VLBI Correlators in Kashima

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Abstract

K5 VLBI data acquisition and processing systems developed at the Kashima Space Research Center have been used for data processing of R&D VLBI experiments. Two major correlation tasks processed in 2010 were the MARBLE project, which aimed at establishing a reference baseline for length calibration, and a project for time and frequency transfer. The high speed software correlation system for K5/VSI called "GICO3" has been extended to be used for geodetic VLBI measurements.

1. General Information

The VLBI group of the Kashima Space Research Center (KSRC) of the National Institute of Information and Communications Technology (NICT: Fig.1) has been contributing to the VLBI community by developing the K5 VLBI data acquisition system (DAS) and correlation systems.

The multi-channel DAS named K5/VSSP32 [1] has been used for geodetic and radio science observations. A corresponding software correlation package for the K5/VSSP32 has been developed and maintained by Dr. T. Kondo. Another DAS system named K5/VSI [2], which captures the data stream from a VSI-H interface [4], utilizes a different software correlator called "GICO3" [3].

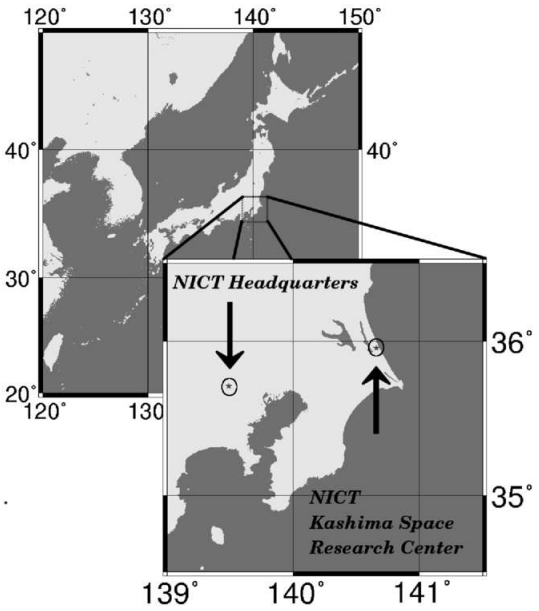

Figure 1. Location of NICT/KSRC.

The former K5/VSSP32 system is a multi-channel data acquisition system with four channel inputs per unit. One unit has the sampling capability in the range of 40 kHz to 64 MHz, with quantization bits 1, 2, 4, and 8 and the limit for the output data rate of up to 256 Mbps. A geodetic K5 DAS system is composed of four K5/VSSP32 units. This system has been widely used for geodesy operationally. e-VLBI experiments for rapid UT1 measurements have been performed using this system in collaboration with the Onsala, Metsähovi, Tsukuba, and Kashima stations.

Another K5 system (K5/VSI) was originally developed with the feature of a high sampling rate for astronomy. Since the K5/VSI DAS is a recording system, it can be used in combination with any sampler systems with the VSI-H interface. For instance, this system has been regularly used in a combination with Mark 5B sampler (VSI-H output) in ultra-rapid UT1 measurements on the Wettzell—Tsukuba baseline.

2. Staff

The names of the staff members who contribute to the Correlation Center at NICT/Kashima and their tasks are listed below in alphabetical order.

- HASEGAWA Shingo: maintenance and troubleshooting of K5 system computers, operation of the 34-m antenna for IVS sessions.
- HOBIGER Thomas: developer of a new VLBI database system that uses NetCDF, research on atmospheric delay calibration with the ray tracing technique, development of software receiver for GNSS.
- ICHIKAWA Ryuichi: VLBI Project Manager at Kashima, research on the MARBLE project, atmospheric delay with ray tracing.
- KAWAI Eiji: maintenance of the 34-m telescope, operation of the telescope for IVS sessions.
- KIMURA Moritaka: developer of the high speed Gigabit software correlator "GICO3" and the K5/VSI DAS.
- KONDO Tetsuro: development and maintenance of the software correlator package of the K5/VSSP32.
- KOYAMA Yasuhiro: Group Leader of "Space-Time Application Group".
- SEKIDO Mamoru: e-VLBI development and observations, maintenance of the 34-m station.
- TSUTSUMI Masanori: maintenance of K5 system computers.

3. Component Description

In 2010 VLBI experiments have been performed for the MARBLE project [5] and for technology development of the time and frequency transfer between distant pairs of atomic time standards [6]. Table 1 shows a brief summary of the experiments.

Table 1. Major correlation tasks processed in 2010.

Project	Exp code	Date	Stations	baseline x scans	Data rate (Mbps)
MARBLE	m10223	11 Aug.	Ks34, Mb1, Mb2	3x239	256
MARBLE	m10259	16 Sep.	Ks34, Mb1, Mb2	3x242	256
MARBLE	m10266	23 Sep.	Ks34, Mb1, Mb2	3x234	256
MARBLE	m10280	7–9 Oct.	Ks34, Mb1, Mb2	3x721	256
MARBLE	m10316	11 Nov.	Ts32, Mb1, Mb2	2x295	2048
MARBLE	m10356	22 Dec.	Ts32, Mb1, Mb2	2x318	2048
Time Comp.	k10116	26 Apr.	Ks34, Ks11 ,Kg11	3x987	256
Time Comp.	k10130	10 May.	Ks34, Ks11 ,Kg11	3x701	256
Time Comp.	k10148	28 May.	Ks11, Kg11	1x627	256
Time Comp.	k10160	9–14 Jun.	Ks11, Kg11	1x2968	256
Time Comp.	k10189	8–10 Jul.	Ks11, Kg11	1x2204	256,2048
Time Comp.	k10212	31 Jul.–01 Aug.	Ks11, Kg11	1x1388	256
Time Comp.	k10216	8 Aug.	Ks11, Kg11	1x490	256,2048
Time Comp.	k10274	1 Oct.	Ks11, Kg11	1x1773	256,2048

Ts32:Tsukuba-32m, Ks34:Kashima-34m, Ks11:Kashima-11m, Kg11:Koganei-11m, Mb1:Marble-1, Mb2:Marble-2

Ultra-rapid UT1 observations with e-VLBI technology have been performed by the Geospatial Information Authority of Japan (GSI) on the Onsala—Tsukuba baseline. In addition, the GSI has started the operational dUT1 observations (i.e., "Intensive" observations) in 2010. We have supported these e-VLBI experiments, although actual correlation has been performed by GSI.

4. Development and Future Plans

4.1. e-VLBI Development

The high speed sampler ADS3000+, which has the function of a digital base band converter (DBBC) and sports a VSI-H interface, has been developed together with the K5/VSI DAS. Digital filtering via FPGA circuit has been tested, and multi-channel observations for geodetic VLBI applications have been performed for evaluation. Software tools for the data conversion from the GICO3 high speed software correlation output to conventional Mark3DB have been developed, and the analysis scheme with the CALC/SOLVE package is being established. This new scheme of VLBI observation and data processing (ADS3000+ and K5/VSI → GICO3 software correlation → Mark3DB → CALC/SOLVE) has been used for the MARBLE and the time and frequency transfer experiments (Table 1).

References

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