Technology Development Center at CRL

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Abstract

Communications Research Laboratory (CRL) has led the development of VLBI technique in Japan and has been keeping high activities in both observations and technical developments. This report gives a review of the Technology Development Center (TDC) at CRL and summarizes recent activities.

1. TDC at CRL

Communications Research Laboratory (CRL) has published the newsletter "IVS CRL-TDC News" twice a year in order to inform the development of VLBI related technology in Japan as an IVS technology development center to the world. The newsletter has been published twice a year. One of them is published as proceedings of the symposium held at the Kashima Space Research Center every autumn. The newsletter is available through the Internet at following URL **http://www.crl.go.jp/ka/radioastro/tdc/index.html**.

2. Staff Members of CRL TDC

Table 1 lists the staff members at CRL who are involved in the VLBI technology development center at CRL.

Table 1. Staff Members of CRL TDC as of December, 2003 (alphabetical).

Name (Last, First)	Works
Ichikawa, Ryuichi	Delta VLBI
Kawai, Eiji	Antenna system
Kimura, Moritaka	Giga-bit e-VLBI
Kondo, Tetsuro	e-VLBI
Koyama, Yasuhiro	e-VLBI, analysis softwares
Kuboki, Hiromitsu	Antenna system
Nakajima, Junichi	Giga-bit e-VLBI
Osaki, Hiro	FS9, e-VLBI
Sekido, Mamoru	Delta VLBI
Takeuchi, Hiroshi	Antenna system, and e-VLBI

3. Recent Activities

3.1. Geodetic VLBI using K5/VSSP system[1]

The first 24-hour geodetic observation using the K5/VSSP (IP-VLBI) system was carried out on the Kashima-Koganei baseline on January 31, 2003. Observations were also carried out by using the K4 system and the gigabit VLBI system in parallel with the K5 system for the system

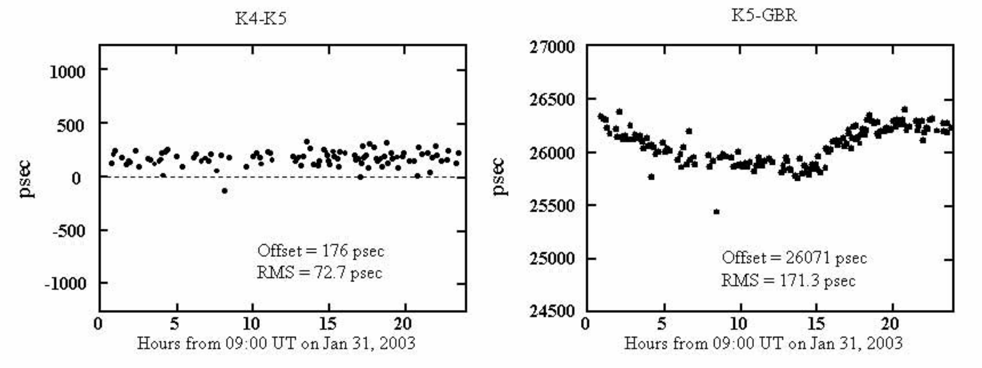

Figure 1. Differences of group delays obtained from K4, K5, and gigabit VLBI systems.

verification by comparing each result. Fig.1 shows results of differences of group delays observed by each system. An offset seen in the comparison result between K4 and K5/VSSP denotes the difference of the instrumental delay of each system. The standard deviation of data variation is consistent with that predicted from a signal to noise ratio. It is therefore concluded that the K5/VSSP has no fatal defect. Long term variations of the scale of several hours or more seen in the results between K5 and gigabit system (GBR) are considered as the characteristics of the gigabit system against the change of ambient temperature. The K4 and the K5/VSSP systems are multi-channel (i.e., band splitting) systems while the gigabit system is a single channel (i.e., full band) system. In the case of multi-channel system, phase calibration signals injected in each channel cancels out delay variations commonly appearing in the both systems such as the effect of temperature variations. Long term variations are usually treated as a clock behavior in a baseline analysis, so that it does not affect positioning accuracy seriously.

3.2. US-Japan e-VLBI for a rapid UT1 measurement[2]

We attained the shortest record of time to obtain UT1 in collaboration with MIT Haystack Observatory team. We succeeded in UT1 measurement in less than 24 hours from the observation start by means of e-VLBI conducted on the Kashima(K5)-Westford(Mark-V) baseline on June 25, 2003. Times required for observations, data transfer, format conversion, correlation processing, and UT1 analysis (including bandwidth synthesis) were 2 hours, 4 hours, 4 hours, 12 hours, and 1 hour, respectively.

3.3. Delta e-VLBI for spacecraft positioning[3][4][5][6]

We carried out a series of delta VLBI observations of "NOZOMI", a Japanese spacecraft exploring Mars, under cooperation of a VLBI community in Japan using the K5/VSSP system during the period just before the last earth swing-by (June 19, 2003) to cruise to Mars. Measurements of group delay were carried out and it was confirmed by a closure test that an accuracy of nanosecond order was achieved. Although the baseline lengths are not long (a few hundreds kilometers) the accuracy of spacecraft positioning of 300 mas was attained in spite of the use of low intensity and narrow-band (< 1MHz) signals. To improve this accuracy ten times or more, we are developing a technique to observe phase delay and to connect it between observation scans.

Technology development of e-VLBI for spacecraft positioning is continued using the “HAYABUSA (falcon)” that is a Japanese spacecraft launched in May, 2003 and aims at the sample return from the asteroid.

3.4. K5/PC-VSI gigabit VLBI system[7]

Using a VSI interface board (PC-VSI 2000DIM) developed in the last fiscal year, it was succeeded in direct acquisition of 1 Gbps data with the Linux file system. Data acquisition of 2 Gbps rate is possible with this interface board. As the K5/PC-VSI system adopts a general-purpose PC and file system, it shows a remarkable affinity for the Internet compared with the Mark-V system. A series of e-VLBI experiment (ftp data transfer after an observation) with the Metsähovi Radio Observatory (MRO), Finland was conducted as in the last fiscal year. Observations with 2 Gbps were carried out in June, 2003 and fringes were successfully detected by using a software correlator (Fig.2).

Development of a 16-ch sampler (ADS2000) (Fig. 3) that substitutes for DFC2000 goes well and is almost finished.

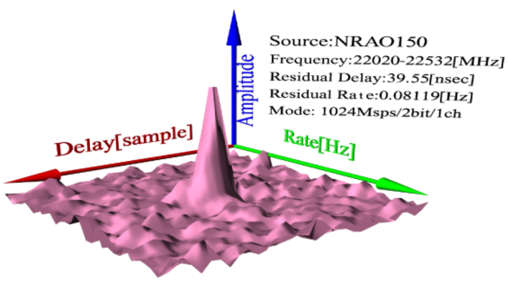

Figure 2. 2 Gbps fringes observed on Kashima - Metsähovi baselline using K5/PC-VSI system.

Figure 3. K5/PC-VLBI system: PCs with PC-VSI board (2TB server), a giga-bit A/D sampler (ADS1000), and a 16ch × 64Msps sampler (ADS2000).

3.5. Practical use of software correlator[8][9]

Two types of software correlator have been developed at CRL. One is a software correlator dedicated to geodetic-VLBI data processing. Real-time processing of 10 Mbps data is possible now by a PC. It was already used practically for the processing of “Nozomi” VLBI observation data and of 24-hour geodetic VLBI session data.

The other type of software correlator is dedicated to the processing of gigabit VLBI data. Real-time processing of 100 Msps (mega-samples per sec) is possible now. Network distributed processing system aiming at the real-time processing of 1 Gsps data is under development.

Figure 4. Logomark of NICT.

4. Coming reorganization from CRL to NICT

Under the "Reorganization and Rationalization Plan of Special Public Institutions" adopted at a Japanese Cabinet meeting held in December 2001, CRL and the Telecommunications Advancement Organization of JAPAN (TAO) will be reorganized as the National Institute of Information and Communications Technology (NICT) on April 1, 2004. Fig.4 shows the new logomark of NICT.

References

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