

ORBIT DETERMINATION OF KOREA REGIONAL NAVIGATION SATELLITE SYSTEM BY USING SATELLITE LASER RANGING

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Introduction: Korea Regional Navigation Satellite System (KRNSS) is a conceptual regional navigation satellite system designed for covering Korea and East Asia only. A candidate constellation of KRNSS consists of four elliptically inclined geosynchronous orbit (EIGSO) satellites and three geosynchronous (GEO) satellites, and are similar to that of Quasi-Zenith Satellite System (QZSS) of Japan Aerospace Exploration Agency (JAXA). As preliminary research on applying satellite laser ranging (SLR) to the orbit determination (OD) of KRNSS, OD is performed for QZS-1 (Michibiki), the first satellite of QZSS possessing similar orbit characteristics to those of KRNSS.

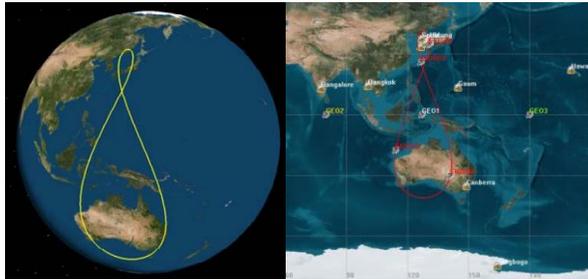


Figure 1. Ground Track of QZSS (Left, Image Courtesy of JAXA) and KRNSS candidate (Right)

QZS-1 Orbit Determination: QZS-1 was launched on September 2010. Due to its EIGSO characteristics, tracking stations located in East Asia only can track QZS-1. The tracking data of QZS-1 were successfully obtained from 7 SLR stations: Beijing, Changchun, Koganei, Mount Stromlo, Shanghai, Tanegashima and Yarragadee station. Based on those observation data, NASA/GSFC GEODYN II program was utilized to acquire OD solution. Augmenting the number of tracking data, JAXA conducted the QZS-1 tracking campaign from February 25 to March 7, 2013. Tanegashima station made 269 nominal points (NPs) in this period. OD period is from March 1 to March 8, 2013. 105 NPs were freely distributed online and 264 NPs were unpublished in this period.

Results: Table 1 shows the OD results with/without unpublished NPs. Figure 2 shows the result of orbit overlap for assessing the OD quality.

Parameters	Published NPs only	All NPs used
No. NPs	102	371
MBIAS	4.08 cm	3.68 cm
PBIAS	(OD Failed)	0.56 cm

Table 1. Post-fit Residual with Different Bias Settings

Reference axis	Radial	Along-track	Cross-track
Differences (RMS)	0.875 m	4.931 m	7.775 m

Table 2. Orbit Overlap Results

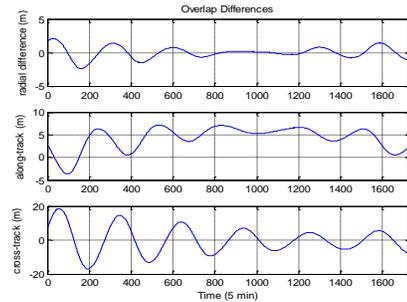


Figure 2. Orbit Overlap Results with 5 Minute Period

Conclusion: OD of QZS-1 was performed as preliminary study of OD of KRNSS. Both published and unpublished NPs were utilized, and orbit overlap method is used to assess the OD quality. The above result suggests that SLR should be efficiently applied to OD of KRNSS. Meanwhile, more tracking data is necessary to facilitate/enhance the OD process/precision.

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