Paper ID: 65455
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IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Space Communications and Navigation Global Technical Session (8-GTS.3)

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A NOVEL SELF-LEARNING GNSS/INS INTEGRATED NAVIGATION METHOD

Abstract

The integrated navigation of global navigation satellite system (GNSS) and inertial navigation system (INS) can provide high precision and continuous navigation and location services. GNSS/INS integrated navigation is widely used in dynamic navigation and positioning. However, in the case of GNSS signal failure for a long time, the accuracy of GNSS/INS integrated navigation system will drop sharply due to the error accumulation of inertial components over time, and the anti-jamming ability and reliability can't be guaranteed. Therefore, the main challenge for GNSS/INS is how to achieve a reliable and low-cost positioning solution during GNSS outage. In this paper, a navigation algorithm with self-learning function is proposed, which introduces LSTM neural network into the traditional GNSS/INS integrated navigation. The general process of the algorithm is that when the GNSS signal is available, the velocity, yaw of INS and preprocessed IMU output are used as the input of LSTM model, the output is the position increment of GNSS. When GNSS signal is lost, the preprocessed IMU data and INS information are input into LSTM model to generate pseudo GNSS position and send it to extended kalman filter (EKF) to correct INS navigation results. In order to obtain reliable and accurate positioning information during GNSS outages, based on the original wavelet threshold de-noising, this paper proposes a data pre-processing method combining empirical mode decomposition (EMD) and wavelet threshold filtering (WTF) to process the original IMU raw measurements, which improves the accuracy of LSTM neural network training input samples. Compared with other static neural networks as an auxiliary navigation algorithm, LSTM neural network has the ability of highly nonlinear dynamic mapping and storing past information. The experimental results show that the proposed navigation algorithm can significantly improve the accuracy and reliability of GNSS/INS integrated navigation during GNSS outages.