Key Stone Project VLBI Correlation Center

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Abstract

Communications Research Laboratory has developed two sets of correlator systems at Koganei, Tokyo for the Key Stone Project. One is for tape-based VLBI observations and the other is for real-time VLBI observations. The overview of the correlator systems will be described in this report.

1. Introduction

Communications Research Laboratory (CRL) has been doing regular geodetic VLBI experiments to monitor crustal deformation around Tokyo metropolitan area. The project was named as Key Stone Project (KSP) [1] and the correlator facilities have been developed at Koganei, Tokyo for the project. Two modes of VLBI observations are possible, one is a tape-based VLBI mode [2] and the other is a real-time VLBI mode [3]. The tape-based VLBI observation mode uses ID-1 standard cassette type magnetic tapes to record observed data. In the real-time VLBI observation mode, observation stations and correlator system are connected via high speed Asynchronous Transfer Mode (ATM) network which has been established under collaboration with the Nippon Telegraph and Telephone Corporation (NTT). Technical details of each system are described in Section 2.

The KSP VLBI correlation system is supposed to be routinely operated by persons who are not familiar with VLBI data processing. Therefore, a man-machine interface with GUI was developed for easy operations of the system. Since an operator is on duty only in daytime, the system is designed so that 24 hours of continuous correlation processing magnetic tapes can be performed without the help of an operator once the process is started. The developments of the real-time VLBI correlation system advanced the automation further. In principle, once the real-time correlation processing software (RKATS) is run, the software selects the schedule file of the day and performs correlation processing continuously without any human operations for unlimited days. At the same time, bandwidth synthesis procedures run to process correlator output data. After all the observations in an experiment are finished, Mark III database files are created and the data analysis processes are executed automatically. After all the required procedures are finished for an experiment, the correlator system starts to wait for the next schedule to be executed [4].

Although the KSP correlation system is designed for regular operations with the KSP VLBI stations, the system can also process general VLBI experiment data recorded in the K4 data format. In fact, several kinds of international VLBI experiments have been processed with the KSP tape-based VLBI correlator system. In addition, the real-time VLBI experiments with Nobeyama (Nobeyama Radio Observatory) and Usuda (Institute of Space and Aeronautical Science) have already been successful with optically linked ATM network as described in section 4.

Table 1. Hardware Components of tape-based KSP correlation system

Device name	Functions
Correlator	Correlation processing, correlator model calculation.
DIR-1000	Data play back unit of K4 cassette type magnetic tape.
DFC-2200	Data output for correlator and synchronization of data stream.
DMS-24	Automatic tape changer; 24 ID-1 cassette tapes can be mounted.
Correlation Controller	Controls correlation processing hardware.
Workstation	Provides GUI environments for operators and management of the correlation processing. bandwidth synthesis, and generation of the Mark-III database files.

2. Technical Characteristics

2.1. The KSP Tape-based VLBI Correlation System

The KSP VLBI correlation system is capable of processing six baselines between four stations simultaneously. The appearance of the correlation system is shown in Figure 1.

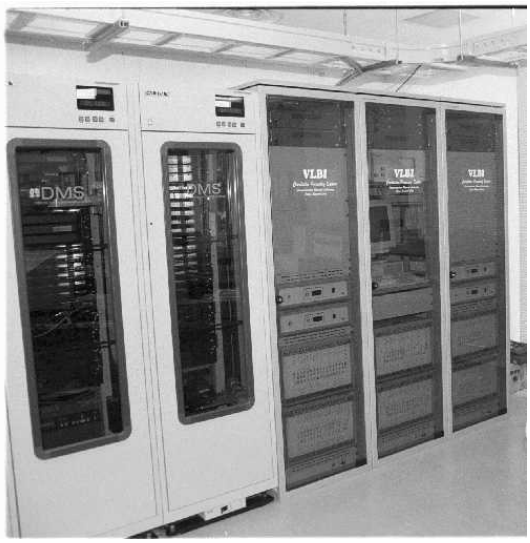

Figure 1. The KSP tape-based VLBI correlation system at Koganei, Tokyo. The left two racks are automatic tape changer (DMS-24). The right three racks contains correlators, output interfaces, and correlation controller.

The system consists of six sets of single baseline correlators, automatic tape changer units (DMS-24), K4/KSP data recorders (DIR-1000), output interface units (DFC-2200), a correlation controller and a host workstation. Function of each hardware is summarized in Table 1.

Two correlator hardware systems are identical which is developed over VME based digital signal processors. The technical parameters of the correlator system are shown in Table 2.

The correlation process control software (KATS) runs on HP-UX host workstation and provides GUI environment for operation of correlation processing [5]. The correlation processing, bandwidth synthesis procedure, and Mark III database creation are performed just by using mouse clicks and

Table 2. Parameters of the KSP correlator system.

Total data rate	64 Mbps, 128 Mbps, 256 Mbps
Number of Channels	16
Number of lags per channel	32
Control Bus	GPIB
Data Output Method	Ethernet (NFS)

several key strokes on the GUI. Then schedule file and log files can be obtained through the network.

2.2. The KSP Real-time VLBI Correlation System

The KSP real-time VLBI system uses the ATM network over 2.4 Gbps optical fiber instead of magnetic tapes for data transportation. The advantages of the real-time VLBI system are summarized as follows.

1. Fully automated VLBI correlation processing can be realized.
2. Since correlation process is done simultaneously with observation, it is possible to monitor the fringes at real-time.
3. Results of the data analysis can be placed in publicly accessible area in less than one hour after the end of experiment.

The real-time VLBI correlation system also has the capability of processing six baselines between four stations. Two correlator systems are identical. Instead of data recorders (DIR-1000), automatic tape changer units (DMS-24), and output interface units (DFC-2200) which are used in the tape-based system, ATM receivers and ATM VLBI interfaces have been used in the real-time VLBI system.

3. Technical Staff for the KSP VLBI Correlation Center

Technical staff members who are contributing KSP correlation center are listed below.

- Tetsuro Kondo, Responsible for overall operations and performance.
- Taizoh Yoshino, Leader of the Key Stone Project team in CRL.
- Hitoshi Kiuchi, Developments of correlation system and real-time VLBI interfaces.
- Mamoru Sekido, Development of correlation processing software.
- Jun Amagai and Kouichi Sebata, Responsible for management of correlation center.
- Naoki Goto and Muneo Takeda, Operator at the correlation center, Space Engineering Development Co., Ltd.

4. Current Status and Future Plans

The KSP real-time correlation system has been used for regular real-time geodetic VLBI experiments once every two days. Unfortunately the KSP Miura station will be unlinked from the KSP

ATM network in May 1999. From that time, regular real-time VLBI experiment will be performed among the three KSP stations, and tape-based 24 hours VLBI experiments including the Miura station will be performed once every six days.

The tape-based KSP correlation system has been used for processing of several kinds of international VLBI experiments. One of them is colocation aimed experiments which include Kashima 34 m antenna and several foreign stations besides the KSP observation stations.

The Key Stone Project ATM network was connected with Kashima 34 m antenna, Usuda 64 m antenna (operated by Institute of Space and Astronautical Science) and Nobeyama 45 m antenna (operated by Nobeyama Radio Observatory). By using these networks, astronomical radio source survey programs have been performed occasionally when geodetic regular VLBI experiments are not scheduled. The observed data are transferred to Koganei KSP correlation facilities and are processed with the KSP real-time VLBI system.

References

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