ABSTRACT

Low Earth Orbit (LEO) satellite technology has become popular these days. Novel proposals and notions about their application continue to emerge, especially to provide global broadband communications services. The utilisation of LEO to provide worldwide services requires immense numbers of satellites. LEO satellite which was originally confined only to accommodates communication services will be more effective if then used to offer navigational services.

LEO satellite has beneficial of smaller propagation losses (28 - 30 dB better) and shorter propagation delay compared to the medium orbit satellite system. Moreover, LEO satellites cause distinguished frequency shifts due to the Doppler Effect (up to ± 40 kHz), thereby it could increase the estimated velocity accuracy of the receiving device on the navigation system. This research analyses the Doppler effect on LEO satellites to determine the velocity of the receiving device. The estimation method used called *Time – Differenced Carrier – Phase* (TDCP).

This study analyses the value of the *Geometric Dilution of Precision* (GDOP) and the estimated velocity error value of LEO satellite systems. Low orbit satellite systems are represented by Iridium NEXT, Telesat, and OneWeb which have orbital altitude ranges at 780 – 1,248 km. As a result, the three observed satellite systems produce GDOP values that meet the standard as a navigation system (< 20). The mean error value of each satellite system is in the order of kilometres per second (1.86E+03 - 2.03E+05 m/s). The error values decrease as it uses an augmentation for the GPS satellite system to the order of hundreds of metres per second (5.06E+02 – 7.12E+02 m/s). The minimum error values have the potential to reach nanometres per second level of accuracy. Generally, the Iridium NEXT satellite system offered the best result for each observed satellite systems. Next, advanced research needs to be done to analyse the causes of error estimation values.

Keywords: *Doppler Effect, Low Orbit Satellite, Navigation, Velocity Estimation, Time – Differenced Carrier – Phase (TDCP)*