

# Tsukuba VLBI Correlator

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## Abstract

In 2002, the Tsukuba VLBI Correlator processed six JADE sessions for geodetic purpose and 18 sessions for ERP (UT1) resolution with K-4 (KSP) correlation system. Also, some revisions were made for correlation devices and programs. As a result, both the accuracy of a priori values used for correlation process and the process efficiency were largely improved. Two new staff members joined Tsukuba VLBI Correlator.

This report describes the above topics, general information, and future plans.

## 1. General Information

The Tsukuba VLBI Correlator is located at Tsukuba VLBI Center in Geographical Survey Institute, Japan. The Tsukuba VLBI Correlator has the K-4 (KSP) correlation system developed by CRL. This system, composed of 3 correlation processors and 3 playback recorders, has capability to perform simultaneous correlation process for 3 stations, 3 baselines. It takes about one week to complete a process for one JADE session in which five domestic stations participate.



Figure 1. K-4 (KSP) correlation devices at the Tsukuba VLBI Correlator. The three boxes on the left are automatic tape changers. A playback recorder is installed in each box. There are two racks at the center. Three correlators, one system controller and other devices are stored in the racks. On the right, there is a rack in which HP workstation and newly introduced disk array are installed to run correlation software and CALC/SOLVE. The appearance of the devices has not changed since last annual report, but some revisions or updates were made during 2002.

## 2. Correlation Processing

In 2002, we processed the following experiments.

- 6 GSI domestic experiments (JADE) carried out in 2002
- 18 intensive experiments between TSUKUB32 and WETTZELL (IN202)
- Some fringe tests

The last session in which KASHIMA took part before being demolished is included in the above JADE experiments. Through the process, some problems which occurred in observation were detected. One of them is that the fringe phase of X-band 8ch on CHICHI10 was different from those of the others. This was because a A/D formatter board in DFC-2100 at CHICHI10 had some trouble. Other problem is that no fringe was detected for SINTOTU3 data on JD0206 and JD0207. It was very serious, and we are investigating the cause.

There were 20 intensive experiments between TSUKUB32 and WETTZELL in 2002, and 18 experiments have already been processed. In the processes, we found one observation problem. The amplitude of P-cal on TSUKUB32 (X-band) tended to be low, and especially for the experiment K02343 it was less than 1%. However its phase was stable, therefore a manual P-cal method was applied to recover this session. As for the other 17 experiments, there are no serious problems. The analysis result of these intensive experiments is good as a whole. Figure 2 shows the residuals of UT1-UTC against IERS C04. The result of K-4 intensive experiments (IN202) generally agree with that of IN102 experiments but seems to have larger scatters. Since the number of IN202 experiments is not enough to discuss them in detail, we are planning to increase the number of K-4 intensive experiments to acquire more time series for data validation and evaluation. Additionally, it goes without saying that we have to make careful studies to take into account the systematic difference between K-4 (KSP) and Mark IV system.

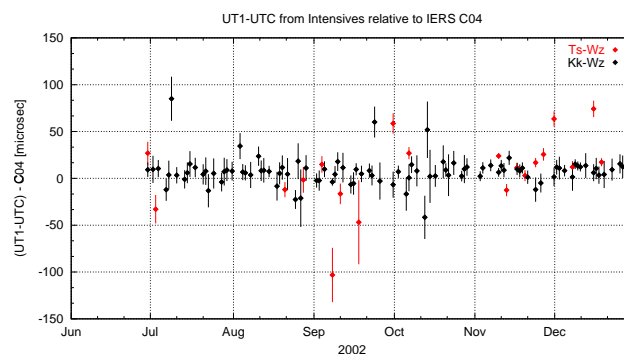


Figure 2. The comparison between the results of analyses by GSI and IERS C04. The red rectangles and bars show the residual of UT1-UTC, subtracting IERS C04 from the values obtained from IN202 experiments (between TSUKUB32 and WETTZELL), and the error bar, respectively. The black ones show the same as IN102 experiments (WETTZELL and KOKEE) from IERS C04.

### 3. Related Topics

In 2002, some major and minor updates were made on the K-4 (KSP) correlation system. Owing to these updates, the accuracy of a priori values for delay tracking, fringe stopping, etc. on correlator has improved to a large extent, and also the efficiency of correlation process has improved. The time spent on correlation process has been shorter than before the updates. The details are as follows.

#### 3.1. Updating the Program for Calculating A Priori Values

One of the major updates was made to the program for calculating a priori values by Dr. Kondo of CRL in July. The program is installed in system controller (CRC-9511-CNT1), which receives the command from workstation and controls correlation devices, and it is used for providing a priori values to the correlator. Due to the update, the precision of meteorological path delays has been improved, and consequently, higher S/N ratio is obtained especially for global range of baseline length and/or long accumulation period (PP). Even with the old program, coherence loss of correlation processing is a little for short baseline, such as JADE experiment, and short PP.

#### 3.2. Debug for Bandwidth Synthesis Program

Some bugs in the program for bandwidth synthesis were found and fixed by Mr. Koyama of CRL in July. In the old program, there were insufficient array declaration and wrong substitution for some variables. Although it didn't affect the following process, the source code in this program was corrected. At the same time, environmental variables were introduced, so this program, at present, can be executed on both GSI and CRL workstations without modification to the program.

#### 3.3. ROM Update

Due to hang-up of protocol converters (DKMS-001) which make GP-IB protocol compatible with RS-422 between system controller and automatic cassette changer, correlation process had often been suspended. It was one of the reasons why we had to spend much time processing. Dr. Kiuchi of CRL and other staff examined the firmware of the converter, and removed the function of collecting logs. A revision of ROM from Ver. 1.4 to 1.5 in each protocol converter in July 2002 completely removed suspension of correlation processes. Thanks to this update, required time for a correlation process has been shortened and the efficiency of correlation process was largely improved.

### 4. Staff

The staff at Tsukuba VLBI Correlator is as follows. The other staff members of GSI VLBI are listed in the table on the report of Tsukuba 32-m VLBI station in network section.

- Kohei Miyagawa : correlation chief, correlator operator
- Kyosuke Sakamoto : correlator operator (SED Co. Ltd.)
- Osamu Motohashi : correlator operator (SED Co. Ltd.)

Mr. Sakamoto and Mr. Motohashi have been hired since April 2002.

## 5. Plans for 2003

There are some future plans for 2003 and a few of them have already been concrete. We list the plans as follows.

- Correlation software upgrade
- Introduction of new workstation
- Increasing the number of sessions processed with K-4 (KSP) correlator
- Employment of full-time staff for 200 days

Correlation software “Oxtail” developed at CRL will be upgraded from Ver. 1.0 to 2.0. Oxtail is the software installed in workstations to handle file control, data transaction, information output, and so on. Although Oxtail at GSI was updated for a Y2K problem and some minor problems since the installation, major updates have never been implemented. In the meantime, several revisions were made at CRL for a GUI interface. So we will introduce the latest software, Oxtail Ver. 2.0. It is planned that the software will be installed in March 2003 and we will use it from April 2003.

A new workstation (HP 5470 server) and disk array will be introduced in March 2003. It will be mainly used for research on the method of global analysis with Batch Solve (NASA/GSFC). So far, we have performed correlation processes and baseline/global analyses only using one workstation (HP d370). We will expect the efficiency improvement for correlation processes and baseline/global analyses.

We will have considerably increased amount of correlation processes, with a plan that GSI VLBI group will have 12 JADE sessions and 100 intensive experiments between TSUKUB32 and WETTZELL from April 2003 until March 2004.

In this fiscal year of 2002, we employed one correlation staff member for 80 days. In the fiscal year of 2003, we are going to extend the period from 80 to 200 days, to cope with the increased processes mentioned above.

## 6. Acknowledgements

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## References

- [1] Ishihara, M., K. Nemoto, M. Iwata, K. Shiba, K. Takashima, and S. Matsuzaka, Tsukuba VLBI Center, In: International VLBI Service for Geodesy and Astrometry 1999 Annual Report, NASA/TP-1999-209243, N. R. Vandenberg (eds.), 160–163, 1999.
- [2] Miyagawa, K., Tsukuba VLBI Center, In: International VLBI Service for Geodesy and Astrometry 2000 Annual Report, NASA/TP-2001-209979, N. R. Vandenberg and K. D. Baver (eds.), 176–177, 2001.