Paper ID: 19870
oral
student

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Poster Session (P)

Author: Dr. Pei CHEN
BUAA, China, cjhien@gmail.com

Dr. Pei Chen
Beihang University, China, cjhien@gmail.com
Mr. Tong Han
Beihang University, China, hantong@sa.buaa.edu.cn
Mr. Ran Ding
China, dingran_buaa@163.com
Mr. Chao Han
China, hanchao@buaa.edu.cn

ESTIMATION METHOD OF THE X-RAY PULSAR DIRECTION ERROR BASED ON BEIDOU SYSTEM

Abstract

X-ray pulsar navigation, which is a newly developed autonomous navigation technology for spacecraft, has long been a hot research subject. Pulsar direction error is an important aspect of astronomy research and is also a main factor which affects the navigation based on X-ray pulsars. However, subjected to the current measurement technology (Very Long Baseline Interferometer), there is an unavoidable error in the pulsar direction information. Unfortunately, even the pulsar direction error of 0.001"(" denotes arcs) will cause the system bias of several hundred meters which cannot be dealt with effectively by EKF and UKF. Consequently, there is a sharp decline in the navigational performance. In order to achieve more accurate pulsar direction parameters, this paper proposes a new estimation method for X-ray pulsar direction error based on the navigation data of Beidou system. Through analyzing the system bias caused by the pulsar direction error, it can be seen that the system bias is slowly time-varying. Based on the analysis result, the unscented Kalman filter (UKF), in which the system bias is treated as the state variable, is designed here to deal with the system bias. The simulation results show that the pulsar direction error could be accurately estimated by this algorithm and the accuracy of pulsar position is well improved, so the new algorithm is of great value to the research of navigation based on X-ray pulsar and astronomy. We find the observation duration and the position error of Beidou satellite have a great influence on pulsar direction error. The accuracy of pulsar position improves with the increase of the observation duration, and it shows a linear relationship with the position error of Beidou satellite that we have used. Besides, compared with the single-satellite system for estimation algorithm, the multi-satellites system is more effective in estimating the pulsar direction error and has a higher accuracy in and a stronger robustness to the pulsar direction error. In conclusion, the new method has the following virtues: (1) it is completely based on the navigation data of Beidou; (2) it has a high accuracy and a low time cost with current measurement technology; (3) it can be applied to deep-space exploration. Therefore, it can be a potential aided method for the X-ray pulsar-based autonomous navigation.