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SINGLE-FREQUENCY-GNSS-BASED RELATIVE NAVIGATION FOR SATELLITE FORMATIONS WITH LARGE BASELINES

Abstract

Relative state estimation is a key factor for the success of formation flying missions. Extended Kalman Filters (EKF) based on Global Navigation Satellite System (GNSS) have shown to achieve superb estimates of the baseline vector for formations with small inter-satellite distances (1-10 km) in LEO. Baseline estimation has also been tackled for longer inter-satellite distances. Dual-frequency receivers in the case of long baselines are very important not only to mitigate the huge difference in ionospheric delay between the two receivers, but also to help precisely fix the double difference integer ambiguities. However, most of the satellites in LEO are equipped with single-frequency receivers.
In this paper, relative navigation for satellite formations equipped with single-frequency GNSS receivers and with large inter-satellite distance (100-1000km) is investigated. In this setting, ionospheric delay is the largest disturbance that needs to be filtered out. The performance of the traditional EKF is compared to that of the Moving Horizon Estimator (MHE) and the latter's computational expense is benchmarked against that of the EKF in different measurement settings. The developed algorithms are validated using the SWARM Earth Observation mission data.