Current Status of Software Correlators Developed at Kashima Space Research Center

Tetsuro Kondo, Moritaka Kimura,Yasuhiro Koyama, and Hiro Osaki
Kashima Space Research Center/CRL

At the beginning era of VLBI development, correlation processing was performed by a computer program. However it took a long time, so that it was unrealistic to process huge data such as 24-hour session data. A hardware correlator was hence developed and has been used for a long time. Kashima VLBI group used to develop the "Software Correlator" named CCC (Cross Correlation in a Computter) for a fringe test of domestic VLBI observations about 20 years ago. The CCC performed correlation processing using the data prepared by the K-3 (or Mark III) decoder. The substance of CCC was a FORTRAN program running on an HP-1000 series mini-computer (e.g., 45F, A900, etc.). It took about 8 hours to obtain 64 lag correlation function by processing 16 Mbit data in the HP-1000 45F. The CCC was used in the actual fringe test of a domestic VLBI measurement in 1985, and we could get fringes. However, it was not practical from the reason that not only data processing but also data transmission took time too much. We had to wait for progresses of both computing speed and data transmission speed to put a software correlator in practical use. Recently the performance of a computer is remarkably developed. For an example, the computing speed of a recent PC is much faster than that of the workstations of ten years ago. Then the use of a software correlator for VLBI data processing has become realistic.

We have been developing a PC-based VLBI data-acquisition terminal named K5 dedicated to transmitting the data through the Internet. A software correlator based on the CCC aiming at obtaining the correlation data compatible with those processed by the hardware correlator has also been developed by using the C language for K5 data processing for geodetic use. A bandwidth-synthesizing program can handle correlated data directly to get a precise observed delay. At present time this software correlator dedicated to a geodetic use can process 4 Mbps data in real time when it runs on a PC equipped with the Pentium III 1GHz processor. We processed 24-hour session data by using the software correlator and it was confirmed that geodetic results obtained by the software correlator gave reasonable results compared with those obtained by the hardware correlator.

On the other hand, the development of an ultra high-speed software correlator for processing gigabit VLBI data has also been carried out. In this development, in order to maximize the performance of CPU, various kinds of optimizations, multi-baseline correlation with multi-PCs and effective use of multi-processors and utilization of SIMD technology for parallel processing, etc., were performed. An assembler language program was also used partially to improve the performance. At present time, this software correlator can process 100Mbps data in real time on a PC equipped with dual AMD Athlon 1.8GHz processors. By use of the latest and fastest four PCs, it is possible to process 1Gbps data in real time.

A software correlator will take over a hardware correlator in near future and will be one of key technologies for e-VLBI. We are now developing the distributed processing technique for further speedup to realize real-time correlation in the e-VLBI system.