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Space-based PNT (Position, Navigation, Timing) Architectures, Applications, and Services (1)

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ANALYSIS OF POSITIONING ACCURACY BY OPERATIONAL SCENARIO ACCORDING TO THE CORRECTION MESSAGE SCHEDULE

Abstract

Positioning technology using navigation systems enables more accurate positioning by using correction information. Satellite Based Augmentation System (SBAS) which broadcasts this correction information from geostationary satellite increases airspace utilization and provides reliable data, which makes possible to reduce air traffic safety accidents. Recently, due to the rapid industry development of Urban Air Mobility (UAM) and autonomous vehicles, interest in precise positioning based on satellite augmentation is increasing. Satellite navigation correction information such as orbit, clock, and ionosphere errors can improve position accuracy by broadcasting near real-time. Correction information of tropospheric errors due to the only modeling can be provided for broadband services. The tropospheric error correction information generated by this way can be used as range and range rate information for fast correction with satellite orbit, clock errors, and ionospheric error. In the case of Japan, which is successfully providing regional navigation services with satellite augmentation services, four inclined geosynchronous orbits are in operation, and two more geostationary satellites and one quasi-inclined geostationary orbit satellite are scheduled to be launched and operated in 2024. We assume that four inclined geosynchronous orbit satellites and three geostationary orbit satellites broadcast satellite navigation correction information. In this study we search the optimized message scheduling scenario for orbit, clock, and ionospheric correction information broadcast in near-real time. It is possible to improve accuracy by allowing users to quickly acquire more correction information within the same time than same correction information provided by geostationary satellite. We analyze whether sub-meter level service and navigation for UAM are possible in the city area. First, we consider that seven satellites broadcast the same correction information message and the other case where seven satellites transmit different correction information messages when the elevation angle is over 45 degrees or higher. Finally, the user's positioning error is calculated according to the operational scenario that each different seven satellites broadcast different correction information from each satellite at the same time.