

# Analysis Center at National Institute of Information and Communications Technology

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## Abstract

This report summarizes the activities of the Analysis Center at National Institute of Information and Communications Technology (NICT) for the year 2005.

## 1. General Information

The NICT analysis center is located in Kashima, Ibaraki, Japan. It is operated by the Radio Astronomy Applications Group, Kashima Space Research Center of NICT. VLBI analyses at NICT are mainly concentrated on experimental campaigns for developing new techniques such as e-VLBI measurements for the real-time EOP determination and differential VLBI (DVLBI) for spacecraft orbit determination. In addition we carried out monthly IVS-T2 sessions. On September 12, 2005 Kashima 34 m station participated in the CONT05 campaign. WVR measurements were carried out at Kashima and Tsukuba during the campaign. We are also developing an automatic GPS analysis system named “APPS (Advanced Precise Positioning System)” to provide precise positioning for non-geodesist users.

## 2. Staff

The staff members who are contributing to the Analysis Center at the NICT are listed below (in alphabetical order):

- ICHIKAWA R., Spacecraft Orbit Determination and Atmospheric Modeling.
- KONDO T., Research Center Supervisor/Software Correlator
- KOYAMA Y., Group Leader/International e-VLBI
- SEKIDO M., Spacecraft Orbit Determination
- TAKEUCHI H., VLBI System Developments

## 3. Current Status and Activities

### 3.1. EOP Measurements

In September 2005, the Continuous VLBI 2005 (CONT05) campaign was carried out. On September 16, 2005 Kashima 34 m station participated in the CONT05 campaign. This measurement could be achieved by expanding the frequency coverage of X-band receiver system [1]. Preliminary results based on analysis between Kashima and Tsukuba baseline indicate that the system improvement worked well. To demonstrate the intercontinental e-VLBI technique Kashima 34 m station participated in two experiments on September 28-29, 2005 (iGrid 2005) and on November 12-18, 2005 (the annual Supercomputing Conference 2005).

### 3.2. Differential VLBI for Spacecraft Tracking

We performed 16 VLBI experiments for tracking HAYABUSA spacecraft during 2005. HAYABUSA, which means “Falcon” in Japanese, was launched on May 9, 2003, landed on asteroid “Itokawa” and tried to execute sampling from the asteroid on November 20 and 26, 2005. Unfortunately, as of the end of 2005, it was not confirmed whether HAYABUSA succeeded in sampling or not. Six VLBI sessions were observed during the HAYABUSA descending phase on Itokawa from November 4 to 26, 2005. In these measurements Kashima, Tsukuba and Chichijima of GSI, Usuda and Uchinoura of ISAS/JAXA, Mizusawa of NAOJ participated. The main purpose of these measurements was to evaluate the accuracy of spacecraft position determination using the differential VLBI technique. In addition the data from the measurements is also used to evaluate an internal time delay in the backend system.



Figure 1. Two WVRs at the Tsukuba 32 m station of GSI. Both Kashima and Tsukuba were equipped with WVRs during the CONT05 campaign.

### 3.3. APPS

We are developing an automatic GPS analysis system named “APPS (Advanced Precise Positioning System)”. APPS enables everybody to obtain accurate GPS solutions without requiring geodetic understanding, the operation of sophisticated GPS software, or complicated data handling. Users can submit static single point or multi-station network GPS data to the APPS analysis

server by e-mail and receive the analyzed results back by e-mail after a few minutes. At present we provide the mail-based APPS analysis service to a limited number of users in order to help to revise the system. We are also developing a web service for APPS.

### 3.4. Evaluation of Atmospheric Model

Both Tsukuba of GSI and Kashima VLBI stations performed atmospheric delay measurements using water vapor radiometer (WVR) during the CONT05 campaign. The data of co-located GPS stations were also obtained. At Tsukuba the radiosonde station of Japan Meteorological Agency (JMA) is located about 9 km south from GSI VLBI station. After the campaign our two WVRs were simultaneously operated at Tsukuba for the comparison with the radiosonde data sets (see Fig 1). Since Tsukuba and Kashima are located in the Asian monsoon region and the campaign was performed in the summer season of Japan, water vapor content was highly variable during the campaign. The maximum value of zenith wet delay (ZWD) is up to 30 cm. We show that the ZWD from GPS is in good agreement at less than 10 mm level. The ZWD derived by VLBI measurements is under investigation. In addition we will compare them also with operational pressure level data from the JMA numerical weather model.

## 4. Future Plans

For the year 2006 the plans of the Analysis Center at NICT include:

- Several international and domestic VLBI experiments for the real-time EOP determinations using e-VLBI and the K5 system (both VSSP system and PC/VSI system).
- Differential VLBI experiments for spacecraft tracking and its analysis
- Development of the analysis software for spacecraft positioning using phase delay observables
- Improvement of processing speed and efficiency for the VLBI data correlation using multi-processor and high speed network
- Evaluation of simulated positioning errors due to the tropospheric parameters (VLBI, GPS, WVR and the numerical weather prediction model)

In addition KSP data sets are still available at the URL <http://ksp.nict.go.jp/index.html>. General information about VLBI activities at NICT is provided at:

<http://www2.nict.go.jp/ka/radioastro/index.html>

(Please note that these URLs were changed from those given in the 2003 annual report).

## References

- [1] Kawai, E., et al., IVS Annual Report 2005, this volume