

Kashima and Koganei 11-m VLBI Stations

Yasuhiro Koyama

Abstract

Two 11-m VLBI stations at Kashima and Koganei used to be a part of the Key Stone Project VLBI Network. The network consisted of four VLBI stations at Kashima, Koganei, Miura, and Tateyama. Since Miura and Tateyama stations have been transported to Tomakomai and Gifu, Kashima and Koganei 11-m stations are remaining as IVS Network Stations. After the regular VLBI sessions with the Key Stone Project VLBI Network terminated in 2001, these stations are mainly used for the purposes of technical developments and miscellaneous observations. In 2006, a geodetic VLBI test experiment using the multi-channel 2 Giga-bits AD sampler unit ADS2000 was performed between Kashima and Koganei 11m VLBI stations. Efforts to determine the precise orbit of spacecrafts were continued by using Geotail spacecraft and two KSP VLBI stations. In addition, a series of experiments were carried out for the development of e-VLBI by using the high-speed network connection between the sites and the two 11-m antennas.

1. Introduction

The Key Stone Project (KSP) was a research and development project of the National Institute of Information and Communications Technology (NICT, formerly Communications Research Laboratory) [1]. Four space geodetic sites around Tokyo were established with VLBI, SLR, and GPS observation facilities at each site. The locations of the four sites were chosen to surround Tokyo Metropolitan Area to regularly monitor the unusual deformation in the area (Figure 1).

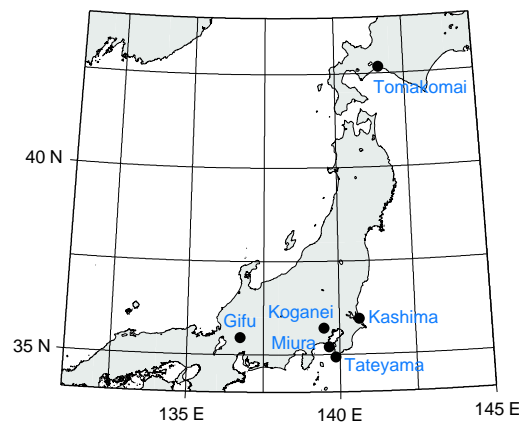


Figure 1. Geographic locations of four KSP VLBI stations and two stations at Tomakomai and Gifu.

Therefore, the primary objective of the KSP VLBI system was to determine precise site positions of the VLBI stations as frequently and fast as possible. To realize this objective, various new technical advancements were attempted and achieved. By automating the entire process from the observations to the data analysis and by developing the real-time VLBI system using the high-speed digital communication links, unattended continuous VLBI operations were made possible.

Daily continuous VLBI observations without human operations were actually demonstrated and the results of data analysis were made available to the public users immediately after each VLBI session. Improvements in the measurement accuracies were also accomplished by utilising fast slewing antennas and by developing higher data rate VLBI systems operating at 256 Mbps.

11-m antenna and other VLBI facilities at Miura and Tateyama stations have been transported to Tomakomai Experimental Forest of the Hokkaido University and to the campus of Gifu University, respectively. As a consequence, two 11-m stations at Kashima and Koganei (Figure 2) are remaining as IVS Network Stations. After the regular VLBI sessions with the Key Stone Project VLBI Network terminated in 2001, 11-m VLBI stations at Kashima and Koganei are mainly used for the purposes of technical developments and miscellaneous observations.



Figure 2. 11-m VLBI antennas at Kashima (left) and Koganei (right).

2. Activities in 2006

For technical developments, the baseline between Kashima and Koganei is now used as a test bed for real-time VLBI observations based on the Internet Protocol (IP). The two stations used to be connected by high-speed Asynchronous Transfer Mode (ATM) network in collaboration with the NTT Laboratories until July 2003. In April 2004, NICT started to operate the high-speed research test-bed network called JGNII and both the Kashima and Koganei stations are connected to the JGNII backbone with OC-192 (10 Gbps) connection. JGNII is a follow-on project of the JGN (Japan Gigabit Network) which was operated by the Telecommunications Advancement Organization of Japan (TAO) for 5 years from 1999. When TAO was merged with Communications Research Laboratory to establish NICT as a new institute, JGNII succeeded the JGN project. Whereas the JGN project was operated based on the ATM architecture, the new JGNII network mainly uses IP. One GbE (Gigabit Ethernet) interface is installed at Koganei station and two GbE interfaces are connected at Kashima station. This environment provides an ideal opportunity for e-VLBI research and developments.

In the year 2006, a geodetic VLBI test experiment was performed on March 17 and 18 for about 10 hours by using the newly developed multi-channel Giga-bit sampler units called ADS2000 [1]. By using the ADS2000 and the K5/VSI system, the 16 channels of data (10 for X-band and 6 for S-band) were recorded to the hard disks in the K5 system at the total data rate of 2048 Mbps. Each channel was sampled at the sampling rate of 64 Msps and the digitization level of 2 bits/sample. The observed data were processed by the K5 software correlator and then analysed with the CALC/SOLVE software. From this experiment, the baseline length was estimated with an RMS uncertainty of 1.3 mm and the performance of the system was confirmed.

Efforts to determine precise orbit of spacecrafts by means of differential VLBI observations were also continued from previous years. The S-band telemetry signal from the Geotail spacecraft was used to demonstrate precise orbit determination by means of differential VLBI observations. These efforts were initiated in 2003 with the requirements for precise orbit determination of spacecraft Nozomi and Hayabusa. Such efforts are still continuing with the hope of improving the technique for future space missions.

In 2006, the operating system for the Koganei KSP station was replaced with the fs9 software running on a Linux PC server. Since the operating system for the Kashima KSP station was also replaced with the fs9 software in 2004, both stations are now operated by using the fs9 software.

3. Staff Members

The 11-m antenna stations at Kashima and Koganei are operated and maintained by the Radio Astronomy Applications Group at Kashima Space Research Center, NICT. The staff members of the group are listed in Table 1. The operations and maintenance of the 11-m VLBI station at Koganei is also greatly supported by Space-Time Standards Group and Space Communications Group at Koganei Headquarters of NICT. We are especially thankful to Jun Amagai and Tadahiro Gotoh for their supports.

Table 1. Staff members of Space-Time Standards Group, KSRC, NICT.

Name	Main Responsibilities
Yasuhiro KOYAMA	Administration
Eiji KAWAI	Antenna System
Hikomitsu KUBOKI	Antenna System
Mamoru SEKIDO	Field System, Calibration and Frequency Standard Systems
Ryuichi ICHIKAWA	Meteorological Sensors, IGS Receivers
Masanori TSUTSUMI	System Engineer

4. Future Plans

In 2007, we plan to continue e-VLBI developments and differential VLBI observations to the spacecraft Geotail for the precise determination of its orbit. In addition to the VLBI observations and developments, there is a plan to use the 11-m antenna at Koganei to receive the downlink data from STEREO satellite.

References

- [1] Special issue for the Key Stone Project, J. Commun. Res. Lab., Vol. 46, No. 1, March 1999
- [2] Koyama, Y., T. Kondo, H. Osaki, K. Takashima, K. Sorai, H. Takaba, and K. Fujisawa, IVS CRL TDC News, No. 23, Nov. 2003, pp. 26-30
- [3] Koyama, Y., T. Kondo, M. Kimura, and H. Takeuchi, IVS NICT TDC News, No. 26, Sep. 2005, pp. 9-12