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Mitaka Correlator for the Space VLBI

K. M. Shibata, S. Kameno, & M. Inoue
VSOP Project, National Astronomical Observatory, Mitaka, Tokyo 181, Japan

H. Kobayashi
Institute of Space and Astronautical Science, Sagamihara, Kanagawa 229, Japan

Abstract. The Mitaka correlator is an FX-type correlator with 10-station inputs, which is designed for space VLBI and will be used for VSOP mainly. We report here the capabilities of the correlator, the results of model comparisons and the preliminary results of fringe test between the satellite HALCA and Japanese ground telescopes.

1. Mitaka Correlator

The capabilities of Mitaka correlator are summarized in Table 1. The correlator has high capabilities for spectral resolution and output data rate. The FFT size allows maximum frequency resolution of 8192 points per one station along the total bandwidth. The available number of output frequency channels is restricted within 1024 points, which can be selected and averaged arbitrarily from 8192 points using a bunching/selection function. The maximum output rate is 40 Hz. Such high output rate gives us a wide search window for fringe rate which is necessary to detect the fringes between satellite and ground telescopes and also gives a wide field of view which is needed for, for example, maser observations in star forming regions.

The correlator can cross-correlate the data between the observations with different channelizations, for example, between a 64 Mbps 2 bit 1 channel satellite data and a 32 Mbps 2 bit 2 channels VLBA data. And also, it is available to make a mixed correlation of different bandwidth, such as between a 128 MHz satellite data and a 256 MHz ground telescope data.

A special characteristic of Mitaka correlator is a tape copy system. There are four tape copiers, two sets are for translation from VLBA to VSOP and other two sets for the translation between S2 and VSOP. Therefore, Mitaka can treat the data from VLBA, S2 and VSOP stations. These copiers translate the VLBA and S2 logs into VSOP log during the tape translation.

Table 1. The capabilities of Mitaka correlator

Stations	1 - 10
Channels	1, 2, 4, 8, 16, 32
Input Recording Rate [Mbps]	16, 32, 64, 128, 256
FFT Size	32 - 16384
Processing Speed [Msps]	256
Speedup Factor	1, 2, 4
Integration Time [sec]	> 0.025
Maximum Output Data Rate [MB/sec]	1.5

2. Interferometer Model Comparison

We have compared the interferometer model for the satellite between Mitaka and VLBA correlator using the simulated orbit data for satellite. Because the Mitaka has the interface for the orbit data with SCEF file format, we could not read the orbit data using in VLBA correlator directly by our calculation software. Hence, we interpolated the orbit data and reconstructed the file of orbit data as the software can read the orbit data as from SCEF file. Our interferometer model coincides with the VLBA model within the differences of 24 to 54 nanosec during the time interval of 22 minutes (Fig. 1). The coincidence may be enough to find fringes in the search window of the correlator.

3. VSOP Fringe Test

We have made the observations for VSOP fringe test using the satellite HALCA, linked with USUDA 10m, and the ground stations, USUDA 64m and KASHIMA 34m, in 1.6 and 5 GHz on 26, 27, 29 March and 1 April. Data were recorded through VSOP terminal in a 16 MHz 2 bit 2 channel mode and correlated at Mitaka. In the correlation, re-constructed orbit data were used for the interferometer model, and only a down link delay calculated from the re-constructed orbit was used instead of applying a time correction file. But, until the conference, we could not detect the fringes from these observations. [1] We examined phase stabilities of phase calibration tones using the cross- correlation data on 1 April between HALCA and USUDA 64m. The phases are relatively stable during the 30-min observations. The deviations of phases after subtracted the linear component of time variation were about 3 degrees at 8 MHz tone.

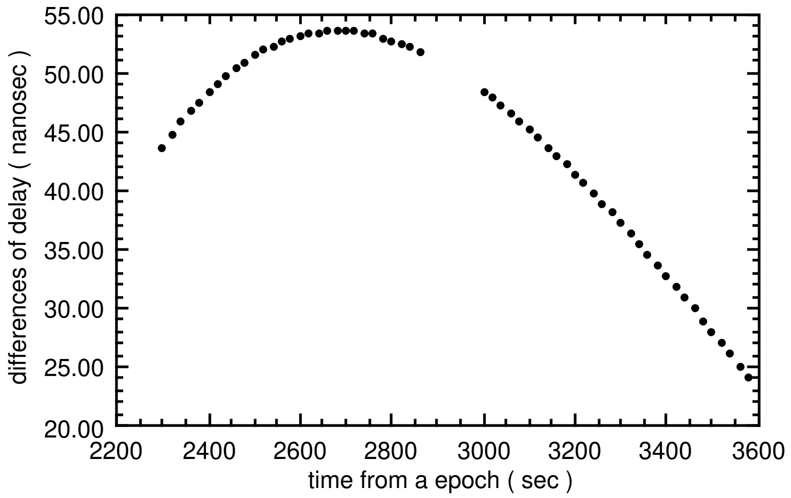

Figure 1. The comparisons of interferometer model between VLBA and Mitaka correlator.

[1] After the satellite eclipse, we re-started VSOP fringe test from 7 May. And we found the first VSOP fringes between HALCA and USUDA on 13 May.