Proceedings of the Canadian Society for Mechanical Engineering International Congress 2022
CSME Congress 2022
June 5-8, 2022, Edmonton, AB, Canada

Model Predictive Control for Spacecraft Attitude Maneuver with Unknown Inertial Tensors by Reaction Wheels

Zheng H. Zhu
Department of Mechanical Engineering, York University, ON, Canada

ABSTRACT

The paper investigates the attitude maneuver control for spacecraft with unknown inertial tensors using reaction wheels. A model predictive control scheme with a recursive least square inertial identification algorithm is proposed to achieve the tasks of inertial tensor identification and attitude maneuver control simultaneously with the consideration of control torque constraint. The new scheme provides a closed-loop optimization strategy to minimize the control error and control increment for a smooth attitude maneuver. As a result, the inertial tensors can be identified effectively and precisely during the attitude maneuver process. The proposed scheme is applied to a rest-to-rest attitude maneuver of a spacecraft with and without the constraint of control torque magnitude. Numerical results show that the convergence rate of inertial tensor estimation is affected significantly by the available control torque. The simulation also demonstrates the newly proposed scheme is effective and easy to implement.