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Author: Mr. Ye Biao
China

Mr. Gu Dongqing
China

RESEARCH ON THE INS/CNS/LNS INTEGRATED NAVIGATION SYSTEM FOR THE LEO SPACECRAFT

Abstract

Compared to GNSS, the celestial navigation system (CNS) does not rely on external information to realize the autonomous navigation, but its accuracy is low (its RMS error is about 4km). The main reason of its low accuracy is the large error of the infrared earth sensor. The accuracy of the landmark navigation system(LNS) is high, due to the high accurate measurement of the landmark on earth sunshine region by the camera. But when the spacecraft entered the earth shadow, due to the uneffective identification and extraction of the landmarks, the measurement data will be disrupted. In this paper, the multi-sensor data fusion will be used to solve the above problem. The integrated navigation system is based on the inertial navigation system (INS), which error will be corrected by the information from CNS and LNS measurements. Firstly, in the period of sunshine, the LNS measurement is valid, the system works in full mode, and the inertial navigation error will be compensated with high accuracy (about 200 meters in RMS), as well as the compensation of the infraed earth sensor error. And then the spacecraft entered the earth shadow and the landmark information is invalid. The navigation system switches to the INS/CNS integrated mode. But at this moment, the measurement error of infrared earth sensor has been estimated and the INS/CNS integrated mode can reach the accuracy of better than 500 meters (RMS), which is much higher than the CNS accuracy of 4km (RMS). The INS/CNS/LNS integrated navigation system is presented in this paper and the simulation results of the system are given.