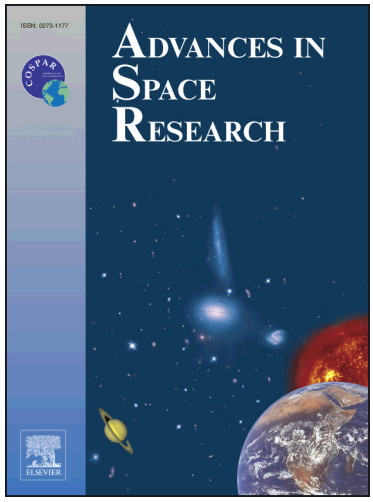

Estimation of Inertial Characteristics of Tumbling Spacecraft Using Constant State Filter

Chuan Ma, Honghua Dai, Jianping Yuan

PII: S0273-1177(17)30220-X
DOI: http://dx.doi.org/10.1016/j.asr.2017.03.032
Reference: JASR 13166

To appear in: *Advances in Space Research*

Received Date: 16 June 2016
Revised Date: 17 March 2017
Accepted Date: 21 March 2017

Please cite this article as: Ma, C., Dai, H., Yuan, J., Estimation of Inertial Characteristics of Tumbling Spacecraft Using Constant State Filter, *Advances in Space Research* (2017), doi: http://dx.doi.org/10.1016/j.asr.2017.03.032

Estimation of Inertial Characteristics of Tumbling Spacecraft Using Constant State Filter

Chuan Ma[a,b], Honghua Dai[a,b], Jianping Yuan[a,b,*]

[a] *Northwestern Polytechnical University, Xi'an, China, 710072*
[b] *National Key Laboratory of Aerospace of Flight Dynamics, Xi'an, China, 710072*

Abstract

Reconstruction of dynamical parameters is one of the main challenges faced in the on-orbit servicing missions for defunct spacecraft. And the quaternion plays a major role in parameterizations of the dynamical model. In this paper, the analytical solution of the quaternion differential equations of a tumbling symmetrical object is derived. Given this solution, a constant state filter is proposed for inertial characteristics estimation and attitude prediction of tumbling spacecraft. The key idea of the present filter is to replace dynamic variables by the undetermined constant parameters of the analytical solution. These parameters are estimated during the filtering process and then used to calculate the dynamic variables of the spacecraft. Furthermore, they are also utilized to determine the inertial characteristics and predict the future attitude motions. Compared with traditional EKFs, the constant state filter shows good performance when the measurement sampling interval is large or a priori estimation of the state is unavailable, because the dynamic model and observation model are transformed into approximate linear forms by utilizing the constant state vector. Numerical simulations verify the convergence and precision of the proposed filter.

Keywords: tumbling spacecraft; attitude estimation; determination of inertial characteristics

*Corresponding author
Email addresses: mach296@mail.nwpu.edu.cn (Chuan Ma), hhdai@nwpu.edu.cn (Honghua Dai), jyuan@nwpu.edu.cn (Jianping Yuan)