

Tsukuba VLBI Correlator

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Abstract

This is a report of the activities at the Tsukuba VLBI Correlator in 2007.

1. General Information

The Tsukuba VLBI Correlator is situated at the Geographical Survey Institute (GSI) in Tsukuba, Ibaraki Pref., Japan. It is a part of 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 Saturday and Sunday on the TSUKUB32–WETTZELL baseline for monitoring UT1-UTC, have been correlated at the Tsukuba VLBI Correlator. Processing of JADE series (geodetic sessions with domestic VLBI network of GSI, run for 24 hours) is also a major task for 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 the 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 on the K5/VSSP correlation unit is based on the 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 “ipvlbi20080110”, and “komb” in “komb20071214”. 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 a priori delay&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-band delays. K5/VSSP also has a conversion program; it can convert K5 to Mark 5 format and vice versa.

The kernel programs have the capability of processing only 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

Table 1. Component description of the Tsukuba correlator

	system 1	system 2
management computer (CPU)	1 Intel Pentium 4, 3.0GHz	1 Intel Pentium 4, 3.0GHz
data servers (CPU)	23 Intel Pentium 4, 3.0GHz	8 Intel Pentium 4, 3.4GHz
correlation servers (CPU)	16 (rackmount type computer) Intel Xeon 3.06GHz (dual CPUs)	8 (rackmount type computer) Intel Xeon 3.4GHz (dual CPUs)
format	K5/VSSP	
media type	SATA disk cartridge	
kernel program package	ipvlbi20080110, komb20071214	
aid application	PARNASSUS 1.3	
OS	Linux	
operation	JADE	IVS-INT2
installation	April 2005	August 2006

interface and facilitating multi-task control. CALC/SOLVE developed by NASA/GSFC is installed on an HP workstation to produce primary solutions.

3. Staff

A list of the staff at the Tsukuba VLBI Correlator in 2007 is given below. 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. K. Takashima, long time VLBI group member of GSI and the operations manager of the Tsukuba VLBI Correlator for the last four years, has left for a new career in April. In his stead, K. Wada took over the responsibility of GSI's representative member for Observing Program Committee. Routine operations were mainly performed under contract with Advanced Engineering Services Co., Ltd (AES) over 200 days in the 2007 fiscal year (April 2007 through March 2008). AES was asked for 20 additional days of routine operations which were funded by National Astronomical Observatory of Japan (NAOJ). AES was also asked for 13 additional days of routine operations which were funded by Japan Aerospace Exploration Agency (JAXA).

- S. Matsuzaka : Supervisor, Head of Space Geodesy Division (GSI)
- K. Wada : Operations manager (GSI)
- E. Iwata : technical staff (GSI), network expert, system development and consultant
- H. Shigematsu : technical staff (GSI), correlation chief, media library and shipping
- M. Machida : technical staff (GSI)
- K. Nozawa : main operator in routine correlation processing (Advanced Engineering Services Co., Ltd)
- K. Takano : sub-operator in routine correlation processing, (Advanced Engineering Services Co., Ltd)

4. Current Status and Activities

During 2007, 95 Intensive sessions (IVS-INT2) on TSUKUB32-WETTZELL single baseline for UT1, three Intensive sessions (IVS-INT2) on KASHIM34-WETTZELL single baseline for UT1, and 12 24-hour geodetic sessions of domestic network (JADE series) were processed at the Tsukuba VLBI Correlator.

One geodetic session for 24-hour (U07173 session) was processed also at the Tsukuba VLBI Correlator. The U07173 session, conducted under GSI's initiative, aimed at the improvement of both the USUDA64 and YAMAGUCH site positions. USUDA64, 64 m in diameter, belongs to and is funded by JAXA as a tracking antenna for deep space missions. YAMAGUCH, 32 m in diameter, belongs to NAOJ's resources, and is operated by Yamaguchi University as a contribution to observational research in astrophysics under cooperative relationship between NAOJ and Yamaguchi University. Processing of U07173 was funded by JAXA.

Some baselines of the four "ultra-rapid dUT1 e-VLBI" sessions were processed at the Tsukuba VLBI Correlator in the form of test experiments.

Processing of JADE series is usually done with "system 1", while "system 2" has continued operations mainly for processing Intensive sessions. One of our plans came due to add some more servers to "system 2" as expansion. Eight rack-mount-type Linux computers were provided for this work.

Many correlation tasks have been routinely loaded on "system 1" and "system 2". Now two years have passed since the installation of "system 1". Some components went down. This may lead to an overload on the remaining group of machines. The task information in the access control list is generally sorted by classification according to scan number first and then to baseline. There sometimes occurred an interruption of the computing process in the middle of a correlation. The cause was likely a full disk drive, which was accessed frequently for reading data files, eventually resulting in an NFS (Network File System) service stop.

5. Plan for 2008

- It is planned to continue to process the TSUKUB32/WETTZELL Intensive sessions (IVS-INT2) with the K5/VSSP system. The sessions are to be performed on both Saturday and Sunday with K5/VSSP (TSUKUB32) and Mark 5 (WETTZELL) systems. The Tsukuba VLBI Correlator is also expected to be responsible for processing 12 geodetic sessions (JADE) of the domestic VLBI network of GSI.
- 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 with modern Linux machines to recover properly the 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 continue in the advisory team of VLBI correlation domain. The current style of distributed computing appears not to be optimized for obtaining the greatest performance from dual CPUs capacity of correlation server. To make multi-task processing executable on dual CPUs mode effectively, we plan to upgrade PARNASSUS by improving the access control to each correlation server. In order to fix the

sudden interruption of the computing process on a machine, the action plan will address the software and hardware levels. New features will be introduced into PARNASSUS, such as handling each task 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 design of interaction among servers will be revised to keep the data processing running.