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ADAPTIVE AUTONOMOUS NAVIGATION FOR MARS' SATELLITE BASED ON THE ORIENTATION INFORMATION OF THE MARS, PHOBOS, AND DEIMOS

Abstract

High precision navigation information during the surrounded phase for mars missions can not only enable the successful of scientific observations of Mars' satellite, but also provide good initial navigation states for subsequent phases. Currently, the navigation for Mars missions relies on deep space network. However, for surrounded phase, the signal delay caused by long distance between the Mars and the Earth may degrade the performance of guidance and control system and even cause failure. Therefore, autonomous navigation methods should be developed.

In this paper, the autonomous navigation based on the line of sight information of Phobos and Deimos and Mar's nadir vector information for Mars' satellite is studied. This paper analyzes beacons' visibility by considering the attitude and orbit constraints and performs observability analysis. An adaptive kalman filter is presented to cope with environmental uncertainties based covariance-matching method. By matching the theoretical covariance with the sampling covariance of the residual of the measurement, the process noise covariance is estimated. In addition, a Chi-Square test is used to evaluate the effectiveness of the process noise covariance estimation. Another advantage of Chi-Square test is that it can improve the computational capability of adaptive kalman filter by avoiding unnecessary updating. The effectiveness of the proposed filter is evaluated through numerical simulations