Geodetic VLBI experiments using giga-bit VLBI system

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In the VLBI observation system, the recording speed of the data recorder determines the total frequency bandwidth of observations and hence the sensitivity of the entire system. Communications Research Laboratory has developed the giga-bit VLBI system with a recording capability at 1024 Mbps, which is four times faster than the previous systems. The system has a potential to improve the sensitivity of the VLBI observations and has unique characteristics because it does not require phase calibration signals and baseband converter units. The preliminary results from geodetic VLBI experiments which have been carried out using the giga-bit VLBI system will be presented.

Communications Research Laboratory has been developing the giga-bit VLBI system with a recording capability at 1024 Mbps, which is four times faster than the previous systems. The primary purpose of the giga-bit VLBI system is to observe weak continuum radio sources by the means of VLBI, and high sensitivity VLBI experiments with Usuda (64-m) - Kashima (34-m) and Nobeyama (45-m) - Kashima (34-m) baselines are planned. On the other hand, geodetic VLBI observations are usually performed with multiple channel observation systems with either 14 or 16 observation channels, because bandwidth synthesis technique has to applied to expand effective observation bandwidth and dual frequency observations at S-band and X-band are necessary to calibrate ionospheric propagation delays. However, unique characteristics of the giga-bit VLBI system are considered to have great advantages in the geodetic VLBI observations since it does not require phase calibration signals and baseband converter units. The high sensitivity of the giga-bit VLBI system is also considered to be desirable for geodetic VLBI observations with a small aperture antenna. Considering these advantages, we have transported 3-m antenna mobile VLBI system to Gifu University and planned to perform geodetic VLBI observations with the Gifu (3-m) - Kashima (34-m) baseline. The preliminary results from geodetic VLBI experiments with the giga-bit VLBI system will be presented.

Softwares have been developed to extract precise time delays and their rates from the output of the correlator system (GICO) of the giga-bit VLBI system and to generate Mark-III database files from the results. A test experiments with 6 hours of duration was performed on October 19, 1999 with Kashima (11-m) - Koganei (11-m) baseline of the Key Stone Project Network. In the Key Stone Project system, a frequency range of 500-1000 MHz is used for the intermediate frequency signal and the X-band receiver output was converted to the baseband signal of the range 0-500 MHz using a hybrid mixer and a CW tone signal generated by a synthesizer. The baseband signal was then sampled by a sampler unit at 1024 Mbps. The observations were performed by using the giga-bit VLBI system and the conventional VLBI system, in parallel. The estimated baseline lengths from both systems showed a good agreement. On the other hand, the RMS delay from the giga-bit VLBI system was 183 psec which was considerably larger than the RMS delay obtained from the conventional observation system which was 48 psec. The comparison suggests that there are still problems in the data processing process for the giga-bit VLBI system and the related softwares have to be improved further. One experiment of 24 hours of duration was performed with the Gifu (3-m) and Kashima (34-m) baseline on January 18, 2000. The data processing of the observed data are in progress at present. The second experiment with the same baseline is scheduled on February 28, 2000 and the results of these experiments will also be presented.