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2015 New Year's Greeting

Dr. Masao SAKAUCHI
President of National Institute of Information and Communications Technology

Happy New Year!

Last year, the Japanese economy showed signs of recovery, with indicators such as improving performance in industry and talk of the Tokyo Olympics and Paralympics to be held in 2020. Information and communications forms a basis for economic activity in Japanese society, and it also holds a key position in the growth strategy. In this field, NICT engages in activities such as R&D and innovation driving.

I would like to reflect on various initiatives in the past year. One example is the decision by many electric power and gas companies to adopt the Wi-SUN standard for wireless communication, and that some power companies have begun installing and using next generation electrical power meters (smart meters) implementing Wi-SUN. NICT played a leading role in promoting R&D and standardization of Wi-SUN, which is an international wireless communications standard. Future development of Wi-SUN as infrastructure for sensor networks is also anticipated, with increasing use for wireless sensor equipment in agriculture and other areas.

In the field of security, international initiatives are becoming a pressing matter, in addition to domestic initiatives, with news reports of cyber attacks crossing national boundaries. NICT works in R&D on technology to monitor unauthorized communication that is likely to be a cyber attack by installing sensors on servers both inside and outside of Japan collaborating with various agencies. On another front, some enterprises have begun using the NIcter Real-network Visual ANAlyzer (NIRVANA), developed by NICT, to monitor targeted attacks on their internal net-

works. The "My Number" system for social security and taxation will be introduced in 2016 and with increasing concern in local governments, alerts provided by NICT for monitoring cyber attacks are being used increasingly.

Regarding the Olympics and Paralympics to be held in Tokyo, the Ministry of Internal Affairs and Communications is promoting its Global Communication Project, with a mission to eliminate language barriers around the world and a goal of implementation in society by 2020. NICT also plans to improve the accuracy of multilingual speech translation systems, and to demonstrate use in various areas besides travel phrases, such as disaster prevention and mitigation, medicine, and shopping, through collaboration among industry, academia and government. To this end, NICT established the Advanced Speech Translation Research and Development Promotion Center last year, including many researchers from industry. The Center played a leading role in establishing the Association for Facilitation of Global Communication Development, comprised of participants from industry, academia and government, and we have been driving the Global Communication Project.

Information and communications technology (ICT) is entering a new era, "the third paradigm", creating new values through the integration of the cyber world of the Internet and the real world, composed of various field and industries, in which we live. A major objective here is to solve societal problems, using ICT, in areas such as transport, disaster prevention, energy, agriculture and infrastructure. Information about events in the real world are gathered using sensors, input into the cloud as Big Data through networks, and processed in various ways to create real value in various fields. Doing this involves handling data that can heavily influence our lives, so attention to security and privacy is very important. We call this series of processes social ICT, considering its public nature and close relationship to a locality. As part of this work, in April of last year we established the Social ICT Promotion Research Center, to create a system to promote social ICT research. The goal of the Center is to demonstrate and implement Big Data applications using a mobile wireless test bed, through collaboration among industry, academia, and government. We will contribute to society as "One NICT", with an overarching view of resources that are distributed throughout the various institutes within NICT.

We are also working proactively on local collaboration. Last year, we held regional ICT research meetings to hear from local chief executives on how NICT research results could be used in local public organizations and on their hopes for research at NICT. We intend to use this information to revitalize R&D from a perspective of local collaboration.

In addition to this sort of research which solves actual problem, it goes without saying that to create new solutions, R&D must also incorporate innovative ideas. From this direction, we have seen results such as innovative neural processing and new structures for high-voltage devices. To form a NICT open innovation base, we also established an academic alliance for collaboration among Japanese universities and industries, and a global alliance for collaboration internationally. We hope to use this base as a starting point to strengthen collaboration and advance research in the future.

This is the fifth and final year of the NICT's third medium-term plan. As such it will include preparation for the fourth medium-term plan, which will start in 2016. This year also marks a turning point for NICT and other organizations, which will re-embark as National Research and Development Institutes this April due to revisions to the incorporated administrative agency system. As the sole National Research and Development Institute in the field of information and communications, we are determined to increase our efforts as an open innovation base on the global stage, conducting research in a way that maximizes research results. We hope for continuing understanding and cooperation from all of you in the coming year.

Finally, I would like to wish you a happy new year and I hope you all have a wonderful year!

Watching Novice Action Degrades Expert Motor Performance

—Common neural processes underlie action production and outcome prediction of observed actions by humans—

Tsuyoshi IKEGAMI

Researcher, Brain Networks and Communication Laboratory, Center for Information and Neural Networks

After completing graduate school, worked as a researcher at the Advanced Telecommunications Research Institute International and then joined NICT in 2010. Engaged in research on human motor control and learning. Current position since 2014. Ph.D. (Education).

Gowrishankar Ganesh

Researcher, Brain Networks and Communication Laboratory, Center for Information and Neural Networks

After completing graduate school, worked as a researcher at the Advanced Telecommunications Research Institute International and then joined NICT in 2010. Engaged in robotics and research on human motor control and learning. Senior Researcher at the French National Centre for Scientific Research (CNRS) since 2014. Ph.D. (Engineering).

Introduction

The ability to understand another's intentions and objectives from their actions and to predict the results of those actions is essential for choosing one's own actions in society and for communication with others. However, how the brain understands or predicts the actions of others is largely unexplained. Till now, it has been theorized that the same neural processes apply when predicting another's actions as when one performs the same actions oneself, but there has been no conclusive evidence for this.

One way to prove this hypothesis is to show a causal effect between inducing a change in the neural processes that contribute to predicting another's actions, and the neural processes that contribute to producing one's own actions (Figure 1). Thus, if this hypothesis is correct, then when ability to predict another's actions changes through learning, these common neural processes will change, so we can expect seemingly unrelated actions of the self to also be changed. We have conducted behavioral experiments with experts at darts to verify whether this effect actually occurs or not.

Experiment details

We conducted two tasks; an observation-prediction task in which an expert at darts predicted the results for a novice throwing darts (Figure 2, left), and a motor action task in which the expert threw darts, aiming for the center of the dart board (Figure 2, right). We then examined whether there was any effect on the expert's darts performance for a case when the expert's prediction abilities (regarding the novice's action at darts) changed (Experiment 1) and for a case when prediction abilities did not change (Experiment 2). The prediction tasks for each experiment were conducted as described below.

Experiment 1:

The expert was shown a video of a novice throwing darts, without showing the trajectory of the dart or the dart board. The expert was then asked to predict the outcome of each throw using a dart board divided into 11 sections (Figure 2, left). The experimenter gave the hint that the novice was aiming for the center, and provided feedback with the correct outcome each time.

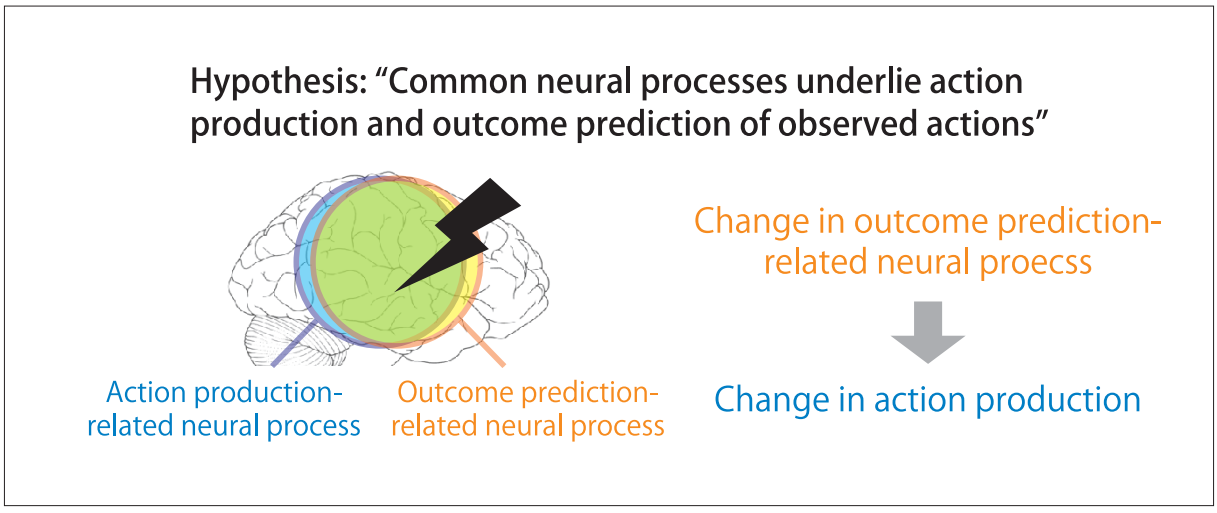


Figure 1 Hypothesis testing method

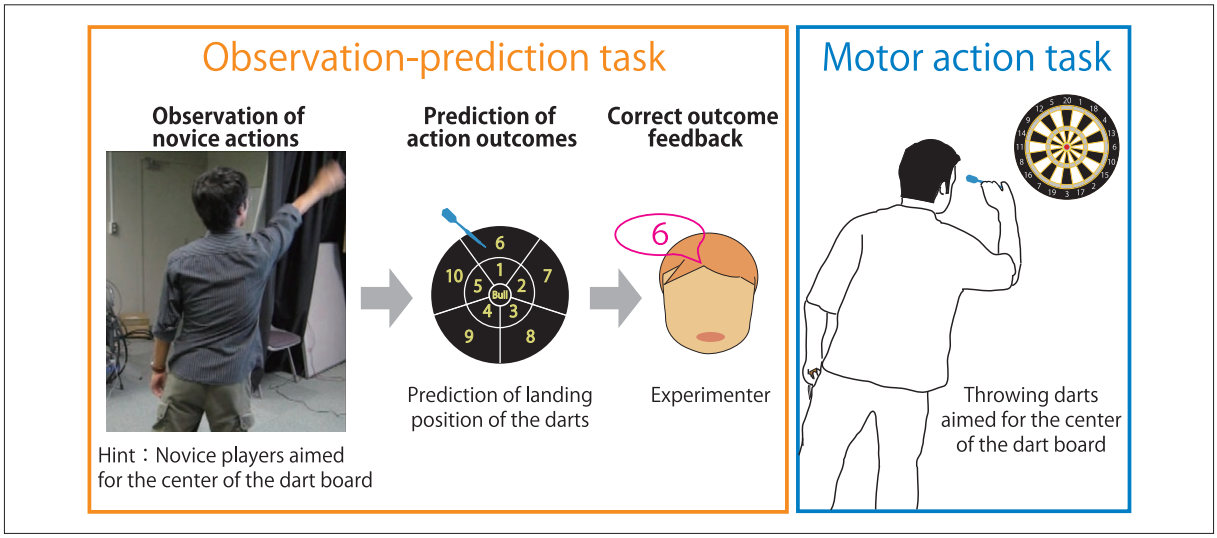


Figure 2 Observation-prediction task and motor action tasks performed by the darts expert

Experiment 2:

The expert was asked to make predictions using the same video as was used in Experiment 1. This time, the expert was not given the hint that the novice was aiming for the center, and feedback with the correct outcomes was not given each time.

For the prediction task in Experiment 1, the expert was not able to predict accurately at first, but gradually was able to predict where the dart would hit, just by observing the action of the novice (Figure 3, Experiment 1). This indicates that the learning of the prediction task induced a substantial change in the neural processes of the expert underlying prediction of the other person's action. If this neural process also contributes to the person's actions, we can predict that some effect will also be apparent in the expert for the action task (Figure 1).

Corresponding to this prediction, when we asked the expert to perform the motor action task before and after the observation-prediction task, we found that after improving his prediction ability, the expert's performance became worse than it was before (Figure 3, Experiment 1).

The possibility still remains that this decrease in darts performance is unrelated to the increase in ability to predict the novice's actions, and is simply caused by watching his unskilled motion. Experiment 2 was conducted to rule out this possibility.

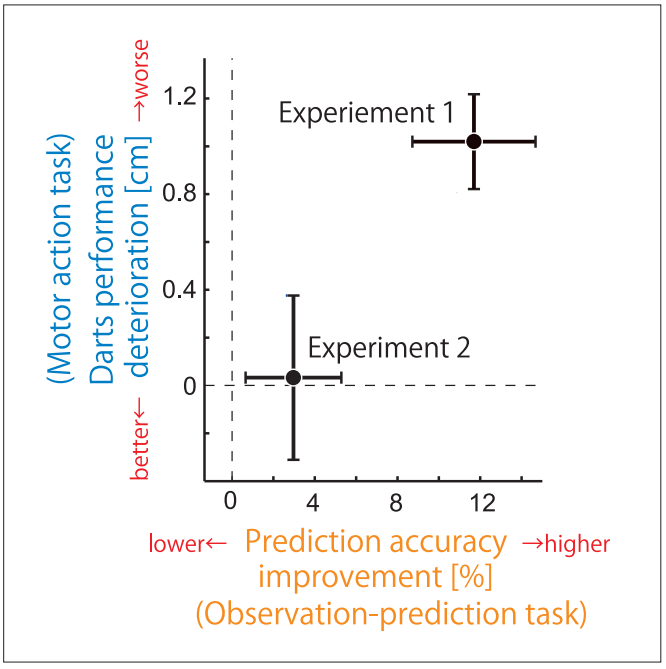


Figure 3 Changes in darts results and accuracy of predictions

As a result, for the observation-prediction task in Experiment 2, the expert's prediction ability did not improve significantly, in spite of watching the same novice's actions as in Experiment 1. More importantly, no change in the darts performance of the expert was observed before and after the observation-prediction task (Figure 3, Experiment 2). Thus, the drop in the expert's performance observed in Experiment 1 was caused by the change in ability to predict the novice's action.

Through these experiments, we have shown a causal relationship between ability to predict another's action and one's own performance for the first time. This gives behavioral evidence supporting the hypothesis that common neural processes contribute to both action production and outcome prediction of observed actions by humans.

In society, we do not simply look abstractly at the actions of others. We read the objectives and intentions behind the actions, predict the outcomes of the actions, and utilize these to select our own reactions. When any of our predictions is incorrect, we use the prediction errors to improve our understanding of the other. Our results of these experiments show that our motor performance is affected, without our awareness, by what we observe in others.

Also, the result that a person's performance can be adversely affected by watching the performance of an unskilled person can lead to practical suggestions in the fields of sports or rehabilitation. As professional baseball player, Ichiro Suzuki said, "I don't want to watch unskilled batters because it will affect my own batting" (Yukan Fuji, June 19, 2007), so perhaps Ichiro already recognized this fact long ago.

Future prospects

In the future, we will develop methods that utilize the interaction between predicting the actions of others and one's own actions, for rehabilitation and cognitive or exercise training, to improve one's own action by improving one's ability to predict others' actions, or conversely, to produce the opposite improvement.

Speech Translation Technology Success in Smartphones and Airports Becoming a Standard in Global Markets

FEAT Limited
Providing the "NariTra" multilingual speech translation application for travelers at Narita International Airport

Mr. Teruji KOBAYASHI
President and CEO of
FEAT Limited

FEAT Limited was established in 2005, and its main business is development and provision of products applying speech-to-speech translation, language processing, language-learning support, and other technologies. It provides products including the "NariTra" application, which it developed using speech translation technology transferred from NICT. We spoke with Mr. Teruji KOBAYASHI, President and CEO of Feat Limited, mainly about their project with the Narita International Airport Corporation.

Creating a product incorporating words often used at Narita International Airport

SHIRADO: First of all, could you explain about NariTra?
KOBAYASHI: NariTra is a speech translation application for travel phrases, developed using speech translation technology provided by NICT. It supports eight languages: Japanese, English, Chinese, Korean, Indonesian, Thai, French, and Spanish, and can translate from Japanese into any of the other seven languages, or from any of them into Japanese. It supports speech input in Japanese, English, Chinese, Korean, and Indonesian, and by speaking to a smartphone in any of these languages, the input speech is converted to text, translated, and output using speech synthesis. Text translation only (without speech input) is provided for Thai, French, and Spanish. NariTra is provided free-of-charge as an official smartphone application of the Narita International Airport Corporation, and we handle all development, upgrades, and system operation. For the development of this application, we received the 11th Annual Merit Award for Industry-Academia-Government Collaboration from the Minister for Internal Affairs and Communications.
SHIRADO: Could you talk about the development process for NariTra?
KOBAYASHI: From 2010 into 2011, NICT and the Narita International Airport Corporation conducted test demonstrations of this technology. The tests involved placing 100 smartphones in shops within Narita International Airport and having them used there. As a result, it became clear that product and shop names and other proper nouns had to be added for smooth communication. The current version of NariTra is a result of efforts in that area.
SHIRADO: About how many such terms have you added?

KOBAYASHI: Some of the proper nouns were already in the dictionary, but we have added several thousand.
SHIRADO: What results have you achieved in operating NariTra?
KOBAYASHI: We are distributing the application on the public markets App Store, for iPhone, and Google Play, for Android, and it has been downloaded approximately 350,000 times since the launch in December, 2011. There have also been many reviews from outside of Japan that recommend this application for travelers going to Japan. When in a shop, it is often difficult to find just the right phrase in a phrase book, but users do not have such difficulties with NariTra.
SHIRADO: Did you have any particular difficulties in developing NariTra?
KOBAYASHI: There were some business issues such as contracts etc., but most significantly testing in both iPhone and Android operating environments took quite a lot of time.

Developing a new application for foreigners visiting Japan

SHIRADO: I've heard you have been creating another application related to NariTra.
KOBAYASHI: In July 2014, Narita International Airport Corporation released "TABIMORI", which is an "omotenashi" (hospitality) application for foreigners visiting Japan. We handled the overall development for this application, including organizing the content. According to surveys asking foreign visitors to Japan about difficulties they encountered, the first was difficulty in using free public wireless LAN environments, the second was difficulty communicating in English, and the third was difficulty obtaining information about public transport. TABIMORI aims to meet these needs, providing speech-to-speech translation as well as information that will be useful when travelling in Japan, such as bus and train transfers, free Wi-Fi guides, a phrase book, and instructions for emergency situations.
SHIRADO: Could you tell us about any future business plans?
KOBAYASHI: The number of foreigners visiting Japan each year has exceeded 10 million. This number will surely increase as the 2020 Olympics approach. We feel it is our mission to provide tools to help these visitors communicate smoothly.
SHIRADO: Finally, do you have any particular hopes for NICT in the future?
KOBAYASHI: Ultimately, it is not practical for us as a single company to do basic research. For example, the speech translation technology required many years of research before becoming ready for real world use. We hope that NICT will continue to do such work. Technology transfer is also happening smoothly now. Technologies are fully realized only through practical use, so we wish for NICT to continue the combination of performing basic research, and then technology transfer.

Our special feature, "NICT Technologies used in Society" has been running since the October issue last year, and in this issue we introduce examples of how speech translation technology is being used in society. Speech translation technology is composed of three technologies: speech recognition, which converts speech to text; text translation, which converts text in one language into text in another language; and speech synthesis, which converts text to speech. Each of these technologies is widely used on its own and has been licensed to various enterprises. On this occasion, Tamotsu SHIRADO, Manager in the NICT Intellectual Property Promotion Office, visited two enterprises with projects using the speech translation technology, that is all three technologies combined.

ATR-Trek Co., Ltd.
Providing "Shabette Concier" for smartphones

Dr. Toshiaki FUKADA
President and CEO of
ATR-Trek Co., Ltd.
Ph.D. (Engineering).

ATR-Trek Co., Ltd. was established in 2007, with investment from both the Advanced Telecommunications Research Institute International (ATR), which conducts R&D on speech translation and other technologies, and FueTrek Co., Ltd. which proposes services and develops systems for mobile phones. ATR-Trek Co., Ltd. provides speech recognition and translation technology services. We spoke with Dr. Toshiaki FUKADA, President and CEO of ATR-Trek Co., Ltd.

Collaborative technical development of a practical implementation

SHIRADO: Could you start by giving a simple overview of your company?
FUKADA: Our company is a subsidiary of FueTrek Co., Ltd. mainly doing speech recognition R&D and licensing the results to FueTrek Co., Ltd. FueTrek Co., Ltd. then develops and provides products around the world using the licensed speech recognition engine.
SHIRADO: Could you tell us about a typical product of yours?
FUKADA: Our technology is used for some of the functions of the "Shabette Concier" product announced by NTT DOCOMO, Inc. in 2010. This is a commercialization of the speech recognition engine we received from NICT by technology transfer. We did this technical development in collaboration with NICT so it is probably the most prominent case.

Handling difficult requirements of a practical implementation

SHIRADO: Could you describe some of the details of this joint development?
FUKADA: NICT developed a speech recognition engine using a new method called WFST, and planned to make a practical implementation of this technology. We did the development work with NICT according to a schedule for creating the product from NTT DOCOMO, Inc.
SHIRADO: Were there any particular difficulties with the implementation?
FUKADA: It isn't just true for NICT, but often technology coming from basic research laboratories is not ready for immediate practical implementation. The implementation requirements from NTT DOCOMO, Inc. were quite difficult, including detailed programming method requirements, and much of the code had to be rewritten to satisfy these requirements.
SHIRADO: The schedule must also have been quite severe as well…
FUKADA: That's right. We began talking about adopting the technology in March, 2012, and an evaluation version had to be provided to NTT DOCOMO, Inc. by the end of July, so it was quite tight. NICT also worked hard to support us, and we were able to finish in time for the October announcement.
SHIRADO: Do you have plans for any future business developments?
FUKADA: We are continuing work on "Shabette Concier", to support multiple languages including English, Chinese, Korean and other South-East Asian languages in addition to Japanese.

We have also received a speech-to-speech translation engine provided by NICT and are using it to provide a service called "Shabette Honyaku". We expect to focus on translation as a mainstay of our business in the future.

Expectations are high, so understanding needs is important

SHIRADO: Finally, do you have any particular hopes or requests for NICT in the future?
FUKADA: Anticipation for speech recognition and speech-to-speech translation is high around the world. It is central to our business, and NICT wants to have it used in society. To achieve this, it is very important to understand needs in society and to address them. I hope that NICT will understand this more deeply, and further expand collaboration with joint research and technical development. The implementation of "Shabette Concier" has resulted from these processes working well.

We hope NICT continues to be aware of this, and continues to engage in technical development with a sense of speed.

Interviewer
Tamotsu SHIRADO
Manager, Intellectual Property Promotion Office,
Outcome Promotion Department

The next issue will include an article featuring the interview with Nassua Solutions Corp., HIRAKAWA HEWTECH CORP. regarding the NerveNet technology transfer.

Report on NICT Open House 2014

The NICT Open House 2014 was held on November 27 and 28, 2014. This event introduces the latest research results from NICT, including its local research facilities all together, through lectures, demonstrations, and panel exhibits.

NICT's current research activities and results, as well as R&D results from commissioned research were presented over the two days, comprising ten lectures, 62 demonstrations and panel exhibits, and eight different laboratory tours. 1,059 visitors attended the event over two days.

Opening ceremony

At the opening ceremony on the first day, Dr. Masao SAKAUCHI, President of NICT, gave a greeting from the organizers, which was followed by a special lecture from Toshio YANAGIDA, Director General of the Center for Information and Neural Networks, titled "Future Society Arising from the Fluctuation Systems of the Human Brain and Muscle."

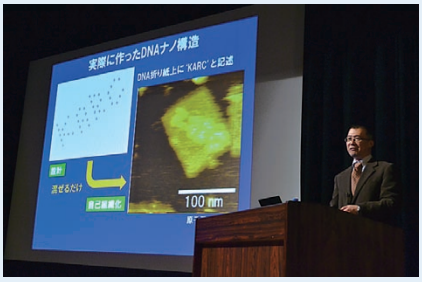
Opening ceremony

Organizer greeting by President SAKAUCHI

Special lecture by Director General YANAGIDA

Lectures

Outlook for Cryptosystems used with Big Data—Security and privacy protection using Big Data in automobiles—



Information and Communications Technologies Inspired by Biological Mechanisms

Neural Mechanisms That Run the Body: Lessons from Neymar

Laboratory tours

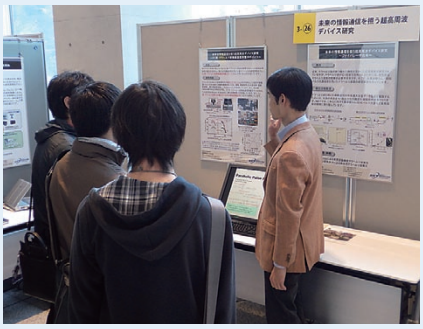
Advanced optical clocks for the next generation

Visualizing Scientific Big Data

Exhibit area

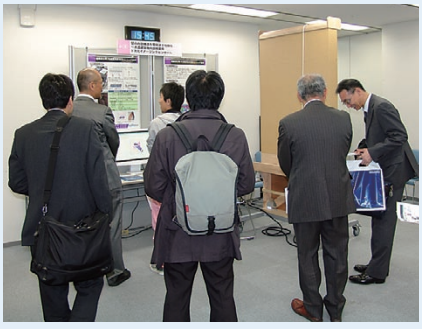
Expansion of public broadband wireless communication systems

Multilingual communication support application for initial assessment in hospitals



Ultra-high-frequency device research for future information and communications

Arbitrary viewpoint video and distribution technologies



Visualizing internal structure of walls using electromagnetic waves

Technology transfer mini workshop

Report on Okinawa Electromagnetic Technology Center Open House 2014

The Okinawa Electromagnetic Technology Center held its 2014 Open House on November 22. There were 147 visitors from within and outside of Okinawa Prefecture. As well as facility tours introducing research activities, there were panel exhibits of images of Mt. Ontake and other regions of Okinawa, taken using the airborne Polarimetric and Interferometric Synthetic Aperture Radar (Pi-SAR2) system, and exhibitions of technologies such as the multi-lingual translation application, VoiceTra4U.

Also this year, the Phased-array weather radar and Doppler lidar network fusion data system (PANDA), completed in March, and a telescope for optical communication were exhibited for the first time.

In addition, Assoc. Prof. Hiroyuki YAMADA from the University of the Ryukyus, together with his students, held a demonstration launching of a meteorological observation sonde, as part of research done in cooperation with NICT.

The Okinawa Office of Telecommunications, Ministry of Internal Affairs and Communications, exhibited a radio-wave monitoring car, and held an electronic radio wave workshop (Visitors assembled AM radio receiver kits and received AM broadcasts.) with the cooperation of Clean DENPA NET: Efficient use of Radio Spectrum Association of Okinawa Prefecture. Many of the visitors also enjoyed these events.

Facility tour of the Phased array weather radar and Doppler lidar network fusion data system (PANDA)

Listening to various electromagnetic waves

Exhibit of Pi-SAR2 images surrounding the Okinawa Center

Assembly and Testing of radio receiver kits with the Okinawa Office of Telecommunications etc.

Launching a meteorological observation sonde by University of the Ryukyus

Ever-popular rain-gauge experiments

Memorandum of Understanding on Research Cooperation Concluded with Institut National de Recherche en Informatique et en Automatique (INRIA)

On November 20, 2014, at NICT headquarters (Koganei City), NICT and Institut National de Recherche en Informatique et en Automatique (hereinafter INRIA; CEO: Dr. Antoine Petit), concluded a memorandum of understanding, establishing a framework for research collaboration in the field of information and communications technology, and specifically in cyber-security and new-generation networking technologies.

Dr. Antoine PETIT, CEO of INRIA (left) and Dr. Masao SAKAUCHI, President of NICT (right)

NICT and INRIA share a particular interest in cyber security and new-generation network technologies. Specifically in the field of cyber security, they will collaborate by sharing information related to cyber attacks and improving data analysis and data analysis methods, for research on measures against cyber-attacks. In the field of new-generation network technologies, they will conduct R&D on a next-generation simulator and test bed for a new-generation network technology called Information-Centric Networking (ICN/CCN) and for evaluating networking technologies. Through collaboration in both of these fields, both NICT and INRIA should be able to advance and accelerate their own research.

INRIA also conducts diverse research in computer science beyond the two fields covered at this time, and in the future, NICT and INRIA plan to effectively strengthen their research collaboration based on this memorandum of understanding, by looking for shared collaborative research themes while sharing information, exchanging researchers, conducting collaborative research and holding research conferences.

Cooperation and Collaboration Agreement Reached with Tokyo Gakugei University

On November 11, 2014, NICT concluded an agreement for cooperation and collaboration with Tokyo Gakugei University, to bilaterally utilize their R&D capabilities and human resources to develop academic research and education in specific fields and to contribute to the local community. A signing ceremony was held on the day, with Dr. Masao SAKAUCHI, President of NICT, and Prof. Toshisada DEGUCHI, President of Tokyo Gakugei University.

Tokyo Gakugei University is a key university training educators in Japan, currently with approximately 6,000 students, being trained as capable teaching personnel with a wealth of knowledge, culture, creativity and experience.

NICT and Tokyo Gakugei University are located next to each other and have a history of collaboration on individual research topics and human resource development in the educational field, but this agreement will expand cooperation to include further use of ICT in the field of education and contribution to the local community.

Prof. Toshisada DEGUCHI, President of Tokyo Gakugei University (left) and Dr. Masao SAKAUCHI, President of NICT (right)

Announcement of nano tech 2015 Exhibition

NICT will exhibit at nano tech 2015, the 14th International Nanotechnology Exhibition & Conference. The exhibit will focus on the Advanced ICT Research Institute, which conducts basic research, and the Outcome Promotion Department, which supports development of technologies.

Date/Time: **January 28–30, 2015 10:00–17:00**
Venue: East Exhibition Halls 4, 5, 6, Tokyo Big Sight
For details, see the following Web site:
http://www.nanotechexpo.jp/

Exhibit at nano tech 2014

Announcement of 19th Earthquake Technology Expo YOKOHAMA and Disaster Crisis Management ICT Symposium 2015

The NICT Applied Electromagnetic Research Institute, together with the ICT Forum for Security and Safety, will exhibit applications of sensing technologies for earthquake disaster prevention, non-destructive sensing, and other technologies at the 19th Earthquake Technology Expo YOKOHAMA.

The "Disaster Crisis Management ICT Symposium —Observation and prediction of heavy rain and volcanic eruption damage—" will also be held in the Annex Hall. The symposium will include lectures on the current state and future of technologies for natural disaster prediction and damage observation, to promote disaster counter measures and crisis management.

Booth at the 18th Earthquake Technology Expo YOKOHAMA

19th Earthquake Technology Expo YOKOHAMA

Date/Time: **February 5&6, 2015 10:00–17:00**
Venue: B Hall, Pacifico Yokohama
Admission: Free. Registration on the day
For details, see the following Web site:
http://www.exhibitiontech.com/etec/gaiyou_yokohama.html (Japanese only)

Disaster Crisis Management ICT Symposium 2015

Date/Time: **February 6, 2015 10:30–16:35**
Venue: Annex Hall, Pacifico Yokohama
Admission: Free
For details, see the following Web site:
http://ictfss.nict.go.jp/yokohama2015/ (Japanese only)

Lecture at the Disaster Crisis Management ICT Symposium 2014

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