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National Geodetic VLBI Plan in Korea

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Abstract

A project of constructing the first geodetic VLBI system in Korea is in progress at the National Geographic Information Institute (NGII). The primary purpose for this antenna will be to participate in the IVS international geodetic VLBI observations, and to maintain the Korean geodetic origin precisely defined in the world geodetic frame, the ITRF. However, since there was no former research or project about geodetic VLBI in Korea, a new R&D is necessary on the fundamental design of the VLBI system. In this presentation, a preliminary study on the necessity of geodetic VLBI in Korea and basic specifications for a core station of geodetic VLBI will be presented together with the possibility of constructing a VLBI antenna in Korea.

1. Geodetic VLBI in Korea

1.1. Korea - Japan VLBI Observation

In 1995, Korea - Japan Collaborative VLBI observations were performed by the National Geographic Information Institute (NGII), Korea, and the Geographical Survey Institute (GSI), Japan, for an accurate connection of the geodetic networks of the two countries, accurate determination of the standard datum of Korea in the ITRF, and understanding tectonic activities in East Asia [2].

The observations were carried out during October and November with a 5m transportable VLBI antenna in Suwon, which was temporarily provided by GSI, and a 26m antenna in Kashima (Figure 1). Three out of four 24-hour sessions yielded satisfactory results which allowed to connect the geodetic networks with mm-level accuracy and to determine ITRF coordinates of the standard datum of Korea.

1.2. Construction Plan for Suwon and KVN Antennas

In 2001, the Korea Astronomy and Space Science Institute (KASI) started the construction of the Korean VLBI Network (KVN). The KVN will be composed of three new-generation 21m radio telescopes to be installed in Seoul, Ulsan, and Jeju. Though the KVN will be mainly used for mm-wave VLBI astronomy, partial use for geodesy is also officially planned. Completion of the Network is expected at the end of 2007 [5].

The NGII is planning to construct a dedicated geodetic VLBI antenna of 26m or 30m diameter in Suwon in order to accurately maintain the national standard datum and eventually establish a

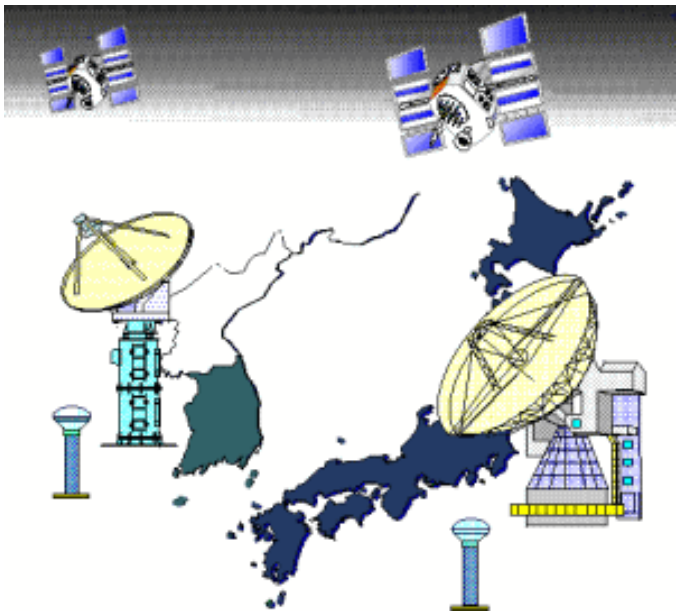

Figure 1. Korea-Japan VLBI&GPS Experiments [2].

Figure 2. Site locations of the Suwon and KVN antennas in Korea

highly accurate new national geodetic system consistent with the ITRF. The planned locations of the KVN and Suwon antennas are shown in Figure 2.

2. Roles of the Dedicated Geodetic VLBI Antenna in Korea

The Suwon antenna will contribute to better define the ITRF in Eastern Eurasia, where no observing site has been selected as sufficiently stable for the ITRF datum definition [1]. According to GPS observations carried out by Yonsei University and KASI [6], the Korean Peninsula is tectonically more stationary than other areas in East Asia. Therefore, we expect that the new dedicated geodetic VLBI antenna in the middle of the Korean Peninsula will be an important stable site for the ITRF.

Also the Suwon antenna will be a stable fiducial point for precise monitoring of crustal deformations, by means of mobile VLBI antennas, in tectonically active areas in Eastern Eurasia. Such a monitoring is indispensable for clarifying mechanisms of disasters, such as the huge tsunami earthquake in 2004, and eventually prevent them.

The Suwon and the KVN antennas will form a powerful domestic VLBI network for geodynamical studies.

First, the domestic network will determine the Euler parameters of the assumed Amurian plate (AM), where a large area of East Asia, including the Korean Peninsula, is likely to reside. Results of previous studies based on seismic and GPS data have not been sufficiently consistent about the plate parameters. We expect that another independent space geodetic technology, with VLBI known to be highly stable and accurate, will finally solve the problem [3][4].

Second, collaborative VLBI and GPS observations will enable us to better examine the internal deformation of the Korean Peninsula. The results of the GPS analysis by Park et al. (2001) suggested possible effects of the northwestward tectonic stress due to the AM - PH (Philippine Sea plate) convergence on the southeastern part of the Korean Peninsula. In particular, the characteristic bend of the Peninsula could be a result of the stress acting on internal faults, striking nearly perpendicularly to the stress trend. New domestic VLBI observations will give us further insight into the tectonics of this region.

3. Considered Specifications for the Suwon VLBI System

Detailed designing of the new geodetic VLBI antenna in Suwon is now starting. Preliminary specifications are shown in the following table, which are subject to change after further discussions, especially in view of valuable comments given at the General Meeting.

Table 1. Preliminary specifications of Suwon geodetic VLBI system

Aperture Diameter	26m or 30m
Slew Rate	$>$ 2 - 3 deg/s in Az and El
Surface Accuracy	$\sim$ 0.37 mm rms($<$10m/s wind)
Pointing Accuracy	$\sim$0.002 rms($<$10m/s wind)
Receiving Bands	2/8/(32), 22/43GHz
Data Acquisition	K-5 Backend System
Recording System	K-5 HD Array
Correlator	4-station class software correlator for geodetic VLBI

We believe that the domestic industry in Korea is capable of producing geodetic VLBI antennas.

For example, a domestic antenna manufacturer, which has provided a number of large aperture satellite communication antennas, is now constructing three KVN antennas under a contract with a US company.

To avoid severe human-made interferences at lower frequencies in geodetic VLBI observations, we need to shift observation frequencies to higher ones. Fortunately, the KVN will have multi-channel receivers including K/Q bands, and for the Suwon antenna it is also considered to install K/Q receivers. Hence we can have a good chance to make a real experiment of the higher frequency simultaneous DUAL-BAND VLBI. The first thing that we have to confirm is if the higher frequency geodetic VLBI is as fruitful as, or better than, S/X.

Not only for geodetic VLBI observations, the Suwon antenna can also support astrophysical observations of the KVN and the VERA (VLBI Exploration of Radio Astrometry, Japan) using K/Q bands. Moreover, from a practical point of view, having 22 GHz and 43 GHz receivers will be useful for achieving high pointing accuracy of our antenna, since we will be able to use many bright water and SiO maser sources for pointing measurements.

4. Construction Schedule

The following table shows a tentative construction schedule of the Suwon geodetic VLBI system.

Table 2. A tentative construction schedule of the Suwon geodetic VLBI system

	2006		2007		2008	
Antenna	Design	Foundation	Manufacture			Test
Receiver			Design	Manufacture		Test
Cable Transmission system			Module purchase	Install		Test
Backend system			Design	Manufacture		Test
Clock, Frequency system					Purchase	Test
Delay, Phase calibration system					Purchase	Test
Correlator		Design & Manufacture				Test
Observatory	Design	Foundation	Construction			

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