Tsukuba VLBI Correlator

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Abstract

This is a report of the activities at the Tsukuba VLBI Correlator in 2004.

1. General Information

The Tsukuba VLBI Correlator, as well as the Tsukuba 32-m VLBI station, was established by the Geographical Survey Institute (GSI), at the GSI site located in Tsukuba city, Ibaraki, Japan. The Correlator routinely processes geodetic VLBI sessions in local range named JADE (Japanese Dynamic Earth observation by VLBI) and UT1 Intensive sessions between Wettzell and Tsukuba. The correlator is preparing for introducing a disk-based K5 system in addition to its existing tape-based K4 system.

2. Component Description

The Tsukuba VLBI Correlator basically operated with the tape-based K4 correlation system for geodetic VLBI that was designed and developed by CRL (now NICT). The K4 correlation system mainly has the following 4 components: 3 correlator units with 32 lags for each 16 channels, a system controller, 3 tape drive units housed in auto tape changers, and an HP workstation. The system uses the correlation processing software "Oxtail Version 2.0" and the analysis software "CALC/SOLVE (NASA/GSFC)".

In 2004, we had a plan to upgrade our correlator to the disk-based K5 correlation system. Although integration of the K5 system has not been completed yet, the following hardware has been introduced into the new system as an initial step: 24 PCs, each ready for externally mounting 4 K5 disks via interface boards, 8 rack mount correlation servers with dual CPUs (Fig.1). Kernel programs of the system have been introduced under license from a developer of the programs, National Institute of Information and Communications Technology (NICT), based on an agreement of research cooperation between NICT and GSI. All four GSI network stations also introduced the K5 recording system in March. A few parallel sessions recorded on K5 and K4 were conducted, but the amount of K5 data was not enough for comparisons with results from K4. Completing integration of K5 requires more parallel observations for resolving this problem. To deal with increasing data volumes from the parallel observations, 3 correlation units and a recorder interface unit that NICT lent us were added on the K4 system in June. This improvement increased the K4 processing capacity from "3 baselines for 3 stations" to "6 baselines for 4 stations".

3. Global Solution

GSI, not the IVS analysis center, independently continued global analyses for determining positions/velocities of the local VLBI stations in Japan. We worked on it on a quarterly basis in 2004, and the latest version of the global solution was "gsi2004d" released December 2004, in which 3888 data from most of the 24-hour sessions between April 1980 and December 2004 were adopted.

Figure 1. K-5 correlator system (in preparation)

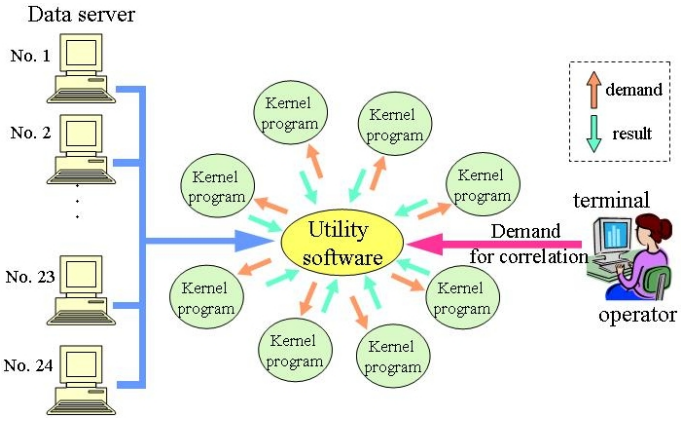

Figure 2. utility software (in preparation)

Table 1 shows the site coordinates as an example for the parameters obtained in the solution. Most of the sites were determined with few mm precision. 148 station positions/velocities were estimated in the analysis as global parameters. Station positions were given at epoch 1997.01.01. The EOPs (x, y pole coordinates, UT1-TAI, nutation offsets) were estimated as local (each session) parameters.

Table 1. Station position from gsi2004d

station	X [m]/sigma	Y [m]/sigma	Z [m]/sigma	session
TSUKUB32	-3957408.776	3310229.386	3737494.810	201
	0.001	0.001	0.001	
SINTOTU3	-3642142.082	2861496.673	4370361.834	31
	0.004	0.003	0.004	
AIRA	-3530219.323	4118797.579	3344015.865	42
	0.003	0.003	0.002	
CHICHI10	-4490618.492	3483908.175	2884899.141	43
	0.003	0.003	0.002	
VERAMZSW	-3857241.857	3108784.796	4003900.611	8
	0.012	0.010	0.012	
GIFU11	-3787123.407	3564181.781	3680275.138	15
	0.005	0.005	0.005	

4. Staff

The staff members of the Tsukuba VLBI Correlator are compiled in the following list. The other staff members of the GSI VLBI team are listed in a table of the Network Station report of the Tsukuba 32-m VLBI station (this volume). The staff of Space Engineering Development Co., Ltd (SED) mainly performed routine operations over 200 days under contract with GSI. Additional 24

days were funded by National Astronomical Observatory of Japan (NAOJ).

- K. Takashima : Operation manager (GSI)
- M. Machida : technical staff, correlation chief, K4 tape librarian (GSI)
- M. Ishimoto : technical staff, intensive set-up (GSI)
- S. Kurihara : technical staff, global solution analyst (GSI)
- K. Sakamoto : main operator in routine correlation processing (Space Engineering Development Co., Ltd)
- T. Nishino : sub operator in routine correlation processing (Space Engineering Development Co., Ltd)

5. Current Status and Activities

The Tsukuba VLBI Correlator processed the following in 2004: 12 domestic 24-hour sessions for geodetic VLBI campaign (project JADE; Japanese Dynamic Earth observation by VLBI), 55 Intensive sessions for UT1, 10 Syowa sessions, some fringe tests.

GSI conducted 24-hour JADE sessions once a month in response to increased demand for geodetic observation. The participants in JADE sessions were not only the GSI network stations, but the other ones including VERAMZSW and GIFU11. JADE was expected especially by NAOJ as a basis for determining the antenna position of VERAMZSW, one of the astrometric VLBI stations in the VERA project promoted by NAOJ. We needed to process each JADE session twice to complete all, because the capacity of our K4 correlator was not enough to process all the participating stations at once in the case of more than five stations. Consequently, we had submitted the processed data twice per session to the MarkIII database in previous years. In 2004, we changed our policy about this flow of submission and have submitted processd databases only once per session after having all baselines processed. Currently, 4 JADE sessions have not been completed yet: JADE-0407, JADE-0410, JADE-0411 and JADE-0412. These sessions have already been processed in 6 baselines for 4 stations, but are missing the second processing for the GIFU11 baselines.

Providing feedback to stations was encouraged as one of the main tasks. In JADE-0408, Pcal was corrupted badly at CHICHI10. The suspected causes of the problem were RF, LNA, cable connection, and IF attenuator. Carefully monitoring CHICHI10 during JADE-0409, Pcal remained corrupted. In addition, there was a gross error of cable value with elevation angle less than 40 degrees. Through the ensuing investigation, the cause turned out to be a cable interrupted around antenna elevation axis. The cable was fixed shortly before JADE-0410.

Corrupted Pcals with poor level of less than 1 percent were frequently detected at TSUKUB32 in correlation processing. In each case, manual phase cal procedure was necessary to apply in fringe fitting. We suspected a base station for commercial cellular phones in the neighborhood of TSUKUBA32 as a radio interference source. However this problem was resolved when we changed formatters at TSUKUB32 in December. The pcal level was improved up to 3 percent and no manual pcal was required after the replacement.

The Tsukuba VLBI Correlator performed correlation processings of Syowa sessions. Because the Syowa sessions were recorded on two different systems, S2 recording system at Hobart and

HartRAO and K4 recording system at Syowa, copying S2 to K4 had to be done at Mitaka Correlator before processing.

The correlator also processed 55 Intensive sessions which were observed on the single baseline between TSUKUB32 and WETTZELL. The intensive sessions performed by the end of July had been recorded and processed on K4 as usual. From August through December, there were two changes in running the Intensive sessions: 1) It was carried out also on Sunday adding to the existing Saturday sessions. 2) As one of our challenges in the field of e-VLBI, sessions on last Sunday of month were with our new disk-based system. In the e-VLBI sessions, data had been recorded on K5 at TSUKUB32 and on Mark 5 at WETTZELL. The data recorded at WETTZELL were transferred to the Tsukuba VLBI Correlator via Internet and then converted to K5 in order to perform correlation processing. We have achieved 2 days in one session data processing: 1 day for data transfer, 1 day for correlation processing.

The Tsukuba VLBI Correlator has presented its detailed current status and activities at the VLBI community in Japan ([1],[2]).

6. Plan for 2005

In 2005, the Tsukuba VLBI Correlator is expected to be responsible for processing 12 domestic 24-hour sessions of the project JADE conducted by GSI. It is also planned to process the TSUKUB32/WETTZELL Intensive sessions on the K5 system starting in April; the sessions are performed on both Saturday and Sunday with K5/Mark 5 system.

We intend to work on integrating our K5 correlation system as well as upgrading and expanding our K-5 hardware, aiming to entirely shift from K4 system. Especially, developing and testing our K5 utility software to handle kernel programs of NICT (Fig.2) is a priority during early part of 2005.

The K4 correlator facility will be kept at least until March 2006 even after the GSI network stations entirely shift to K-5 mode.

References

[1] K. Takashima, M. Ishimoto, M. Machida, J. Fujisaku, S. Kurihara: The practical operation of eVLBI session to obtain UT1 solution rapidly, 102nd Meeting of the Geodetic Society of Japan, Tokyo, October, 2004.

[2] M. Ishimoto, K. Takashima, M. Machida, J. Fujisaku, S. Kurihara: Result of domestic VLBI experiment with the K5 VLBI system, 102nd Meeting of the Geodetic Society of Japan, Tokyo, October, 2004.