

Doppler Positioning with Movable Transmitter Antennas as a High-accuracy IMES Localization Method

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ABSTRACT

An indoor messaging system (IMES), which is proposed as a part of Japanese Quasi-Zenith Satellite System, does not use trilateration (unlike GPS or pseudolites), and its transmitter simply broadcasts a fixed position by modulating it on the navigation message. As a result, positioning accuracy of IMES is limited to the installation interval of the transmitters (normally 10-20 m). In the present work, a method to improve positioning accuracy of IMES is introduced. In this method, two-dimensional receiver's position is determined by using Doppler shifts generated by rotating transmitter antennas of IMES. This method is similar to previous works with a movable receiver antenna and a three-axis attitude sensor especially with respect to observation equations, but the proposed method has an advantage that an attitude sensor, which is a major error source, is not necessary. In the positioning algorithm, an extended Kalman filter is used so that the receiver's position is estimated in real-time as well as while the receiver is moving. A positioning system based on this method was developed and experimentally evaluated. Experimental results show that centimetre- to decimetre-level positioning accuracy is achievable.

KEYWORDS: Indoor Positioning, IMES, Doppler Positioning, QZSS