lectures" page of the National Institute of Informatics' official website (http://www.nii.ac.jp/event/shimin/).

News 4 Now-familiar "voice" interfaces

1st NII Industry–Government–Academia Collaboration Lecture

The 1st NII Industry–Government–Academia Collaboration Prep School of this fiscal year was held on July 11. These are public lectures that provide an opportunity for NII researchers and relevant people in business and local government to exchange ideas about research trends in cutting-edge informatics and to explore the potential for industry–government–academic collaboration.

Under the theme of "Our Now-Familiar Dialogue with Machines: Underlying Technologies and Future Development," Associate Professor Junichi Yamagishi of the Digital Content and Media Sciences Research Division and two researchers from other organizations involved in voice interface research each spoke about their own research.

Associate Professor Yamagishi spoke about speech synthesis technology that uses machine learning to convert text data into an easily understandable voice. He said, "Various speech synthesis methods have been developed, but since around 2010, a great deal of research has been done on speech synthesis based on deep learning, and the quality of synthesized speech has improved dramatically." He demonstrated natural accented speech that had been synthesized based on deep learning. With regard to future research, he expressed his desire to develop speech synthesis technology, saying, "There is still a difference between the naturalness of the human voice and that of the synthetic voice, but some synthetic speech achieves the same level of clarity and intelligibility as the human voice. In noisy environments, it could be more clearly comprehensible than the human voice."

After lectures by the three researchers, the researchers and participants divided into groups for discussions, where participants had the opportunity to deepen their understanding of their areas of interest.

The next lecture will be given by Associate Professor Michihiro Koibuchi and Specially Appointed Associate Professor Ikki Fujiwara of the Information Systems Architecture Science Research Division on October 4 on the theme "The Architecture of Large-Scale Computer Networks." For details, including how to participate, go to "NII Industry-Government-Academia Collaboration Prep School" page of NII's official website (http://www.nii.ac.jp/research/iga/juku/).

Human Resources Administrative staff (Officially announced on July 1, 2016)

(Assistant section managers and above, *officially announced on June 30, 2016)

	Name	New position	Old position
Transfers in	Toshiya Takemoto	Deputy Manager, Budget and Accounts Division, General Affairs Department	Deputy Manager, Facilities Division, Finance and Facilities Department, Tokyo Gakugei University
	Yukiyo Mori	Assistant Section Manager (Personnel Affairs Team), General Affairs Division, General Affairs Department	General Affairs Team Leader, Institute of Molecular and Cellular Biosciences, University of Tokyo
	Kenichi Matsumoto	Assistant Section Manager (Procurement Team), Budget and Accounts Division	Chief of Contract Section, Graduate School of Frontier Sciences, University of Tokyo
	Yumiko Okawa	Assistant Section Manager (Finance and Accounting Team), Budget and Accounts Division	Team Leader (accounting), General Service Center, NIPR/ISM Joint Administration Office
	Takashi Naridomi	Assistant Section Manager (International Affairs and Education Support Team) (international coordination), Planning Division, General Affairs Department	Chief (information environment), URA Station, Strategic Planning Office, ROIS
Internal transfers	Kazuha Hemmi	Assistant Section Manager (Collaboration Support Team), Office for Social Collaboration, Planning Division	Assistant Section Manager (Finance and Accounting Team), Budget and Accounts Division
	Akiko Maekawa	Assistant Section Manager (International Affairs and Education Support Team) (graduate schools), Planning Division	Assistant Section Manager (International Affairs and Education Support Team) (international coordination), Planning Division
Transfers out	Kiyotaka Nitta	Head, Asset Management/Acceptance Office, Financial Affairs Section, National Institute of Genetics	Deputy Manager, Budget and Accounts Division
	Haruo Asoshina	Chief (information environment), URA Station, Strategic Planning Office, ROIS	Assistant Section Manager (Collaboration Support Team), Office for Social Collaboration
	Minoru Sonobe	Chief, General Affairs Section, Graduate Schools for Law and Politics, University of Tokyo	Assistant Section Manager (Personnel Affairs Team), General Affairs Division*
	Junko Matsuyama	Team Leader (research support), Planning Section (ISM), NIPR/ISM Joint Administration Office	Assistant Section Manager (International Affairs and Education Support Team) (graduate schools), Planning Division

Research and teaching staff leaving NII

Takuya Akiba Assistant Professor, Principles of Informatics Research Division(June 30, 2016)

Topics

Acquiring a new Grant-in-Aid by clarifying specifics of research activities

Report on overseas academic life—Associate Professor Bono@Netherlands

The research activities of NII researchers extend worldwide. Not only are they involved in international conferences but many researchers go abroad to work on research. In April this year, Associate Professor Mayumi Bono of the Digital Content and Media Sciences Research Division was among them as she went to the Netherlands together with her 5-year-old daughter. As an example of overseas academic life for an NII researcher, Associate Professor Bono reports from the Netherlands. In this report, she describes the efforts she made in the run-up to being awarded the Grant-in-Aid for Scientific Research and her first step into academic life overseas.

I am at the Max Planck Institute for Psycholinguistics in Nijmegen in the south of the Netherlands, not far from Germany. Under the umbrella of the German Max Planck Society, the institute is known for developing ELAN, annotation software for linguistic studies and interaction research. Situated in a forest surrounded by the pleasant sounds of twittering birds and rustling leaves, I have been given my own room and computer (photo) as an associate researcher here.

The funding I was awarded is from the Fund for the Promotion of Joint International Research (Fostering Joint International Research), which is a Grant-in-Aid for Scientific Research offered for the first time last year. FY2016 was to be the final fiscal year of a Grant-in-Aid for Scientific Research (Grant-in-Aid for Young Scientists (A)) that I had received, and so I was thinking about doing joint research overseas. Before making my application, I investigated not only the research achievements of the joint research destination but also the local living environment there, including schools for my daughter. I knew that it would be impossible to leave for a long overseas trip unless my daughter could be happy there. Luckily, I found an international school in a neighboring town and discovered the rental market value of apartments between the research institute and the school. When awarded the Grant-in-Aid, I received a very high valuation with a satisfaction ratio (ratio of amount granted to amount applied for) of over 90%. I believe that this was a result of carefully including the information obtained in my preliminary investigations, such as the amount of rent and insurance, and making efforts to clarify the specifics and feasibility of my research activities in my application, with the support of NII's URA(University Research Administrators).

As I write this report in August, five months have passed since my life in the Netherlands began. I feel that the first two months were eaten up in dealing with processes such as acquiring a visa.

I am studying sign language communication with researchers here in the Netherlands. There is no written language for sign language, and there is no universal sign language. Japan has Japanese Sign Language, the U.S. has American Sign Language—and American Sign Language is completely different from British Sign Language, despite the two countries both having English as their official languages. Sign languages are not built upon the foundation of a spoken language, but are independent languages with unique linguistic systems. Because there is no written language, people who use Japanese Sign Language as their spoken language, for example, are bilingual, since they use Japanese as their written language. When researchers attempt to write sign language down, they tend to use the written language of the country that they are from. In this case, the written materials are in the "translated" language, and they lack the expressiveness of untranslated sign language. Using my knowledge and experience in research on gestures and multimodal interaction, which has been my area of specialization up until now, I am trying to construct a framework for describing in writing the richness of sign language communication.

Saying goodbye to my husband, with whom I shared the responsibility of childcare in Japan, and coming to live overseas with my daughter for a year was extremely difficult. But something that my daughter said to me at that time made me happy. This is a conversation we had before moving to the Netherlands:

Me: After we move to the Netherlands, even if you say "I miss Daddy" or "I want Daddy," you won't be able to see him right away.

Daughter: Yeah...(thinking carefully)

Me: Won't you feel lonely? I might feel lonely...

Daughter: But I'll be there for you, won't I!

I studied abroad for about a year in the U.S. before my daughter was born, but the sparkle of everyday life is clearly different now. I hope to carry out good research that will make my supportive daughter proud.

SNS

"Hey, this is great!"

Hottest articles on Facebook and Twitter (May–August 2016)

National Institute of Informatics, NII (official) Facebook
www.facebook.com/jouhouken/

▶ **End of NII Open House 2016**

Today was the second and last day of NII Open House 2016, and it saw the successful completion of the entire program. Thank you to all of the many visitors! (Omission) NII advances research and operations in tandem. Regarding operations, we held the Academic Information Infrastructure Open Forum on the 25th to 27th, and regarding research, we held the Open House on the 27th and 28th as an opportunity for explanation. We are committed to reporting NII's activities to everyone, not only through annual events but by actively providing information on a continuous basis. We ask for your continued support. (05/28/2016)

National Institute of Informatics, NII (official) Twitter
@jouhouken

［NII NEWS］ Assistant Professor Takuya Akiba (Principles of Informatics Research Division) has won the Japanese Society for Artificial Intelligence (JSAI) Incentive Award (06/28/2016)

Bit on Twitter! Twitter
@NII_Bit

Today I sneaked into NII Today's interview location. Celebrity Ayaka Ikezawa was interviewing NII's Professor Hideaki Takeda. I'm looking forward to September's NII Today (No. 73)! (07/19/2016)

*Some text omitted.

NII People Vol.2

"Why Do People Design?" The Answer Lies in Artificial Intelligence

Hideaki Takeda

(Professor, Principles of Informatics Research Division, National Institute of Informatics)

Born in 1963. Ph.D. Engineering (University of Tokyo). Specializes in design engineering, artificial intelligence, and Web informatics. Engaged in Web research since the early days of the Web, and now conducts research on a wide range of topics from social networks to open science.

—— Oh, wow, why the cat ears? (Ikezawa)

Takeda These cat ears catch brain waves, and the movement of the ears expresses my current mood. I'm not usually very good at talking in front of people, but when I put on the cat ears, I am able to transform into a chatty, jovial scientist. I have chaired "Running Fire of Research Presentation at NII"[As interpreted in NII Today No.55 P10] like this at the NII Open House for two years running now.

—— And you went for the same style when we chaired the NicoNico Gakkai Beta together in December of last year too. So, why the white coat? Informatics researchers don't usually wear white coats.

Wearing a white coat is like dressing up as a scientist (laughs). Of course, I don't usually wear one for research, but I've always found the white coat fascinating. I loved science fiction when I was at high school, and the cool scientists that appear in those stories always wear a white coat, don't they? That's why I wanted to become a scientist and chose to study science at university.

—— And that's why you started researching artificial intelligence? AI is definitely like science fiction!

No, I loved SF, but it was the mechanics that interested me, so I studied precision machinery engineering at first. However, in my third year at university, I met Dr. Hiroyuki Yoshikawa (25th president of the University of Tokyo), an authority on design engineering, and became fascinated by the question, "Why do people design?" That led me to study design engineering.

Professor Takeda in his transformation as a "chatty, jovial scientist" with the aid of cat ears and his "scientist's costume", a white coat. Ayaka Ikezawa says the costume is "cute!"

—— That sounds quite philosophical. But how did it lead to research on artificial intelligence?

In design engineering research, we use computers to simulate the appropriate forms of objects of design. I started research that simulated people's act of designing. I observed people's actions, and modeled and simulated them. That is actually programming human intelligence, and it led naturally to research on artificial intelligence.

—— What research are you working on now?

I am working on building DBpedia Japanese, which extracts and structures information from the Japanese version of Wikipedia and makes it available on the Web as data that anyone can use. When a million items of scattered information are interconnected, it creates a massive database.

—— Does that mean artificial intelligence taking on a portion of human knowledge?

Yes, that's right. I think that advances in artificial intelligence will mean that people will be able to use the energy that they no longer need to expend on a "memory" crammed with knowledge to live in a more human way and make full use of their creativity. In the course of research on artificial intelligence, I think we may find the answer to the question that was the starting point for my research, "Why do people design?"

(Written by Mito Takahashi. Photography by Aki Nagao.)

Face-to-face with "NII People"

Professor Takeda says he "likes looking at data." Apparently, his ultimate pleasure occurs at the moment a beautiful network structure appears during data analysis. This must be a feeling unique to informatics researchers! He looks cute in his cat ears and white coat, but a serious expression appears on his face when talking about artificial intelligence. Some recent press reports on artificial intelligence have suggested that people's jobs will be replaced by AI, but talking to Professor Takeda, I began to look forward to a future in which people are able to live more intelligently and in a more human way with the help of AI.

Ayaka Ikezawa

Celebrity/Engineer. Known as "The Ruby Goddess," she is especially active in IT fields. The author of *Programming Wo Hajime Yo Idea Wo Jitsugen Saseru Saiko No Tool* (Let's Start Programming: The Best Way to Realize Your Ideas) (Daiwashobo). Won the Special Jury Award at the 6th Toho Cinderella Audition.

Essay

The Cyber-Physical Space Supported by CPS

Hideyuki Tokuda
Professor, Faculty of Environment and Information Studies, Keio University

The craze for Pokémon GO has spread worldwide. It has been a long time since a game using Japanese content has taken the world by storm. The sight of people in usually empty public parks holding out their smartphones to capture Pokémon or gathered together in large groups to battle Pokémon is bizarre. I am sure that everyone experienced the cyber-physical space that integrates cyberspace and real space through Pokémon GO. So, when did the real space in which we live our daily lives come to be integrated with cyberspace?

Looking back to the 1970s, the names of variables used in programming, "x" and "y", were chosen arbitrarily by programmers, and they were not linked to real objects. In the 1980s, email came into use, and for the first time, we had specific addresses in cyberspace with "username@machine name." In the 1990s, commercial use of the Internet advanced, the Domain Name System (DNS) became widespread, and Web space was created. From that point, integration with real life accelerated, and it became possible to book an airplane or train, shop at a supermarket, call a taxi, and so on, via the Web. The name "www.keio.ac.jp" in cyberspace was linked to Keio University, which exists in real space. In recent years, with the popularization of sensors such as smart devices and smartphones, we are advancing towards the age of IoT (Internet of Things) and IoE (Internet of Everything), where "everything", including objects, people, data, and processes, are connected to the Internet.

A cyber-physical system (CPS) is a system or group of systems targeted at cyber-physical space. CPS provides a kind of internet of controlled things. This is an important topic in the implementation of new social infrastructure to support a super smart society, including traffic, energy, environment, construction, disaster prevention, and medical care. CPS technologies geared towards applying new enablers (components that will give a boost to business) such as automatic driving and drones in society are receiving much attention. As well as technical innovations in CPS, an important issue for new social infrastructure to be accepted in society is coordination with social innovations such as the reform of laws, systems, and guidelines.

Future Schedule

October 4–7 | CEATEC JAPAN 2016 (Exhibitor)

October 20 | "The Forefront of Informatics" 2016 Public Lectures: 3rd Lecture "How Can You Easily Write Correct Programs? Program Types and Debugging Techniques" (Assistant Professor Kanae Tsushima, Information Systems Architecture Science Research Division). A program of lectures in which the National Institute of Informatics' researchers explain topics in advanced informatics to the general public, held six times a year. Details on the 5th lecture onward, including subjects and schedule, are available at http://www.nii.ac.jp/event/shimin/.

Late October | 2nd SPARC Japan Seminar 2016. Details at http://www.nii.ac.jp/sparc/.

Late October | Information session about the Department of Informatics at The Graduate University for Advanced Studies. Details at http://www.nii.ac.jp/graduate/.

November 8–10 | 18th Library Fair & Forum (Sponsor/Exhibitor)

November 27 | Inter-University Research Institute Corporation Symposium (Exhibitor)

November 29 | 4th Public Lecture "Interactive Intelligence: Making AI More Than Just a Buzzword" (Professor Seiji Yamada, Digital Content and Media Sciences Research Division)

December 14–16 | Annual Meeting of the Academic Exchange for Information Environment and Strategy (Exhibitor)

Notes on cover illustration By drawing a situation in which temperature and humidity in a greenhouse (the real world) is sensed, the information is shared and analyzed in cyberspace, and then conveyed to robots working in the greenhouse to prompt their actions, I am presenting a view of the future opened up by CPS. I hope readers will get a sense of that from the expressions and movements of the humorous robots.

Weaving Information into Knowledge
NII

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