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Author: Mr. Zhao-Yang Gao
Nanjing University, China, gaozy@smail.nju.edu.cn

Prof. Xiyun Hou
Nanjing University, China, silence@nju.edu.cn

AUTONOMOUS NAVIGATION CONSTELLATIONS AROUND THE MOON BASED ON HALO ORBITS AND DISTANT RETROGRADE ORBITS USING SATELLITE-TO-SATELLITE TRACKING

Abstract

The capability of continuous navigation and communication is crucially important for lunar exploration missions, especially for crewed missions. At present, the navigation of lunar probes is strictly dependent on the ground stations around the globe. To relieve the burden on ground stations and strengthen the autonomy of the lunar probes, autonomous navigation constellations based on halo orbits and distant retrograde orbits (DROs) are proposed. Navigation satellites are deployed on halo orbits and DROs, tracking each other with satellite-to-satellite tracking (SST) measurements. By the use of SST data alone, the states of the navigation constellation can be determined autonomously. Afterward, lunar probes receive the navigation message from the navigation satellites and the states of the lunar probes are determined onboard. The study is conducted in three aspects. Firstly, the autonomous orbit determination performance of the navigation constellations is analyzed in two aspects. One is the effect of different observation arcs. Another is the performance of different configurations. Then, the feasibility of autonomous navigation is verified in a real force model. Finally, after a comprehensive study of the navigation constellations, the navigation performance of user lunar satellites is studied.