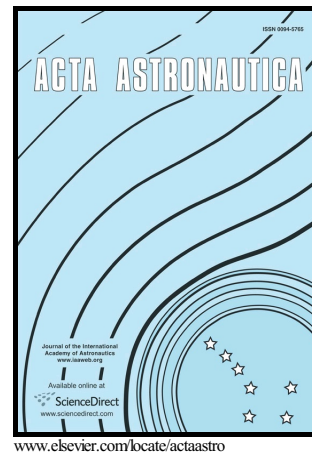


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Unscented Predictive Variable Structure Filter for Satellite Attitude Estimation with Model Errors When Using Low Precision Sensors

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Abstract: For the satellite attitude estimation problem, the serious model errors always exist and hinder the estimation performance of the Attitude Determination and Control System (ACDS), especially for a small satellite with low precision sensors. To deal with this problem, a new algorithm for the attitude estimation, referred to as the unscented predictive variable structure filter (UPVSF) is presented. This strategy is proposed based on the variable structure control concept and unscented transform (UT) sampling method. It can be implemented in real time with an ability to estimate the model errors on-line, in order to improve the state estimation precision. In addition, the model errors in this filter are not restricted only to the Gaussian noises; therefore, it has the advantages to deal with the various kinds of model errors or noises. It is anticipated that the UT sampling strategy can further enhance the robustness and accuracy of the novel UPVSF. Numerical simulations show that the proposed UPVSF is more effective and robustness in dealing with the model errors and low precision sensors compared with the traditional unscented Kalman filter (UKF).

Keyword: Attitude estimation; Predictive variable structure filter; UT; Model error; UKF

I. Introduction

The satellite technologies are rapidly developed in the two directions: large satellite technology and small satellite technology. Especially for the past decades, the small satellite technology has attracted the growing interests due to its low cost and short period [1-2]. Moreover, the increasing universities and institutions have poured

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