

Evaluation of the new approach to improving compact-compact antenna baseline in VLBI

Hiroshi Takiguchi[1]; Atsutoshi Ishii[1]; Ryuichi Ichikawa[1]; Yasuhiro Koyama[2]

[1] KSRC,NICT; [2] NICT

<http://www2.nict.go.jp/w/w114/stmp/>

Basically, the signal-to-noise ratio (SNR) in VLBI is proportional to the product of the two dish diameters of baseline. And also, the SNR is in inverse proportion to the delay errors. To improve the SNR and the delay errors, using the large antennas is one of the effective plan. On the other hand, the portability is lost, use is limited, and there are a lot of problems in respect of the cost of construction and the maintenance expense.

To use VLBI for more wide-ranging area, the compact and transportable antenna is developed for a long time. Usually, when using compact and transportable antenna while keeping high SNR, we construct the baseline with large antenna. In this approach, we can set up compact antenna in any optional place. Also, we can improve SNR of baseline that construct two compact antenna that doesn't obtain enough SNR, in using large antenna. Recently, a novel approach has been proposed to improve compact antenna baseline [Koyama unpublished]. That is calculate the group delay of compact-compact antenna baseline from the two large-compact antenna baseline. In this approach, there are many advantages as follows:

We could not consider the sensitivity of the compact-compact antenna baseline. It is possible to shorten the integration time and to increase the number of scan. Also, we can cancel the effects of the large antenna's problems as gravitational and thermal deformation. This approach was adopted the Multiple Antenna Radio-interferometry for Baseline Length Evaluation (MARBLE) system (Ishii et al., 2009) that jointly develops with the NICT and GSI. In addition, we are planning to apply this approach to VLBI time and frequency transfer. In this time, we evaluated this approach by using the past experiments databases.

In this study, we reanalyzed the data which made the experiment using KASHIM34, KASHIM11 and KOGANEI antennas at August 2008. First, we analyzed the KASHIM11-KOGANEI baseline by the normal approach. Second, we calculated the group delay of KASHIM11-KOGANEI baseline from KASHIM34-KASHIM11 baseline and KASHIM34-KOGANEI baseline. And, we made new database from that group delay and analyzed that. Then, we compared the results of both. The results are as follows.

Normal approach : Baseline length 109099630.92mm, formal error 2.68mm, RMS of delay residual 79.7ps.

New approach : Baseline length 109099634.76mm, formal error 1.77mm, RMS of delay residual 50.6ps.

That results show the great improvement. In addition, the number of scan has increased by about 18% in the new approach compared with the normal approach.

Based on these findings, we will discuss in detail. Additionally, we will show the results of the experiment that used the MARBLE first prototype.