

Tsukuba VLBI Correlator

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Abstract

This is a report of the activities at the Tsukuba VLBI Correlator in 2008. The Tsukuba VLBI Correlator processed 99 intensive sessions (IVS-INT2), nine JADE sessions and two geodetic sessions for JAXA. Additionally, we processed ultra-rapid dUT1 e-VLBI experiments and obtained UT1-TAI only 3 minutes 45 seconds after the end of the observing sessions.

1. General Information

The Tsukuba VLBI Correlator is situated at the Geographical Survey Institute (GSI) in Tsukuba, Japan. It is a part of the VLBI components operated by GSI, together with the Tsukuba 32-m VLBI station (TSUKUB32). There are two K5/VSSP correlator units. Intensive sessions (IVS-INT2), performed on Saturdays and Sundays on the TSUKUB32–WETTZELL baseline for monitoring UT1-UTC, have been correlated at the Tsukuba VLBI Correlator. The processing of the JADE series (geodetic sessions with domestic VLBI network of GSI) is also a major task of the Tsukuba VLBI Correlator.

2. Component Description

Both the K5/VSSP correlator units “system 1” and “system 2” have been in operational use. A component description for both units is presented in Table 1.

Removable disk cartridges from the stations are connected to a data server in an external mounting mode. Each data server can share a couple of disk cartridges at once through a drive unit. The data servers can perform distributed computing, as well as function as correlation servers. File handling and multi-task control is assumed by the management computer. There is no need to assemble a K5/VSSP correlator unit from individual components; an off-the-shelf computer provides sufficient hardware to support a K5/VSSP correlator unit.

Software correlation processing with the K5/VSSP correlation unit is based on IP-VLBI technology. It has been developed at NICT (National Institute of Information and Communications Technology, Japan). The most essential elements are four kernel programs: “apri_calc”, “cor”, “sdelay” in correlation package “ipvlbi20080930”, and “komb” in “komb20080219”. These K5/VSSP packages are licensed by NICT. Based on an agreement about research cooperation between GSI and NICT, the Tsukuba VLBI Correlator is allowed to take advantage of the products. “apri_calc” calculates the a priori delay and rate for each scan per single baseline. “cor” executes software correlation. “sdelay” makes coarse fringes directly from correlator output. “komb” is a bandwidth synthesis program to obtain multi-channel delays. K5/VSSP also has a conversion program; it can convert K5 to Mark 5 format and vice versa.

The kernel programs only have the capability of processing one single baseline scan. To meet the demands for processing many scans for multi-baselines, a simple way of distributed computing is brought into the unit. Once there is an uncorrelated data set, the task for it is distributed to any vacant correlation server. The auxiliary application software “PARNASSUS” handles the detailed control of processing multiple tasks. The acronym “PARNASSUS” stands for Processing

Application in Reference to NICT's Advanced Set of Softwares Usuable for Synchronization. The latest version PARNASSUS 1.3, developed at GSI and released March 2006, is installed in the management computer. PARNASSUS serves the operator as a tool, providing a graphical user interface and facilitating multi-task control. MK3TOOLS [1] developed by NICT is installed on a Linux computer to make Mark III databases. CALC/SOLVE developed by NASA/GSFC is installed on a Linux computer to produce primary solutions.

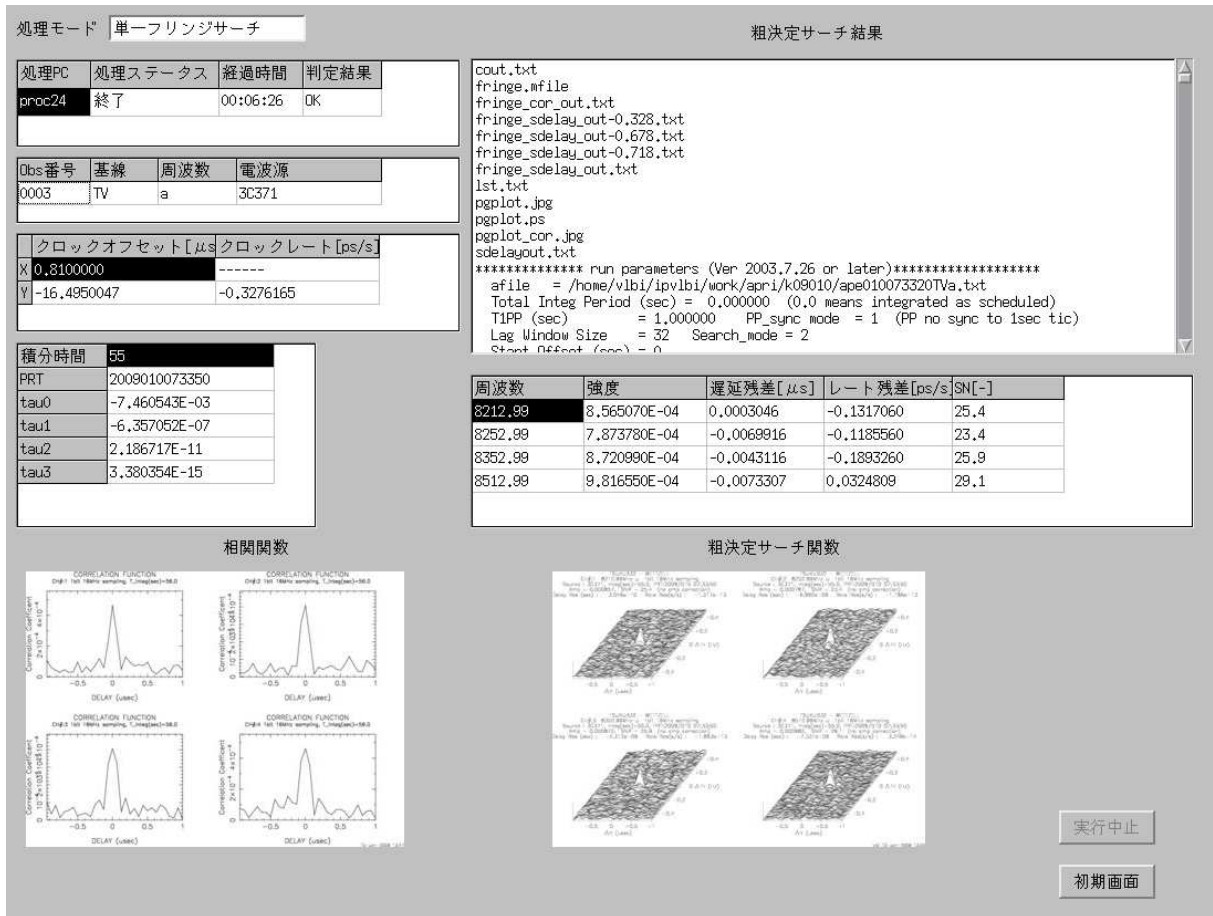


Figure 1. The fringe decision result from Parnassus.

3. Staff

A list of the staff at the Tsukuba VLBI Correlator in 2008 is given below. Routine operations were mainly performed under contract with Advanced Engineering Services Co., Ltd (AES) 227 days in the 2008 fiscal year (April 2008 through March 2009). Among the operations of 227 days, the operations for 20 days were funded by the National Astronomical Observatory in Japan (NAOJ) and the operations for 7 days were funded by the Japan Aerospace Exploration Agency (JAXA). Staff in the observation domain are listed in the report of the Tsukuba 32-m VLBI station in the Network Stations section of this volume.

Table 1. Component description of the Tsukuba correlator

	system 1	system 2
management computer (CPU)	1 Intel Pentium 4, 3.0 GHz	1 Intel Pentium 4, 3.0 GHz
data servers (CPU)	23 Intel Pentium 4, 3.0 GHz	8 Intel Pentium 4, 3.4 GHz
correlation servers (CPU)	16 (rackmount type computer) Intel Xeon 3.06 GHz (dual CPUs)	12 (rackmount type computer) Intel Xeon 3.4 GHz (dual CPUs)
format	K5/VSSP	
media type	SATA disk cartridge	
kernel program package	ipvlbi20080930, komb20080219	
aid application	PARNASSUS 1.3	
OS	Linux	
operation	JADE	IVS-INT2
installation	April 2008	August 2006

- Shigeru Matsuzaka : Head of Space Geodesy Division
- Kozin Wada : Deputy head of Space Geodesy Division
- Shinobu Kurihara : Responsible official
- Hiromi Shigematsu : Correlation chief, system manager
- Kensuke Kokado : Technical staff
- Kentarou Nozawa : Technical staff (AES)
- Yasuko Mukai : Technical staff (AES)

4. Current Status and Activities

During 2008, 99 intensive sessions (IVS-INT2) on TSUKUB32-WETTZELL or KASHIM34-WETTZELL single baseline for dUT1 determination and nine JADE sessions were processed at the Tsukuba VLBI Correlator. Almost all the data was processed correctly. Significantly, despite 2-bit sampling data, the correlation of jd0811 was not a problem either.

Two 24-hour geodetic sessions (the u08020 and u08170 sessions) were also processed at the Tsukuba VLBI Correlator. The u08020 session, conducted under GSI's initiative, aimed at the improvement of the UCHINOUR site position. The u08170 session, conducted under GSI's initiative, aimed at the improvement of the USUDA64 site position. UCHINOUR, 32-m in diameter, and USUDA64, 64-m in diameter, belong to and are funded by JAXA as tracking antennas for deep space missions. The processing of u08020 and u08170 was funded by JAXA.

Four ultra-rapid dUT1 e-VLBI sessions were processed at the Tsukuba VLBI Correlator in the form of test experiments. UT1-TAI was successfully obtained only 3 minutes 45 seconds after the end of the observing sessions. Since then, we have been attempting a 512 Mbps transfer rate, but we have not succeeded so far.

The e-VLBI correlation of the INT2 sessions has been possible since April, 2008. As the data transfer is done while observing, the correlation is immediately done by an automated operation

after the session. We do not have to correlate on Monday, and the database submission has become quicker than before, but only if there is no failure in the data transfer, the data conversion and the fringe detection.

A new computer was introduced to “system 1” as it became superannuated. To deal with high-speed processing for the Intensive sessions, the number of correlation servers was increased from 8 to 12. Moreover, because several data servers had broken down after two years of operation, we added 8 servers to “system 1”.

5. Plans for 2009

- We will continue to process the TSUKUB32/WETTZELL Intensive sessions (IVS-INT2) with the K5/VSSP system. The sessions are scheduled for Saturdays and Sundays with K5/VSSP (TSUKUB32) and Mark 5 (WETTZELL) systems. The Tsukuba VLBI Correlator is also expected to be responsible for processing several JADE sessions.
- We will add some more correlation servers and data servers to the existing K5/VSSP correlation units. At the same time, overloaded servers will be replaced by modern Linux machines to recover the proper performance of the K5/VSSP correlation units. In addition, the interface devices of the drive units have been gradually damaged through frequent loading of disk cartridges into the drive slots. The recovery process requires an overhaul of the drive units for both correlator and station use.
- Discussions for the next version of “PARNASSUS” will be continued. The current style of distributed computing appears not to be optimized for obtaining the greatest performance from the dual CPU capacity of the correlation server. To make multi-task processing in dual CPU mode effective, we plan to upgrade PARNASSUS by improving the access control to each correlation server. In order to fix sudden interruptions of the computing process on a machine, our action plan will address our software and hardware. New features will be introduced into PARNASSUS, such as handling each task’s information in a random manner and sorting access control first by baseline and then by scan number in order to avoid frequent access to a specific data server. The interaction among servers will be redesigned to keep the data processing running.
- We will use OCCAM as well as CALC/SOLVE for the primary solutions of the INT2 sessions. The database generation software MK3TOOLS is able to make the Mark III database and the NGS file by using NetCDF, and it is possible to solve by the automatic operation. Therefore, INT2 sessions will be solved by OCCAM, and the result will be delivered to the IVS mailing list in the future. This processing can be done by automation. We want to obtain the analytical result within a few minutes after the end of the session.

References

- [1] Y. Koyama, M. Sekido, T. Hobiger, H. Takiguchi and T. Kondo: Developments of automated data processing system for ultra rapid dUT1 e-VLBI sessions, The 5th IVS General Meeting Proceedings, 2008, p. 405-409