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Research Site Visit

Kashima Space Technology Center

NICT

Research Site Visit (Kashima Space Technology Center)

In 1960, the Communications Laboratory (currently NICT) started the construction of a 30m diameter parabolic antenna in Kashima (Ibaraki Prefecture), opened the Kashima branch office in May of 1964, and in October of the same year, successfully broadcasted the Tokyo Olympics on television around the world. In this feature, we will introduce current research happening at this historic Kashima Space Technology Center.

(Interview/Fulfill Co.)

Space-Time Measurement Technology

1.6m diameter antenna (left) and 34m diameter parabola antenna (right) that comprise the micro-VLBI system

—Seeing the 34m diameter parabolic antenna firsthand is overwhelming, isn't it? Is the frequency difference of atomic clocks being measured using this antenna?

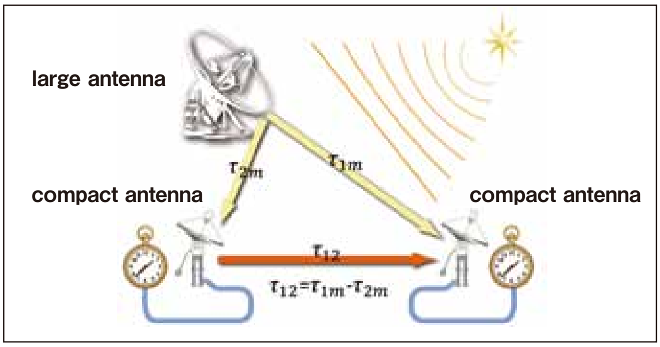
Position coordinates and time are the essential physical parameters in science and technology. Very Long Baseline Interferometry (VLBI) is technology that can precisely measure variations in time used for distance between observation points and observation by precisely measuring with several antennas the waveforms of radio waves emitted from radio stars. We are now developing micro-observation systems using VLBI in order to compare frequencies of next-generation frequency standards being developed in standards research institutes in different countries.

— SEKIDO Mamoru, Associate Director of Space-Time Standards Laboratory, Applied Electromagnetic Research Institute, continues explaining.

Measuring precision of clock variations used for distance and observation in VLBI depends on the precision of observation of waveforms from radio stars. Specifically, observation sensitivity of radio wave waveforms is determined by the observed frequency width and product of diameter of the parabola antenna used at two observation points. Observation with a compact antenna is inadequate, but by combining large and compact antennas together, you can improve the S/N ratio.

—What is the compact VLBI system, exactly?

When we conduct observations by combining the 34m Kashima parabola antenna with the Kashima 1.6m antenna and NICT headquarters 1.5m antennas in Koganei City, Tokyo and take the difference of both observables, we can seek the frequency difference of atomic clocks used for observation between compact antennas. Simultaneous observation with these three antennas is equivalent to a combination of 7m diameter parabola antennas. However, in order to increase accuracy in measurements, we are extending the observation bandwidth of observing frequencies. We are aiming to improve the S/N 5.6 times more than the conventional ratio by making upgrades to enable 1GHz × 4 Band × 2 Polarization observations from within VLBI-observing band frequency 3–14GHz. This is equivalent to a combination of 17m diameter antennas.



Schematic diagram of frequency comparison observation based on micro-VLBI system

—Please share your future prospects.

We hope to take advantage of micro-VLBI systems and conduct frequency comparisons of atomic clocks in intercontinental distance in collaboration with overseas institutes which are developing the atomic frequency standards, leading to more high-precision measurement of time.

SEKIDO Mamoru
Associate Director of Space-Time Standards Laboratory, Applied Electromagnetic Research Institute

Wideband Inter-Networking engineering test and Demonstration Satellite (WINDS) “KIZUNA” Project

WINDS in-vehicle earth station (left) and transportable earth station (right)

We are conducting experiments and research related to next-generation high-speed satellite communications technology using Wideband Inter-Networking engineering test and Demonstration Satellite (WINDS) “KIZUNA” in an effort to realize information-communications environments where the internet can be used anywhere and anytime.

— Speaking is TAKAHASHI Takashi, Research Manager, and OHKAWA Mitsugu, Senior Researcher, of Space Communication Systems Laboratory, Wireless Network Research Institute.

“KIZUNA” was jointly developed by NICT and JAXA (Japan Aerospace Exploration Agency) in order to demonstrate 21st century high-speed satellite network technology. At NICT, besides having designed a high-speed switching router equipped to satellites, we are also engaged in Active Phased Array Antenna (APAA) element research. Furthermore, we also developed a high-speed burst modem as a ground system that enables 1.2Gbps/622Mbps high-speed communication.

—What kind of results did you achieve?

In 2009, we distributed in high-definition a total solar eclipse from Iwo Jima Island in collaboration with the National Astronomical Observatory of Japan, NHK, and JAXA, and in 2010 transmitted live 3D high-definition footage of cardiac surgery, confirming the possibility of transmitting large quantities of data to a remote location. We also conducted a demonstration experiment in which we transmitted ultra-high definition television of Daigokuden Palace 4K footage from the 1300 year Heijo capital transfer festival venue via NICT’s multi-channel video codec system. After the Great East Japan Earthquake of 2011, we provided “KIZUNA” communication lines in collaboration with JAXA and supported disaster response activities by securing communication networks with emergency fire relief teams and self-defense forces who dispatched to the area. This allowed us to confirm the usability of provisional broadband communication networks at the time of a disaster. In 2012, we conducted: an experiment in which we transmitted a scene of Tokyo Fire Department disaster drill to the Tokyo Fire Department’s headquarters; a data transmission property measurement in Hawaii—a satellite-equipped APAA radiation zone; and a remote medical educational experiment that connected John A. Burns School of Medicine, University of Hawaii and Okinawa.

—Please share your future prospects.

Five years have passed since the launch of WINDS (February 23, 2008). In the future, using newly developed in-vehicle earth stations, we plan to conduct disaster countermeasure experiments (connection experiments with wireless mesh networks, etc.) and experiments in which marine resource exploration information is transmitted from ships. This broadband satellite transmission technology is expected to contribute significantly in disasters which are concerned to be occurred in the future.

TAKAHASHI Takashi / Photo: right
Research Manager, Space Communication Systems Laboratory, Wireless Network Research Institute

OHKAWA Mitsugu / Photo: left
Senior Researcher, Space Communication Systems Laboratory, Wireless Network Research Institute

Engineering Test Satellite VIII (ETS-VIII) "KIKU No. 8" Project

Fishing buoy (Tosakuroshio Ranch No. 16, Kochi Prefecture)

—We talk with YAMAMOTO Shinichi, Senior Researcher of Space Communication Systems Laboratory, Wireless Network Research Institute, about experiments using ETS-VIII.

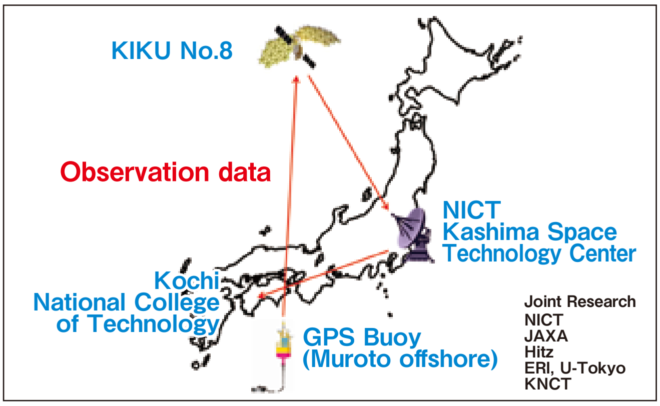
ETS-VIII (Engineering Test Satellite VIII (ETS-VIII) "KIKU No. 8") was launched in December 2006. In outer space, we deployed two large antennas for transmission and reception, both close to the size of a tennis court at 19m long and 17m wide—the world's largest communications satellite.

—Please share your recent experiment results.

In 2012, we conducted a data transmission experiment from a marine buoy as a satellite sensor network experiment aimed at the early detection of tsunamis. We attached a small sensor earth station to a fishing buoy (8m diameter) floating approximately 40km off of Murotomisaki, Kochi Prefecture, transmitted wave information using "KIKU No. 8"—which was received at Kashima Space Technology Center—and conducted an experiment where we send received data in real time to related institutions through terrestrial lines. This experiment was conducted in collaboration with Kochi National College of Technology, Earthquake Research Institute of the University of Tokyo, Hitachi Zosen Corporation, JAXA, and NICT. The marine buoy is tossed around by waves and moves non-stop. Using an antenna system which track a satellite automatically was difficult because the amount of power we can use with the buoy is limited, so in the experiment, we needed to use an omnidirectional antenna. Although the transmission power was 0.8 watts and information speed 50bps, we were able to sufficiently transmit wave information.

—How will you utilize the experiment results?

Based on this experiment, we were able to get a fundamental data for data transmission from the marine buoy including many amount of knowledge. Today, people are worried that a tsunami will occur from a large earthquake centered in the Tonankai trough. Although we hope for data from more than 100km offshore for tsunami observation, it is hoped that the early detection of the tsunami is enabled without having the distance from the coast by using satellite communications. Also, we can transmit data from disaster areas to places far away and therefore can without fail send out received information. We use the results obtained this experiment for the early detection of disaster and for the systems design of an information collection, and also for the system operation.



Conceptual diagram of the experiment
(Image provided by: Kochi National College of Technology)

YAMAMOTO Shinichi
Senior Researcher, Space Communication Systems Laboratory, Wireless Network Research Institute

Precise Orbit Control Technology

35cm telescope used for geostationary satellite monitoring

— On top of the research headquarters are two observation domes that observe the orbit of artificial satellites. We talk with KUBO-OKA Toshihiro, Senior Researcher of Space Communication Systems Laboratory, Wireless Network Research Institute.

Artificial satellites are broadly divided into two types: geostationary and orbiting satellites. Geostationary satellites do not actually remain stationary but appear to be in the same position from land because they orbit in concert with Earth's rotation period. However, because Earth is not a uniform sphere, gravity differs in certain places, and due to the influence of the sun and moon's gravitational pull and sunlight's radiation pressure, the orbits of artificial satellites change subtly and satellites in geostationary orbits also move in different ways. Hence, satellite proximity and radio wave interference problems may arise as geostationary satellites increase. We have been conducting research and development on geostationary satellite orbit monitoring technology that uses optical telescopes and CCD cameras, and at present, can determine the location of a satellite orbit at an altitude of 36,000km, 1/1,000 degree angle and distance accuracy of approximately 700m. We are providing geostationary observation image and orbit location information in response to requests from businesses that operate geostationary satellites.

The reason why there are two observation domes is because we must monitor two satellites simultaneously with two telescopes when a geostationary satellite approaches the geostationary satellite we are observing.

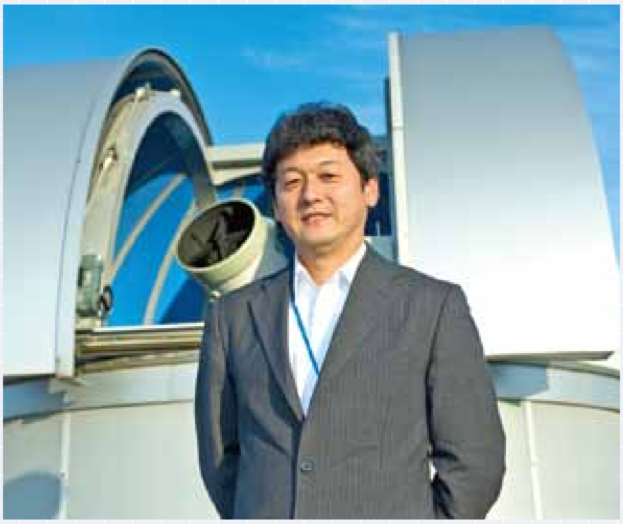
—Are you also checking the orbit of orbiting satellites?

We are planning an experiment as a new initiative in which we connect an optical satellite with an artificial satellite that revolves at a low-altitude geocentric orbit. We made adjustments to quickly and smoothly operate the telescope mount in order to track orbiting satellites. We also increased the sensitivity and definition of CCD cameras and improved the shutter mechanism that accurately measures shutter opening and closing times in order to determine satellite orbits with a high degree of precision. This has made possible the world's first experiment that determines the orbit of low-orbiting optical communication satellites via an optical method.

—Please share your future plans.

We are planning to launch a small satellite equipped with an optical communication device next year and currently working on tuning that will improve the tracking accuracy of telescopes aimed at the international space station which orbits at a low altitude.

—Thank you very much for your time today.



KUBO-OKA Toshihiro
Senior Researcher, Space Communication Systems Laboratory, Wireless Network Research Institute

Report on Memorial Symposium for the Establishment of the Terahertz Technology Research Center

"The Possibility of the Terahertz Waves for its Industrial Applications"

—With eager anticipation for Terahertz Technology!—

Photo 1 Opening address (KUMAGAI Hiroshi, Vice President, Member of the Board of Directors, NICT)

Photo 2 Glimpse of the symposium

With terahertz technology that uses terahertz waves located between light and radio waves (frequency band of approximately 0.1–10THz(terahertz)), we are beginning to see the possibility of its application in various industries such as non-destructive inspection through terahertz wave characteristics, spectroscopy analysis, and ultrafast radio. Various research development projects are also actively being planned and implemented in Japan and abroad. In light of this situation, the Terahertz Technology Research Center was established at NICT in June 2012 in order to further promote research and development of terahertz technologies. In commemoration of the Center's establishment, we held "The Possibility of the Terahertz Waves for its Industrial Applications" Symposium on January 16, 2013 at IINO Hall & Conference Center with the support of the Ministry of Internal Affairs. Divided into four sessions—Imaging, Interdisciplinary Integration, Spectroscopy Infrastructure, and Ultrafast Radio Communications (8 presentations and 40 posters)—the symposium was aimed at deliberating the future of industry applicability potential, along with providing an overview of NICT independent/commissioned research and research/development for the radio wave resource augmentation by Spectrum User Fee, Ministry of Internal Affairs and Communications and a research/development overview in the terahertz technology fields by Strategic Information and Communications R&D Promotion Programme (SCOPE).

The symposium was at full capacity with approximately 300 participants from government, universities, and the private sector including manufacturing and information-communications businesses (Photos 1 & 2). Furthermore, we held a poster session, "Disciplinary Integration," in collaboration with the NICT Photonic Device Lab result briefing session in the venue lobby, where many visitors stopped at the exhibit introducing research in detail and listened intently to the researcher's explanations (Photo 3). The participant survey also garnered scores of responses, which indicated that the participants were pleased with the event content. During break times and at the end of the event, the research center also received many words of encouragement and anticipation. The research center hopes to further strengthen cooperation with other related institutions and continue promoting research and development aimed at the early realization of future industrial applications.

Photo 3 Poster session

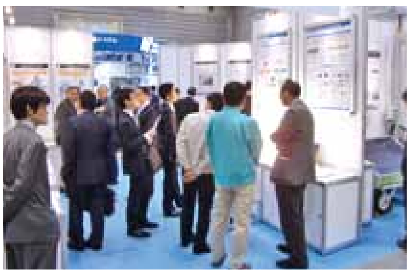
Report on “Holding the Disaster Crisis Management ICT Symposium 2013” and “The 17th Earthquake Technology Expo”

Panel discussion at the symposium

On February 8, 2013, Applied Electromagnetic Research Institute, NICT and ICT Forum for Security and Safety held the “Disaster Crisis Management ICT Symposium 2013—Application and Practical Realization of Communications Sensing Technology for Earthquake Disaster Countermeasures” at PACIFICO YOKOHAMA, Annex Hall.

At the symposium, after greetings from the host, KUMAGAI Hiroshi, Vice President of NICT and ICT Forum for Security and Safety Planning Chairman, MATSUI Toshihiro, Director of the Research and Development Office, Global ICT Strategy Bureau, Ministry of Internal Affairs and Communications, gave a welcoming address as a guest. Next, after a keynote speech entitled, “Issues from East Japan great earthquake disaster, present measures; from a viewpoint of local government ICT” from IMAI Takehiko, Director of Information Policy Section, General Affairs and Planning Bureau, Sendai City, NEMOTO Yoshiaki, Director of Resilient ICT Research Center, NICT, held a lecture entitled, “Research activity for disaster-resilient ICT system”, where he gave an overview of the research facility and explained the background and aims of the research center’s establishment. Later, lecturers from NEC Corporation, Kochi National College of Technology, and NTT Network Innovation Laboratories gave lectures. In the following panel discussion moderated by IGUCHI Toshio, Director of Applied Electromagnetic Research Institute, NICT, attended by approximately 200 participants including municipal and government disaster-prevention officials, academics, and disaster-prevention device manufacturers, discussion was held on necessary technology development challenges as earthquake disaster countermeasures and its research system, and also the path towards practical application of available technologies.

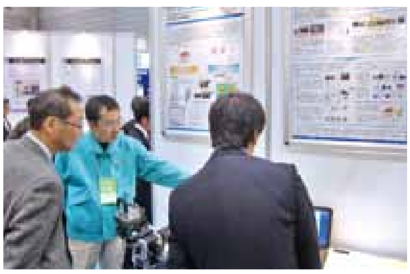
On February 7–8, NICT displayed an exhibition booth at the event “The 17th Earthquake Technology Expo” held jointly with the symposium above at PACIFICO YOKOHAMA. The following exhibits were held via panels and demonstrations: “Satellite sensor network and a data transmission experiment from a marine buoy using ETS-VIII”, “Phased array weather radar”, “Radiation dosage monitoring system using the smart utility networks”, “Infrared 2D lock-in amplifier system for nondestructive testing of small cracks in building wall”, “Case studies of electromagnetic observation of partially-destroyed houses after the Great Eastern Japan Earthquake”, “Decentralized regional area wireless network: NerveNet”, “Compact free-space optical communication terminal for multi-Gbps class point-to-point wireless links”, and “Fully-automatic transportable station”. ICT Forum for Security and Safety members also held panel discussions on disaster response efforts. With over 15,000 exhibition visitors and many of them visiting the NICT booth, we attracted a lot of interest towards NICT disaster countermeasure technologies.



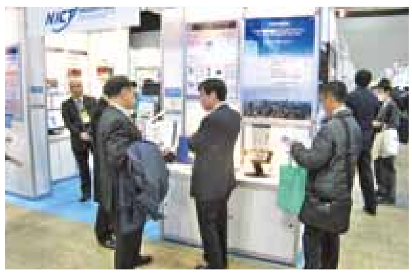
NICT booth

Satellite sensor network and a data transmission experiment from a marine buoy using ETS-VIII

ICT Forum for Security and Safety member efforts on disaster response



Infrared 2D lock-in amplifier system for nondestructive testing of small cracks in building wall



Case studies of electromagnetic observation of partially-destroyed houses after the Great Eastern Japan Earthquake

NICT Entrepreneurs' challenge 2days

2nd Kigyouka Koshien

A business contest for students in technical college, university, and graduate school to discover and foster the future entrepreneurs of Japan through creating PR plans and developing both products and services related to ICT.

Date/Venue

Thursday, March 7, 2013

CyberAgent Ventures, Inc.
(Akasaka, Tokyo)

Presentations by Teams

■Team name: "Yonago Technical College Procon Team"
Yonago National College of Technology / 23rd Programming Contest
■Team name: "ShinBunet"
Okinawa National College of Technology / 23rd Programming Contest
■Team name: "Aita Shingo"
University of Aizu / Aizu IT Technology Approval Council
(Hokkaido/Tohoku area/Fukushima)
■Team name: "Team Incubator"
Yokohama National University / 7th YNU Business Plan Contest (Kanagawa: Kanto area)
■Team name: "Kotoshino fuyukoso stoikkuni ikirutte kimetakara"
Chuo University / Nojima Business Award Contest 2012 (Tokyo: Kanto area)
■Team name: "IT"
Digital Hollywood University / Venture Special Course Selection (Tokyo: Kanto area)
■Team name: "Team☆Hitoride dekirumon"
The University of Electro-Communications / General Public/Student Idea Contest
(Tokyo: Kanto area)
■Team name: "Watashino oyakoukou"
Kwansei Gakuin University / Ritsumeikan University Student Venture Contest
(Kyoto: Kansai area)
■Team name: "Mokutomo"
Doshisha University / Doshisha New Island Contest 2012 (Kyoto: Kansai area)

Program

14:00	Opening
14:20	Presentations (Break)
17:00	Awards Ceremony / Exchange Party

ICT Venture Business Plan Contest 2012

A venture business plan presentation contest by individuals aiming at venture business & manufacturing in the field of ICT in order to promote opportunities for technology/business collaborations, funding, HR recruitment, and market expansion.

Date/Venue

Friday, March 8, 2013

WTC Conference Center [World Trade Center Building 38F]
(Hamamatsucho, Tokyo)

Companies Presenting

■Agri Future Corp. (Miyagi Pref.)
■GClue, Inc. (Fukushima Pref.)
■ShuR Co., Ltd. (Kanagawa Pref.)
■ACROSS Solutions, Inc. (Ishikawa Pref.)
■Kinoki (Aichi Pref.)
■Matilda (Gifu Pref.)
■sofnetjapan Co.,Ltd. (Hiroshima Pref.)
■REEVO Inc. (Fukuoka Pref.)

Program

12:00	Registration begins
13:00	Opening
14:00	Presentations
	(Break)
17:00	Awards ceremony / Information Exchange Event

Inquiries

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ICT Industry Promotion Office
http://www.venture.nict.go.jp/
Email: sougyo@ml.nict.go.jp

We will be streaming live via USTREAM!

Channel	
Entrepreneurial Koshien	kigyokakoshien
Business Plan Contest	nict-bp

Information for Readers

Due to certain circumstances, our February issue is 8 pages.
The next issue will feature research on cryptographic technologies at NICT.

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〈Recycled Paper〉