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Geodesy with the World's Smallest (3-m) VLBI Telescope

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Abstract

We show results of geodetic VLBI with the world's smallest 3-m VLBI telescope at Gifu University (Figure 1). This telescope was originally made for mobile VLBI experiments in 1984 by the Communications Research Laboratory, and was moved to Okinawa, Wakkanai, Minami-Daitoh Island, and Koganei [1]. In 1999, the telescope was moved to Gifu University, which lies at the central part in Japan. Geodesy VLBI experiments by using the Giga-bit Recorder System suceeded and the baseline between Kashima 34m telescope and Gifu 3m telescope was obtained.

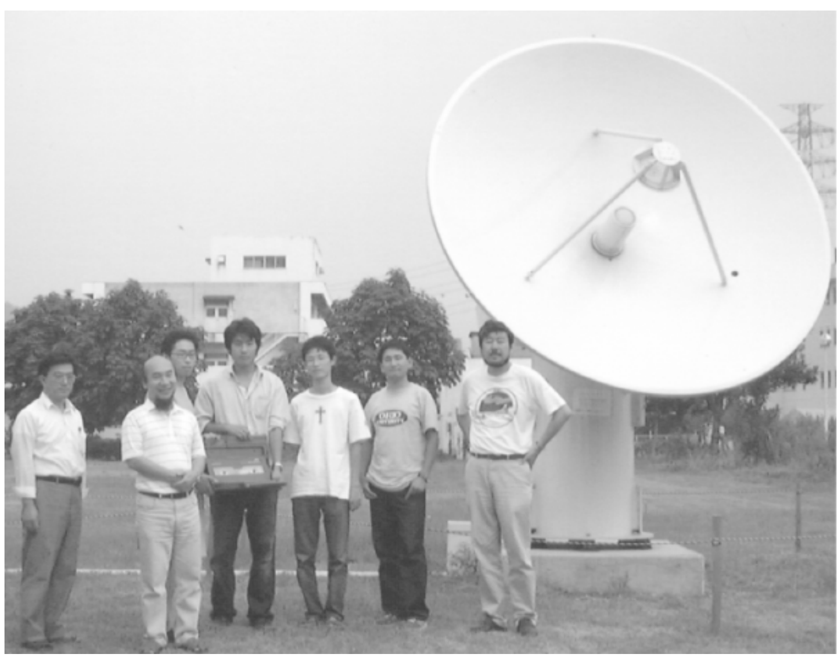

Figure 1. Gifu University 3m Radiotelescope.

Table 1. Specification of the 3-m radio telescope of Gifu University.

Parameter	Gifu Univ. 3-m telescope
X-band (standard $\nu = 8.230GHz, \lambda = 0.0365m$)	$7.860 - 8.600\,GHz$
T_{sys} $Efficiency$ $HPBW$	$135\,K$ 0.43 0.8°
Az and El Drive speed	10° /sec.

1. Merits of the Small Telescope

Small VLBI telescopes are good at geodesy because

- 1) very little thermal and gravity deformation
- 2) large slew rates (10°/sec. both in azimuth and elevation axies for our 3m telescope)
- 3) low costs for building and maintenance
- 4) simple collocation with GPS.

2. Results of Giga-bit Recorder Experiments

The most serious problem for the small telescope is its low sensitivity. By using the most advanced Giga-bit Recorder (GBR: 1Gbps) system developed by CRL [2], the sensitivity grows up to 4 times compared to the normal K-4 VLBI system (64Mbps). Then we tried to conduct Giga-bit recorder experiments between Kashima 34-m telescope and Gifu 3-m telescope (GIFT01 and GIFT02), the K-4 system (64Mbps) was also used for comparison. Results are shown in Table 2. Because of a problem in the sampler, errors were larger for GBR than K-4, but we could obtain the geodesy solution. The baseline length repeatability and accuracy were good within errors for GBR and K-4, respectively. New Giga-bit VLBI samplers are now being developed by CRL and we will try again to obtain more accurate geodesy solution.

Table 2. Results of the VLBI experiments by using K-4 (64 Mbps) and GBR (1 Gbps) between Gifu 3-m and Kashima 34-m telescopes.

Exp. Code	X (mm)	Y (mm)	Z (mm)	Baseline (mm)
GIFT01(K-4)	- 3787518271.5 ± 10.6	3564247195.4 ± 9.2	3679797149.1 ± 8.9	358918278.6 ± 3.5
GIFT02(K-4)	- 3787518246.6 ± 11.8	3564247170.2 ± 10.0	3679797146.6 ± 10.3	358918279.1 ± 3.7
GIFT01(GBR)	- 3787518255.2 ± 37.3	3564247235.5 ± 29.7	3679797178.3 ± 30.3	358918316.6 ± 11.9
GIFT02(K-4)	- 3787518248.7 ± 17.3	3564247131.9 ± 15.5	3679797135.2 ± 14.6	358918248.5 ± 6.1

3. Collocation of The VLBI and GPS

Before construction of the 3-m radio telescope, we set the GPS antenna at the telescope base and made GPS observations for 6 days. Figure 2 and 3 shows results of the horizontal and vertical position of the 3-m telescope obtained by VLBI (GIFT: Gifu 3-m - Kashima 34-m, JADE: Gifu 3-m - Tsukuba 32-m) and GPS. The horizontal positions of the VLBI and GPS coincide within several centimeters. The vertical positions of the GPS differ from VLBI by about 10 centimeters.

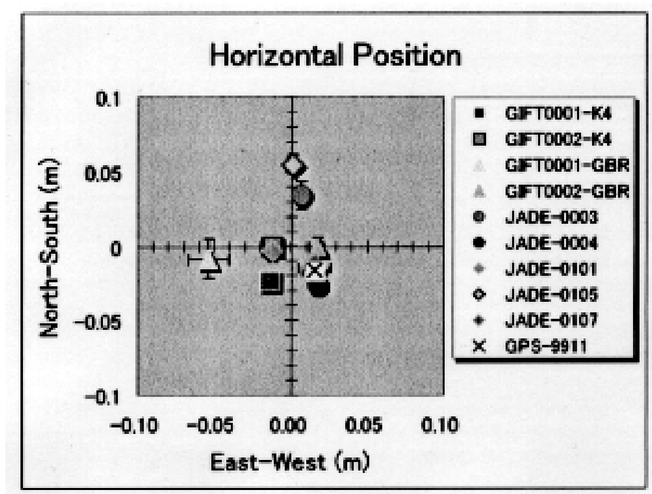

Figure 2. Horizontal Position of the 3-m telescope obtained by VLBI and GPS,

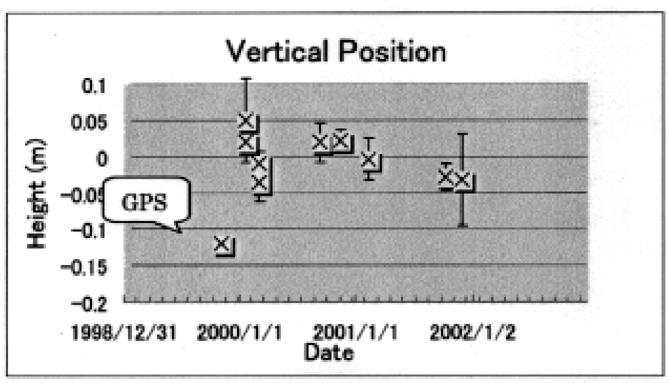

Figure 3. Vertical Position of the 3-m telescope obtained by VLBI and GPS,

References

[1] Amagai,J., et al., Journal of the Communications Research Laboratory, Vol. 37, 63, 1990

[2] Koyama, Y., et al., Proceedings of the IVS 2000 General meeting, p98, 2000