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NICT 独立行政法人 情報通信研究機構 NEWS

National Institute of Information and Communications Technology

The Use of Terahertz Measurement for Evaluating Materials

−Diagnosis of biological tissue condition−

Maya Mizuno

Senior Researcher, Electromagnetic Compatibility Laboratory, Applied Electromagnetic Research Institute

After serving as a unit researcher in the Initiative Research Unit at Riken, Mizuno joined NICT in 2006. She has been researching millimeter and terahertz wave measurement technology. Ph.D. (Engineering).

Introduction

The Electromagnetic Compatibility Laboratory at the Applied Electromagnetic Research Institute is participating in the terahertz collaboration project that started at NICT at the beginning of this year. The goal of the project is to research fundamental technology and standardize the use of terahertz waves in cooperation with the Advanced ICT Research Institute, the Photonic Network Research Institute, and the Wireless Network Research Institute. Terahertz waves lie between light and radio waves and have yet to be fully investigated. In this project, the main roles of the laboratory include reviewing the method for precisely measuring power, creating a technical guide, establishing a database, and demonstrating various ways that terahertz waves can be applied in society. This article will introduce our use of terahertz waves for determining the condition of biological tissues, one of the most challenging subjects.

Evaluating materials using terahertz waves

Terahertz waves have both the directionality of light and the permeability of radio waves and can pass through various nonmetallic materials. By analyzing the electric field waveform (Figure 1) after propagation, we can infer the collective behavior of the molecules in a material. This is because the absorption property of materials can be determined at each frequency from the amplitude and phase of the electric field. It is also possible to know the direction of the movement—not just the energy necessary for a group of molecules to move—by changing the polarization direction of the incident terahertz waves. Moreover, when the waves propagate through a composite of two different materials over a large contact area, we can observe changes in the property due to weak repulsion and the attraction between the molecules in the contact area, which cannot be observed through analysis of the individual materials. It is difficult to catch a low energy phenomenon that can be observed in the terahertz band with high sensitivity using X-rays or electromagnetic waves in the optical range, so the use of terahertz waves is expected to help us learn more about the collective behaviors of various molecules and the interactions between molecules, which up to now have been difficult to describe. In fact, the method is already used for revealing the excellent properties of nanocomposite*1 insulating materials, which consist of polymer molecules and an inorganic crystal.

Determining the condition of biological tissues

We have been examining the possibility of evaluating the condition of biological tissue using the aforementioned analysis approach. Several things have been learned from measuring collagen and some biominerals, which are biological materials. For example, even if the collagens have the same amino acid composition, the absorption properties of the terahertz waves may change as the collagens contract or undergo other kinds of morphological changes, as shown in Figure 2. Moreover, the absorption property may depend on the crystallinity of calcium carbonate and hydroxyapatite. Figure 3 shows that when terahertz waves are used to create an image of a cuttlefish bone, which consists of calcium carbonate and an organic substance (β-chitin), the intensity of the waves can be used to distinguish area A, which has a smaller contact area between calcium carbonate and β-chitin, from area B, which has a larger contact area (black and white on the image), although both look similar to the naked eye. This morphology and the distribution of biological materials have a significant impact on the function of biological tissue, so future research, including detecting morphological changes in hydrated state*2, must be done with test samples that are closer to those in the real tissue. We believe that this research also should be helpful in determining the safety of terahertz waves on living tissue, which must be done if terahertz waves are to be used in practical applications.

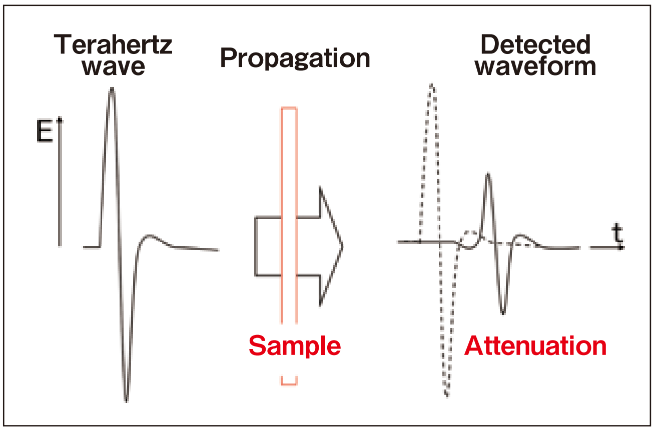


Figure 1●Example of electric field waveform of terahertz waves

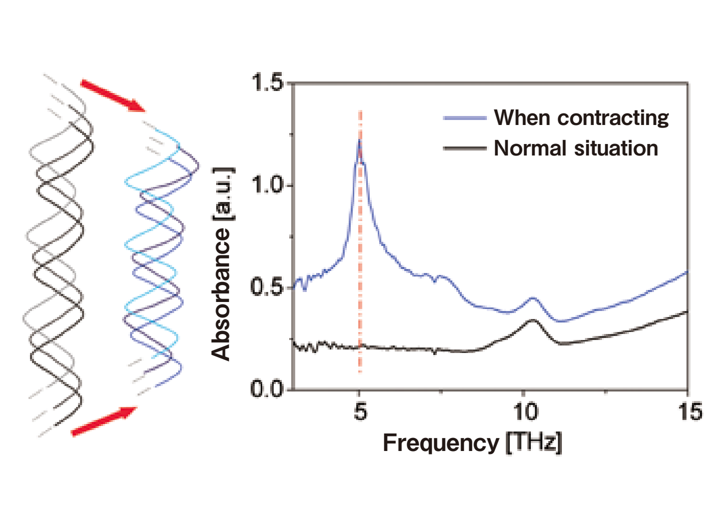


Figure 2●Contraction of collagen and its absorption property

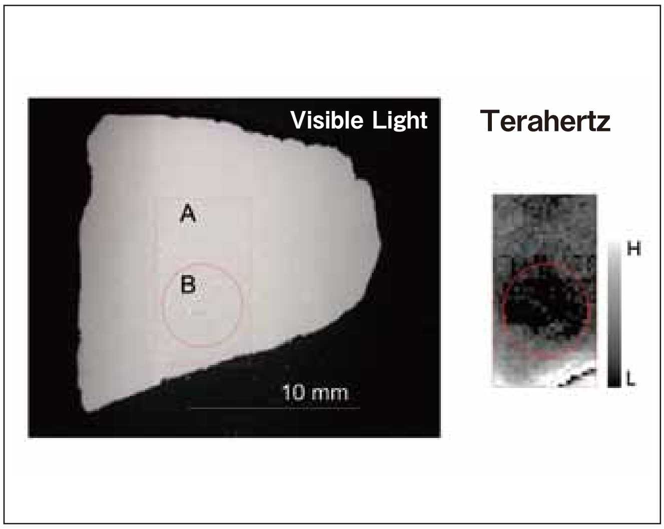


Figure 3●Picture of cuttlefish bone and the image created using terahertz waves

Vision and challenges

Since terahertz waves are strongly absorbed by water and cannot penetrate deeply into the body, research into using terahertz waves to determine the condition of body tissue will focus mainly on methods for internal examination (similar to how gastric cameras are used) as well as methods for body surface and in vitro examinations. The methods will greatly aid analysis of cell morphology in a dish, the extracellular matrix, and the interaction between molecules. Therefore, one of our goals is to use terahertz waves to evaluate the adhesion between scaffolding materials[*3], which are used in regenerative medicine, and cells before they are implanted in the body. To achieve such challenging goals, fundamental technologies must be developed, such as how to generate terahertz waves, detect them with high sensitivity, and amplify them. At the same time, a simple terahertz measurement system for biological samples must be developed by combining various fundamental technologies. Appropriate technical standards also must be developed, including safety standards covering the application of terahertz waves to the biological body. The road to the practical use of terahertz waves is long and winding (Figure 4), but we will proceed with research step by step until we can use terahertz waves to determine the condition of body tissue.

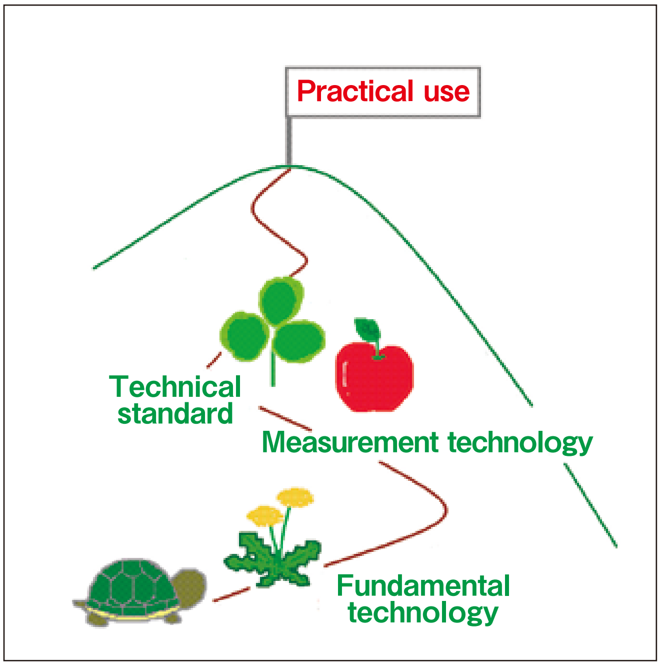


Figure 4●Road to the use of terahertz waves

Glossary

＊1 Nanocomposite
A composite that can be created by dispersing dissimilar materials on a nanometer scale. They display properties that cannot be displayed using macro or micro level composite methods.

＊2 Hydrated state
The state where water molecules are added to organic compounds. Hydration deeply affects the structural stability of proteins and the expression of functions.

＊3 Scaffolding material
An artificial extracellular matrix (a supramolecular structure that exists outside a cell). It is used to promote regeneration of body tissues in defect areas.

Concentric Waves Appear at 300 km Altitude after the 2011 Tohoku Earthquake

−Atmospheric waves reach ionosphere−

Takuya Tsugawa

Senior Researcher, Space Weather and Environment Informatics Laboratory, Applied Electromagnetic Research Institute

After completing a doctoral course and staying at Nagoya University and Massachusetts Institute of Technology as a JSPS postdoctoral fellow, Tsugawa joined NICT in 2007. He has been researching the monitoring, prediction, and correction of ionosphere disturbances that affect radio propagations. Ph.D. (Science)

Introduction

The Earth's atmosphere at an altitude of 60 km or higher is partially ionized by solar EUV, existing as ionized gas (plasma). This plasma-rich region in the atmosphere is called the ionosphere. The electron density in the ionosphere is generally largest at an altitude of about 300 km. The ionosphere has characteristics to reflect HF radio waves and affect satellite communications and GNSS navigations. The ionosphere varies greatly under the influence of the activities of the sun and the lower atmosphere, and sometimes interferes with HF radio and satellite communications and degrade precise satellite positioning. (Figure 1) To research monitoring and forecasting the ionospheric variations, the Space Weather and Environment Informatics Laboratory at the Applied Electromagnetic Research Institute has been observing the ionospheric total electron count (TEC) using a dense GPS receiver network (GEONET) provided by the Geospatial Information Authority of Japan in cooperation with Kyoto University and Nagoya University in addition to regular ionospheric observations using the ionosonde network.

The 2011 Tohoku earthquake off the Pacific coast of northern Honshu (magnitude 9.0) struck at 14:46 JST (JST = UT + 9 hours) on March 11, 2011. We observed concentric atmospheric waves propagating in the ionosphere from the epicenter about seven minutes after the earthquake onset. (Figure 2) These waves were observed for several hours.

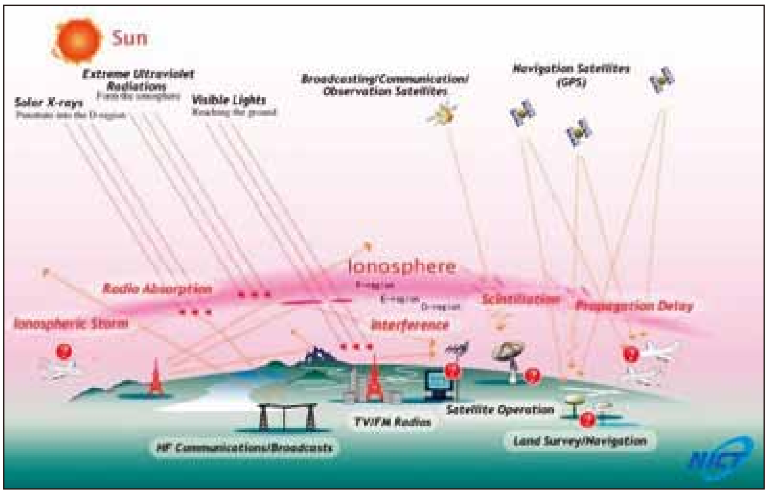


Figure 1●Ionospheric Effects on Radio Applications

Ionospheric observations after the earthquake

The phase and group velocities of radio waves vary in the ionosphere dependent on the TEC along the ray path and on the frequency of the radio waves. Using these characteristics, we can measure the TEC integrated along the ray path between a GPS satellite and a receiver from two GPS signals in different frequencies. The TEC strongly reflects variations in the ionosphere at an altitude of about 300 km, where is the peak height of ionospheric electron density. Figure 3 shows the TEC variations calculated from the GEONET consisting of more than 1,200 stations. Using such dense GPS receiver network and all of the GPS satellites in the field of view, we can observe the ionosphere in wide area and at high spatial resolution. In Figure 3, the short-period TEC variations of less than ten minutes are shown in TEC Units (TECU) of 10^{16} electrons/ m^2. Each color represents the amplitude of the TEC variations, with red indicating +0.2 TECU and black indicating -0.4 TECU. Background TEC level is 20–30 TECU during this period. According to the GPS-TEC observa

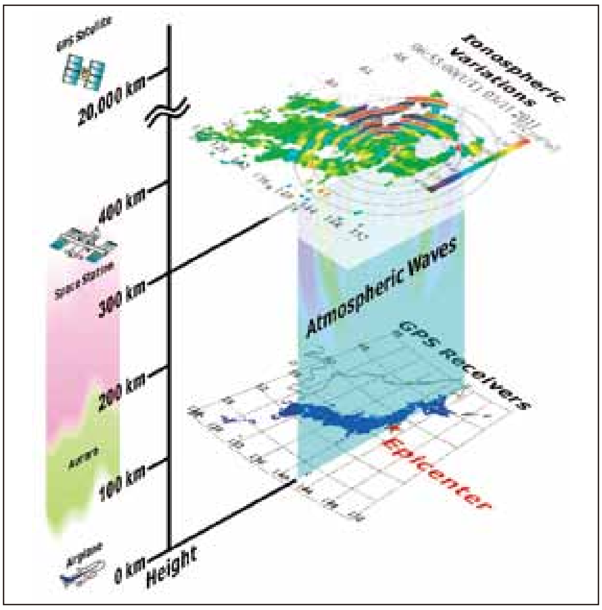


Figure 2●Schematic picture of atmospheric waves and the ionospheric variations after the earthquake

Ionospheric variations around 300 km altitude are observed using two-frequency GPS signals transmitted from satellites at about 20,000 km altitude and recorded by ground GPS receivers (GEONET, consisting of more than 1,200 stations). It is considered that the atmospheric waves were excited at sea surface in the vicinity of epicenter, propagated up to 300 km altitude, and generated the concentric structures in the ionosphere.

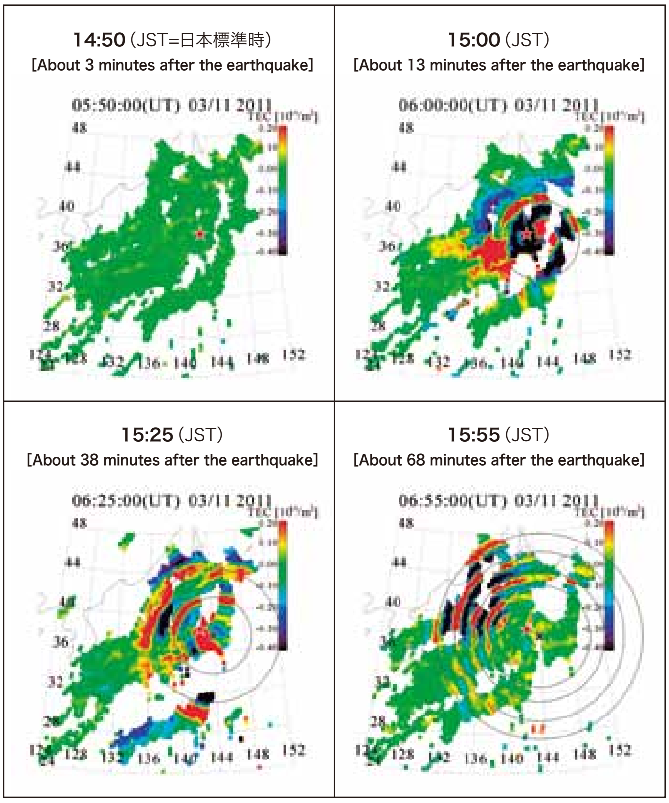


Figure 3●TEC variations derived using GEONET

Two-dimensional maps of total electron content (TEC) variation derived using the data of GEONET, a dense GPS receiver network operated by GSI. The TEC data are detrended values derived by subtracting 10-minute running average of the data. The star and cross marks represent the epicenter and "ionospheric epicenter", respectively. Gray circles represent concentric circles with the ionospheric epicenter. The animation of TEC maps is available on the NICT website.
http://www.seg.nict.go.jp/2011TohokuEarthquake

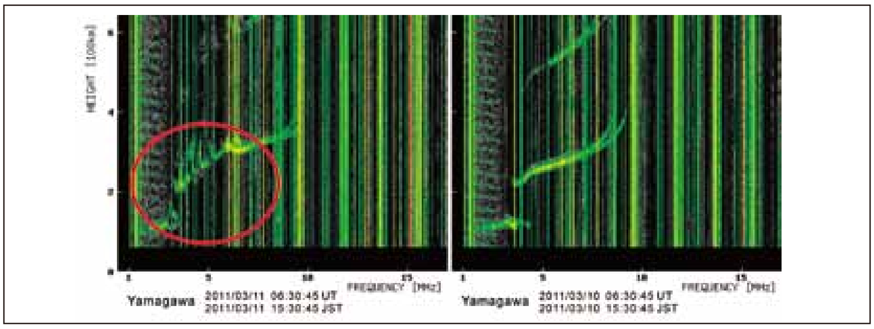


Figure 4●Ionograms from ionosonde observations at Yamagawa (31.20 deg N, 130.62 deg E) just after the earthquake (left) and at the same time one day before (right)

The horizontal and vertical axes of ionograms represent the frequency from 1 to 15 MHz and the virtual height from 0 to 600 km, respectively. The ionospheric echo traces in the ionograms correspond to the virtual height of the ionosphere. As indicated by the red circle, irregular distortion of echo trace was observed at virtual height of 200–300 km after the earthquake. The 200–300 km virtual height corresponds to the real height of 150–250 km. These irregular echo traces are considered to be caused by the modulation of ionospheric height due to the atmospheric waves associated with the earthquake.

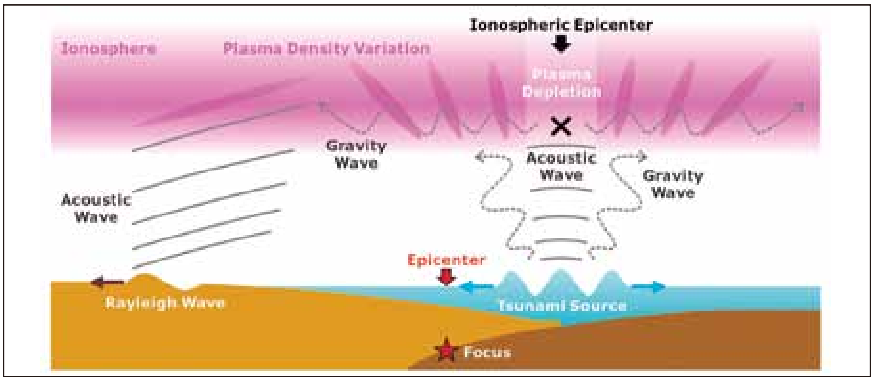


Figure 5●Schematic picture of the generation mechanism of atmospheric waves and ionospheric variations after the earthquake

It is considered that the first ionospheric concentric wave with the propagation velocity of about 3.5 km/s was caused by the acoustic wave generated from the propagating Rayleigh wave. The second and following concentric waves would correspond to the atmospheric gravity waves (AGW) propagating in the ionosphere. The AGWs could be generated mainly at the lower ionosphere by the acoustic wave launched at the sea surface around the tsunami source.

tion, concentric waves in the ionosphere began to appear about 7 minutes after the earthquake onset at 14:46:23 JST (05:46:23 UT) near the epicenter (38.322 ° N, 142.369 ° E, according to the U.S. Geological Survey). The center of these ionospheric concentric structures, termed the "ionospheric epicenter", was located about 170 km from the epicenter in the southeast direction. The ionospheric epicenter was closer to the Japan trench than the epicenter and consistent with estimated areas of the tsunami source. These concentric waves appeared in the western part of Japan until around 18:00 JST (09:00 UT).

Figure 4 shows the altitude profile of electron densities in the ionosphere observed by an ionosonde. The ionosphere tends to reflect radio waves at certain frequencies corresponding to the electron density. The ground-based ionosonde shoots radio waves of varying frequencies into the upper atmosphere and records the arrival time of ionospheric echo. This reveals the altitude profile of ionospheric electron density. NICT regularly observes the electron density profile at four stations in Japan: Hokkaido, Tokyo, Kagoshima, and Okinawa. In Figure 4, the altitude profile of electron density at Kagoshima just after the earthquake (left) and at the same time on the previous day (right). Irregular distortions of ionospheric echo trace was observed at virtual height of 200–300 km at Kagoshima after the earthquake. These irregular echo traces are considered to be caused by the modulation of ionospheric height at the real height of 150–250 km due to the atmospheric waves associated with the earthquake.

These observational results indicate that this great earthquake caused not only underground waves (seismic wave) and sea waves (tsunami) but also atmospheric waves which propagated upward in the atmosphere and reached the ionosphere. Although some aspects of coseismic ionospheric waves were observed after great earthquakes such as the 2004 Sumatra earthquake and the 2010 Chile earthquake, it is the first time to detect all the details of post-seismic ionospheric disturbances by high-resolution and wide-coverage ionospheric observations.

Future perspective

It is recently revealed that the ionosphere is largely affected not only from the upper region such as the sun, magnetosphere, etc., but also from the lower atmosphere such as the troposphere. It is difficult to observe the lower atmosphere in a wide area and at high resolution Therefore, the lower atmospheric effect on the ionosphere remains unclear. The observation data obtained after the Tohoku Earthquake is valuable to clarify the relationship between the ionosphere and the lower atmosphere because of the clear causal connection. In addition, considering the fact that the ionosphere started to fluctuate about seven minutes after the earthquake and that the center of the ionospheric variations corresponds closely to the tsunami source, further development of real-time ionospheric observation could allow us to monitor tsunami with a wide area. The first result of this study have been summarized in five articles and published in the journal, "Earth, Planets and Space."

※Collaborative researchers

NICT: Dr. Takashi Maruyama, Dr. Michi Nishioka,
Dr. Hiroyuki Shinagawa, Mr. Hisao Kato,
Dr. Tsutomu Nagatsuma, Dr. Ken T. Murata
Kyoto University: Dr. Akinori Saito,
Dr. Mitsuru Matsumura, Dr. C.H.Chen
Nagoya University: Dr. Yuichi Otsuka

Propagation Properties of LF Standard Frequency Waves and Development of Field Strength Prediction Method

—Sea voyage from Japan to Antarctica to investigate the reception intensity of LF standard frequency waves—

Shigeru Tsuchiya

Senior Researcher, Space-Time Standards Laboratory, Applied Electromagnetic Research Institute

Tsuchiya joined the Radio Research Laboratory (currently NICT) in 1980. After being involved mainly in satellite communications and ionosphere observation, he is now engaged in activities related to Japan Standard Time.

Introduction

NICT used high frequency radio waves from 1940 and low frequency from June 1999 for distributing standard time and frequency signals. Then, in March 2001, NICT stopped using high frequency waves. Low frequency of 40kHz signal started to be transmitted from the Ohtakadoya-yama LF Standard Time and Frequency Transmitting Station in Fukushima Prefecture since June 1999. In October 2001, we also began transmitting 60 kHz signal from the Hagane-yama LF Standard Time and Frequency Transmitting Station located on the border between Saga and Fukuoka Prefecture. NICT measured the field strength across the country in 2004 to check the reception condition and developed a method of calculating the field strength to verify those measurements. The calculation method has officially been approved by International Telecommunication Union; ITU Radiocommunications Sector (ITU-R) for calculating field strength at distances of 4,000 km or less from a transmission station. Various countries transmit standard time and frequency signals via low frequency waves. Some kinds of the newer radio controlled clocks and watches support the low frequency time signals that are being transmitted by six stations around the world. Two of them are in Japan, with the others in the U.S., the U.K., Germany, and China. The same or the close frequency signals in the LF band are occasionally transmitted from stations. These stations are located, however, far from each other, so no interference has taken place. To determine possible interference occuring in the future, a new method was needed to calculate field strength for distances greater than 4,000 km from a transmission station. NICT developed such a calculation method and verified it using observation equipment installed on a container vessel travelling east-west across the Pacific Ocean, as well as on Japan's Antarctic Research Expedition vessel, SHIRASE.

Observations in Japan

For the observations conducted in Japan in 2004, we installed observation equipment in a vehicle and looked for locations from Hokkaido to Kyushu and Okinawa where we could stop the car for hours at intervals of about 100 km from each transmitting station, and where ground waves and sky waves tend to interfere with each other as well. We conducted two types of observation: 1) fixed points observations were carried out to measure diurnal variation for 24 hours at the above fixed points, and 2) while mobile observations were performed continuously to measure range variation using moving vehicles. Fixed-point observations took place mainly in relatively unobstructed spaces where the radio waves could be received without disturbance, although some were conducted in urban areas. Mobile observations were conducted at distances of about 600–700 km from each transmitting station where ground waves and sky waves can easily interfere with each other. Figure 1 shows a comparison of the observed values (black dots) and the calculated values (blue line). The black bold line describes the calculated results of ground waves alone.

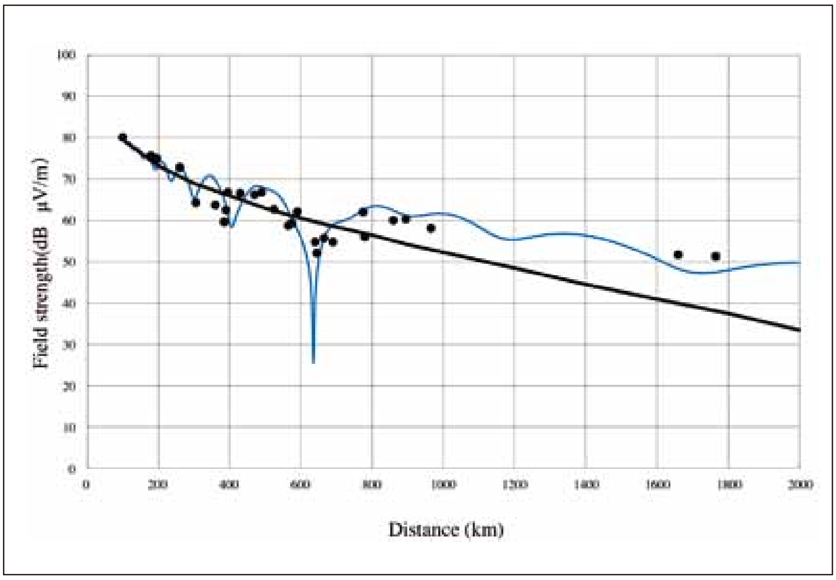


Figure 1●Range variation of JJY40kHz Field Strength in Daytime

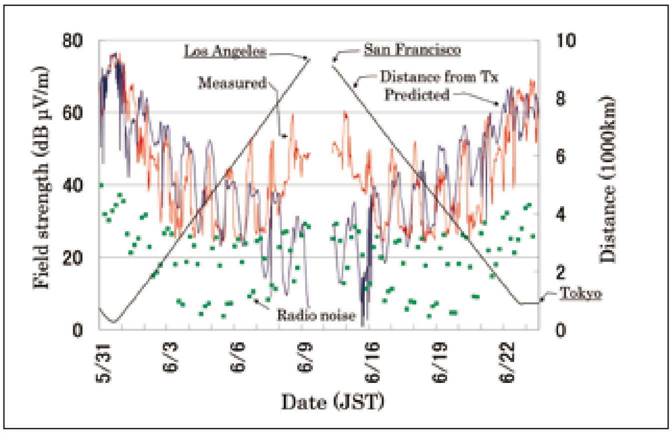


Figure 2●Field Strength of the 60kHz on the Pacific Route

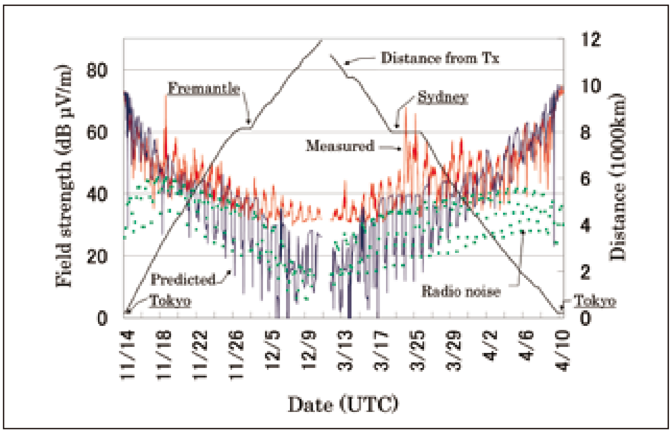


Figure 4●Field Strength of the 40kHz on the Antarctic Route

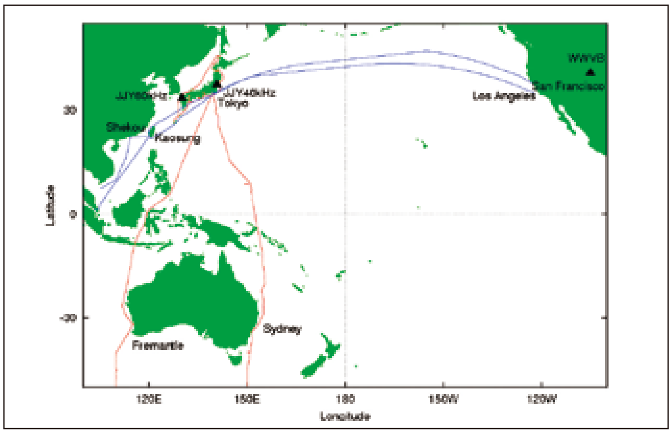


Figure 3●Route On-board Mobile Measurement

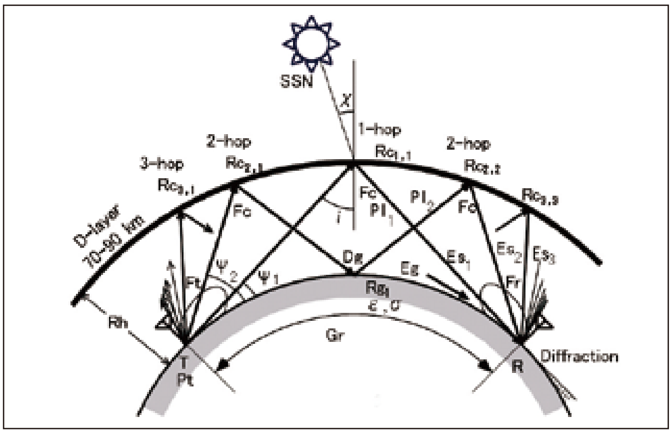


Figure 5●Parameters for calculating the Field Strength

Observations aboard ships traveling in the east-west and north-south directions

While travelling from Asia to North America, the field strength decreased until about 170 degrees west longitude and then started increasing as we approached the U.S. This is because the standard time and frequency signals in the U.S. use the 60 kHz frequency same as Hagane-yama Transmitting Station. (Figure 2) This observation also showed that the autocorrelation coefficient method could effectively distinguish standard time and frequency signals from atmospheric noise in the received radio waves. We also carried out observations aboard the Antarctic research vessel, in the sea off Japan to check the observation equipment for proper operation before leaving for the Antarctica. It showed that urban noise increased when the ship called at a port. The observation equipment basically collects data automatically, but since the observations were to be carried out in a very harsh environment on the voyage to Antarctica, we asked for help from NICT's Antarctic Project (observing radio waves in Antarctica) and had members of the Antarctic observation team inspect the observation equipment and read out the data. The observation is currently being conducted under the Antarctic Project. The ship travels to Antarctica via Freemantle, Australia, and returns from Antarctica via Sydney. The distances from the Ootakadoya-yama and Hagane-yama Standard Frequency Transmitting Stations are about 8,000 km respectively. Around the Showa Station in Antarctica, the distance is 10,000 - 12,000 km. Figure 3 shows the sea routes taken. The initial version of the observation equipment started to show its limitations in measuring the field strength around the time the ship passed Australia, so we have been upgrading the observation equipment for higher sensitivity and checking its operation (Figure 4).

Calculating the field strength

The method developed by NICT for calculating the field strength sees the propagation of radio waves as a combination of ground waves that travel mostly along the ground surface and sky waves that reflect between the ground surface and the ionosphere. Ground waves are calculated from the earth reflection coefficient (according to ITU-R Sector), distance, and frequency. For sky waves, the question is how many reflections the waves make between the ionosphere and the earth. For short distances, field strength is expressed by two reflecting waves and for long distances, it is calculated by up to ten reflections. Figure 5 shows the main parameters of the calculation.

Future plan

NICT is now checking the new observation equipment installed aboard the Shirase for proper operation. Exposure to the harsh environment often cause the antennas and cables deteriorate before they reach Antarctica. We cannot fix any problems with the observation equipment in the half year or so before the vessel returns to Japan, so the observation equipment must be improved to properly conduct observations in harsh environments and receive weaker radio waves over a longer distance. We also plan to collate the gathered data regarding the length of time the waves propagate so that the data can be utilized more effectively.

Prize Winners

Prize Winner ● **Tran Ha Nguyen** / Expert Researcher, Smart Wireless Laboratory, Wireless Network Research Institute

◎Date: 2011/4/22

◎Name of Prize:

IEEE Standards Association Award (as Contributor)

◎Details of Prize:

In recognition of the contributions to the development of IEEE Standard 1900.6TM-2011

◎Name of Awarding Organization:

IEEE Standards Association

◎Comments by the Winner:

The IEEE P1900.6 working group was set up in July 2008 as a standardization group and given the task of defining a logical interface and data structure for information exchange between spectrum sensors and their clients in a wireless communications system without relying on specific sensing technology. I have participated in this group from the very beginning with my colleagues at NICT and have contributed our research, such as distributed sensing technology and sensing database technology, which has been adopted. I also served as a secretary for over two years, from January 2009 to April 2011, which may be one of the factors behind this award. I could not have received the award without the valuable advice and support of all of the members of the former Ubiquitous Mobile group, especially the group's leader. I would like to take this opportunity to express my deep gratitude.

Prize Winner ● **Kenji Suzuki** / Senior Researcher, Space Communication Systems Laboratory, Wireless Network Research Institute
Ryutaro Suzuki / Managing Director, Applied Electromagnetic Research Institute

Joint Prize Winners:

Midori Kato (NEC Corporation)
Shiro Yoshikawa (NEC Corporation)
Tamio Okui (NEC Corporation)
Tetsuya Watanabe (NEC Corporation)
Masayoshi Yoneda (NEC TOSHIBA Space Systems, Ltd.)

◎Date: 2011/5/9

◎Name of Prize:

Satellite Communications Research Award 2010

◎Details of Prize:

In recognition of the excellence of the paper, "Evaluation of an RF signal Direct-processing Receiver for Reconfigurable Communication Equipment"

◎Name of Awarding Organization:

IEICE Technical Committee on Satellite Communications

◎Comments by the Winner:

In developing reconfigurable communication equipment for small satellites, we evaluated a prototype 16APSK transmitter and receiver that can directly perform A/D and D/A conversions of RF signals in the L band and directly output and sample RF signals. In other words, digital signals can be processed without the need for frequency-conversion components. This allowed for a drastic reduction in the size of the devices. We would like to thank all concerned, as the paper received the first Satellite Communications Research Award, 2010, which has greatly encouraged all involved in the research and development.

From left, Ryutaro Suzuki and Kenji Suzuki

Prize Winner ● **Masahiro Tsuchiya** / Executive Researcher, Photonic Network Research Institute

◎Date: 2011/5/11

◎Name of Prize:

The 23rd Small and Medium Enterprises New Technology and New Products
Special Award for Industry-Academic-Government Cooperation

◎Details of Prize:

In recognition of the significant contribution to promoting the growth of Japan's industries and the technologies of small and medium enterprises with new technology and products based on LeoProbe, an electric field probe with an electro-optical effect that was co-developed with Stack Electronics Co., Ltd.

◎Name of Awarding Organization:

The Resona Foundation For Small And Medium Enterprise Promotion (Organizer), The NIkkan Kogyo Shimbun, Ltd. (Organizer), Small And Medium Enterprise Agency, Ministry of Economy, Trade and Industry (Sponsor)

◎Comments by the Winner:

The Small and Medium Enterprises New Technology and New Products Awards are given to small and medium-sized enterprises that have little connection with large companies in terms of funding and management. It is a true honor that the LeoProbe (Stack Electronics Co., Ltd.), developed based on NICT intellectual property, has received the special award after a strict screening in which just a small number of companies were selected. The Special Award for Industry-Academic-Government Cooperation was given to us in recognition of our contribution of technical advice. This is a result of the generous support from the former Intellectual Property Management Group and former Expert Researcher of NICT, Dr. Kiyotaka Sasagawa. We sincerely hope that it will further enhance the technical role of small and medium-sized enterprises, as emphasized by Prof. Hiroyuki Yoshikawa and Mr. Eiji Hosoya at the award ceremony.

Photos courtesy of The Nikkan Kogyo Shimbun, Ltd.

Prize Winner ● **Naoto Iwahashi** / Expert Researcher, Spoken Language Communication Laboratory, Universal Communication Research Institute

Joint Prize Winners:

Ryo Taguchi (Advanced Telecommunications Research Institute International, Nagoya Institute of Technology)
Kotaro Funakoshi (Honda Research Institute Japan Co., Ltd.)
Mikio Nakano (Honda Research Institute Japan Co., Ltd.)
Takashi Nose (Advanced Telecommunications Research Institute International, Tokyo Institute of Technology)
Tsuneo Nitta (Toyohashi University of Technology)

◎Date: 2011/6/2

◎Name of Prize:

2010 Best Paper Award

◎Details of Prize:

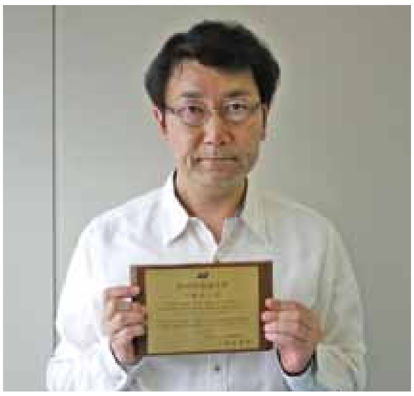
Learning Lexicons from Spoken Utterances Based on Statistical Model Selection

◎Name of Awarding Organization:

Japanese Society for Artificial Intelligence

◎Comments by the Winner:

The paper is about language acquisition, one of the most important subjects in artificial intelligence research. The award was given in recognition of the world's first success in learning lexicons from spoken utterances with high accuracy based on the criteria of statistical model selection. I would like to express my deep appreciation for those who have supported the research in this field over the years. With this award as a huge encouragement, I will continue to work toward higher goals.



Report on New-generation ICT Testbed Symposium 2011

Shuji Yamaguchi, Director of Network Testbed Planning and Deployment Laboratory,
Network Testbed Research and Development Promotion Center
Kazushi Komura, Specialist

On Thursday, October 13, NICT held the New-generation ICT Testbed Symposium 2011 in Tokyo (Garden City Shinagawa) to introduce the JGN-X and StarBED^3, which started operation in April 2011. At the event, the services and vision for the JGN-X and StarBED3 were explained, and speeches were given and discussions held about this new-generation network and ICT testbed, especially in light of the 2011 Pacific Coast Tohoku Earthquake. In addition, on the day before the symposium, a Workshop on the Use of Broadband Networks (ADVNET2011) was held in cooperation with IEICE Technical Committee on Internet Architecture to welcome researchers involved with domestic research networks, such as JGN-X and SINET4.

●Symposium meeting

At the plenary session of the symposium, following the opening address by Hideo Miyahara, President of NICT, we welcomed guest speaker Takashi Morita, Vice-Minister for Internal Affairs and Communications, Atsushi Murase, Managing Director of Research Laboratories, NTT docomo, and Shigeki Goto, Professor, Computer Science and Engineering, Waseda University, gave keynote speeches.

●Panel discussion

Following that, Shinji Shimojo, Director of the Network Testbed Research and Development Promotion Center at NICT, Yoichi Shinoda, R&D Advisor, and Akihiro Nakao, Network Virtualization Project Leader gave lectures on the latest network trends in the industrial world, the evolution of the Internet resulting from new-generation network technologies, the recent research trend in network virtualization and large-scale emulation technology, as well as on An overview of the services and vision of the ICT testbed, including JGN-X and StarBED^3. Yuji Inoue, Chief of the Testbed Network Promotion Working Group, described the expectations for new-generation networks and testbeds from the standpoint of a user and the possibility of new applications and value creation resulting from connecting cars to the network. Miki Yamamoto, Professor, Faculty of Engineering Science, Kansai University, described how dissimilar networks eventually will coordinate with each other with the help of content-oriented network and speculated about the possible effects.

At the end of the program, panel discussions were held with six panelists under the theme of “Creating new-generation networks on the ICT testbed.” As for new-generation networks, various expectations were expressed, such as the needs for (1) a revolutionary paradigm shift, such as the one from phones to the internet, (2) security and reliability, (3) generating innovative ideas and strengthening international competitiveness, and (4) smooth migration from existing networks to new-generation networks. As for the ICT testbed, various opinions were heard, such as (1) to be a useful tools for the users, we should collect various ideas and suggestions and verify them,(2) it should be a foundation for fostering venture companies for new industries and creating jobs, (3) it should offer an environment that encourages the providers of the testbed themselves to use it by eliminating the wall between the providers and users, and (4) it also should be an environment conducive to the development of legal systems, not just technologies. We will use the valuable input as a reference point for promoting new-generation networks and the ICT testbed.

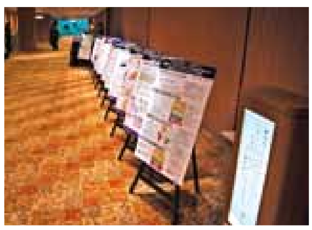
We welcomed about 200 visitors to the symposium. Many people also participated in the workshop held the day before, so the total number of visitors was 340. We ended the event on a high note.

Lastly, we would like to express our sincere gratitude to the many people who gave us kind support and cooperation in organizing the symposium.

●Hideo Miyahara, President of NICT (delivering an opening address at the plenary session)

●Takashi Morita, Vice-Minister for Internal Affairs and Communications (guest speaker)

●Masahiko Tominaga, Vice President of NICT (giving a closing address)



●Panel display

For more details on the program, please visit the JGN-X website. http://www.jgn.nict.go.jp/english/index.html

Report on NICT's Participation in ITU Telecom World 2011

●NICT exhibition corner

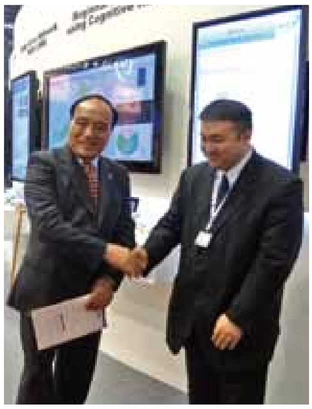
ITU Telecom World 2011 was held in Geneva, Switzerland, from Monday, October 24, to Thursday, October 27, under the auspices of the International Telecommunication Union (ITU), a specialized agency of the United Nations. The ITU Telecom World is a venue for discussing information and communications policies and other issues (forum) and exhibiting cutting-edge information and communications technologies. More than 330 senior government officials and private-company executives, as well as over 6,500 delegates, visited ITU Telecom World 2011. This was the 12th ITU Telecom World event to be held, and was held during the ITU's 40th anniversary.

Together with NTT and NTT docomo, NICT participated in the event in a corner of the Japanese pavilion. We outlined the research and development activities underway at NICT, including the technologies that have been incorporated in ITU standards and the technologies used to support relief activities after the 2011 Pacific Coast Tohoku Earthquake. In addition to the outline, the following panel and dynamic demonstrations were given. The Universal Communication Research Institute: "Network-based speech translation system in accordance with ITU-T Recommendation F.745 and H.625" [*1]. The Wireless Network Research Institute: "Body area network using Ultra-wideband technology" [*2], "Regional network infrastructure using cognitive radio technology" [*3], and "Human detection system using radio waves" [*4].

Dr. Hamadoun Touré, Secretary-General, and Mr. Houlin Zhao, Deputy Secretary-General of ITU visited the Japanese pavilion. Secretary-General Touré kindly gave us a compliment on the exhibition of the technologies incorporated in ITU standards and expressed his gratitude for the Japanese pavilion amid the hard times after the 2011 Pacific Coast Tohoku Earthquake. The network-based speech translation system developed in accordance with the ITU recommendation can translate 21 different languages in both directions from either speech or written text. Many visitors were amazed by the real-time translation of their mother tongues. Upon seeing the body area network system, which detects colors and obstacles by means of cameras and sensors attached to the body and can be used to enhance safety for visually impaired people, and the human detection system that uses radio waves and has practical applications in the field of home security, many people expressed high expectations for these technologies in the near future. As for the cognitive wireless technology, visitors were greatly interested to learn that the technology is particularly effective when networks cannot fully function after a disaster, such as the 2011 Pacific Coast Tohoku Earthquake, and in that the technology may allow frequency bands to be used more effectively and new types of networks to be built.

●ITU Secretary-General Touré receiving an explanation of the network-based speech translation system

●ITU Secretary-General Touré listening to an explanation about the body area network system



●ITU Deputy Secretary-General Zhao after hearing about cognitive wireless technology (left)

●Tetsuo Yamakawa, Vice-Minister for Policy Coordination, the Ministry of Internal Affairs and Communications, Japan, showing interest in the human detection system that uses radio waves

For more details about each technology, please see past issues of NICT News.
＊1 March and August, 2011 ＊2 July, 2011 ＊3 May, 2011 ＊4 August, 2011

Report on NICT New Vision Conference
—Third Medium-Term Plan/Disaster and ICT—

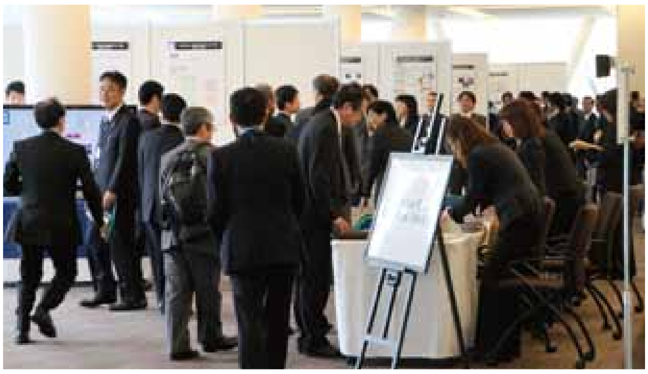
We held "NICT New Vision Conference —Third Meium-Term Plan/Disaster and ICT—," at Tokyo Conference Center Shinagawa on Wednesday, November 9, 2011. We welcomed 337 visitors that day and the event was a great success.

This New Vision Conference initially was scheduled for May, with the aim of introducing the third medium-term plan that started at the beginning of this year. Because of the 2011 Pacific Coast Tohoku Earthquake that hit in March, the event was postponed to the fall.

The event started with a presentation of "NICT's New Vision" by Hideo Miyahara, President of NICT, and keynote lectures were given by Hisashi Kobayashi, Senior Distinguished Researcher (Sherman Fairchild University Professor Emeritus of Electrical Engineering and Computer Science, Princeton University) and Toshio Yanagida, Distinguished Researcher (Professor, Special Research Promotion Group, Graduate School of Frontier Biosciences, Osaka University). We then introduced the four research fields that are pursued at NICT.

During intermissions and coffee breaks, visitors looked around live demonstrations of the research results and panel displays of the planned research for each organization within the framework of the third medium-term plan. The presentation materials and videos are available from NICT's website.
http://www.nict.go.jp/data/presentation/NICTnew_vision.html

●Meeting place



●Exhibition place

●Kimiaki Matsuzaki, State Secretary for Internal Affairs and Communications: Guest Address

●Hideo Miyahara, President: "NICT's New Vision"

●Hisashi Kobayashi, Professor: "Expectations for Studies of New-generation Networks"

●Toshio Yanagida, Professor: "Paradigm Shift in Information Communications Technology Learning from Living Organisms"

●Hiroshi Kumagai, Vice President: "Recovery Efforts by NICT after the Disaster – Fundamental Technology of Electromagnetic Sensing"

●Masahiko Tominaga, Vice President/Network Director General: "Network Fundamental Technology"

●Yutaka Kidawara, Director General of Universal Communication Research Institute: "Universal Communications Fundamental Technology"

●Kazuhiro Oiwa, Director General of Advanced ICT Research Institute: "Advanced ICT Fundamental Technology"

Report on Demonstration at Joint Comprehensive Disaster-preparedness Drill for Kodaira City, Nishitokyo City, Musashino City, and Koganei City (International Exchange Program)

NICT demonstrated the regional distributed wireless network (NerveNet) at “A Joint Disaster management Drill by Tokyo Metropolitan Government, Kodaira City, Nishi-Tokyo City, Musashino City, and Koganei City” held on Saturday, October 29 in Koganei Park, Tokyo.

NerveNet is a wireless multihop network developed by the Network Architecture Laboratory, the Photonic Network Research Institute. It consists of small wireless base stations that automatically interconnect via Wi-Fi. In a disaster, the system can be used to create a network in situation that cell phone networks are interrupted.. For the demonstration, we installed nine demonstration equipments of the base station in Koganei Park and established wireless multihop network. In the demonstration using five disaster information terminals installed in the three NICT booths, participants were able to register evacuees, share safety information between shelters, and distribute messages.

About 300 citizens and members in disaster prevention service in municipalities of the four cities visited the NICT booths and experienced the demonstration. Especially local authority representatives, staffs in disaster-related companies, and university teachers with their students were very interested in the demonstration. Under the third medium-term plan that started at the beginning of this year, NICT is focusing on returning the fruits of research to society. We would like to take every opportunity like this and to continue to publicize NICT’s contribution to society.

●**Outdoor tents (Areas for exhibitions and hands-on demonstrations)**
We also displayed a panel describing the disaster-related technologies that NICT has researched and developed.

●**Koganei City Gymnasium**
Citizens participating in the shelter management drills also had a chance for a hands-on demonstration.

●**Participants in the drills see how the safety check works**
Using their own IC cards, they simulated registering and searching for evacuees.

●**NerveNet base stations installed in various locations in Koganei Park**
Using directional planar antennas, we installed the stations at intervals of 200 to 300 m.

Information for Readers

The next issue will discuss the lectures given in the NICT New Vision Presentation and report on NICT’s facility open house in Keihanna and Okinawa.

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4-2-1 Nukui-Kitamachi, Koganei, Tokyo 184-8795, Japan
Tel: +81-42-327-5392 Fax: +81-42-327-7587
E-mail: publicity@nict.go.jp
<NICT URL> http://www.nict.go.jp/

Editorial Cooperation: FULFILL co., ltd.