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Author: Mr. Boyu Lin
Deep Space Exploration Research Center, Harbin Institute of Technology, China, lbyhit@163.com

Mr. Cui Hutao
Harbin Institute of Technology, China, cht@astro.hit.edu.cn
Prof. Minqiang Xu
Harbin Institute of Technology, China, xumq@hit.edu.cn

AN AUTONOMOUS NAVIGATION METHOD FOR PLANETARY APPROACHING PHASE BASED UPON FUSING PLANETARY IMAGERY FEATURE AND PULSAR INFORMATION

Abstract

In this paper, an autonomous navigation method for planetary approaching phase based on fusing imagery feature of target planet and pulsar information is proposed. Firstly, an online method is introduced to calibrate the focal length of the optical system which provides the foundation of navigation. In this method, measurements obtained by on-board star sensors are implemented to determine the spacecraft's attitude, and the target planet is extracted as a feature point from an on-board monocular camera at the same time, through which the focal length can be estimated by synthesizing the information of spacecraft's attitude and coordinate of feature point. Simulation result shows that a calibration error under 2% could be achieved. Secondly, the spacecraft's orbital and attitude dynamic model which uses the planet's relative position as statement on planetary approaching phase is established and simplified. Then, measurement formula is established based on the sensors' measuring principle. In this navigation method, information of feature point of target planet and pulsar is used to update the position of spacecraft. Rate gyroscopes and star sensors are used to constitute the attitude determination system. Also, the extended Kalman filtering method is introduced to design the navigation filter. Finally, the navigation scheme's accuracy is demonstrated via Monte Carlo Simulation. Simulation results show that the accuracy of estimated spacecraft's location can reach 300m, and the accuracy of spacecraft's velocity and attitude can reach 0.1m/s and 0.003 degree respectively.