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CONTROL APPROACH FOR REACTION WHEEL DEVELOPMENT IN LAB ENVIRONMENT

Abstract

The attitude and orbit control subsystem (AOCS) provides attitude information and maintains the required spacecraft orientation during all phases of the mission, starting from the satellite launch and throughout its operational lifetime. Reaction wheels are the main actuators of an AOCS System as they generate a significant embedded kinetic momentum, serving as an effective actuation for satellite attitude control. The reaction wheels are characterized by inner specific parameters, such as inertia, electrical features, and motor efficiency. These parameters are computationally identified in order to define the available energy of actuation, expressed by speed variation rate, and the generated capacity of kinetic momentum and torque. The presented work is part of a laboratory development approach using COTS and engineering experiment. The project is the development of a pedagogical CubeSat satellite, starting from the development of satellite modules in flat configuration and the integration of the different units until the complete satellite system. The proposed methodology is the identification of the reaction wheel model based on laboratory development, and the integration of this actuator into a representative satellite platform. The first leg is to identify the characteristics and the transfer function of the reaction wheel based on lab measurements and physical principles. Then, the second part will be the design of a representative simulation model based on a pedagogical CubeSat platform, one-axis reaction wheel, a sensor block and the implementation of a control algorithm. The final phase is to define and validate the theorical representation of the Lab development products and to test the behavior of the complete system. Performances analysis campaign covers the fulfillment of users and system requirements, tuning of control algorithm parameters, and the robustness of the solution against manufacturing uncertainties, environment constraints, control stability and time bias. The system is developed in an open environment in order to permit the enabling of reaction wheel realization process and satellite control testing for other engineering projects.