Development of a GPS Augmentation Technique Utilizing QZSS Broadcasting

Yuki Hatanaka, Yuki Kuroishi, Hiroshi Munekane, *Geographical Survey Institute*
Akira Wada, *Nippon GPS Solutions Co.*

INTRODUCTION

The Quasi-Zenith Satellite System (QZSS) is a dedicated Japanese geodetic Satellite system under development, which consists of three satellites with at least one satellite positioned near zenith over Japan anytime. The satellites will transmit L-band experimental (LEX) signals, which can be used for broadcasting messages. Geographical Survey Institute (GSI), Japan, developed a GPS augmentation technique utilizing QZSS broadcasting channel for GPS survey.

DESIGN OF THE TECHNIQUE

The augmentation technique is designed to be applicable to geodetic surveys with a single frequency GPS receiver. Augmentation parameters, which are assumed to be broadcasted via a QZSS LEX-band channel, are generated from the real-time data of the GPS Earth Observation Network system (GEONET), which covers Japanese islands with more than 1200 permanent GPS stations. The parameters are applied by users to the data obtained with their own single-frequency GPS receivers. The target of the development is to achieve sub-cm level of positioning accuracy within ~15 minutes session.

The data rate transmitted on the LEX channel is limited to 1695bps. The augmentation technique is, however, designed to be applicable to broader channel up to 1Mbps for technical verification and potential use with other communication technique.

DESIGN OF AUGMENTATION PARAMETERS

The augmentation parameters consist of four sets of information: satellite orbit/clock correction, GPS observation data at reference stations, parameters of an ionosphere delay model, and troposphere delay estimation. The satellite orbit/clock correction is excerpted from IGS Ultra Rapid products for a 180-minute period around the session and use as it is. The Japanese land area are divided into several (~12) sub-areas, and transmitted are GPS data at a reference station which is selected from the GEONET stations located around the center of each sub-area. Relative positioning technique is carried out for a baseline between the reference station and a user GPS antenna by correcting ionosphere delay and troposphere delay. The ionosphere delay for the line-of-sight to each satellite is modeled on a grid for each sub-area configured on thin spherical shell at altitude of about 500 km, using data of all GEONET stations belong to the sub-area. Troposphere delay is estimated at each GEONET station.

Users can receive the augmentation parameters through the LEX channel, calculate the ionosphere and troposphere delay correction by interpolation of the ionosphere delay model and troposphere delay estimates at GEONET stations, respectively. They then analyze the corrected GPS data to get the coordinates of the GPS antenna. Because of the data rate limitation, coordinates of the GEONET stations including the reference stations are not transmitted. Instead, they are provided in a form of a text file and the users need to get it in advance.