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Modeling of the Attitude Control Reaction Wheels of a Spacecraft in Software in the Loop Test Bed

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Abstract : Reaction wheels (RWs) are generally used as main actuator in the attitude control system (ACS) of spacecraft (SC) for fast orientation and high pointing accuracy. In order to achieve the required accuracy for the RWs model, the main characteristics of the RWs that necessitate analysis during the ACS design phase include: technical features, sequence of operating and RW control logic are included in function (behavior) model. A mathematical model is developed including the various errors source. The errors in control torque including relative, absolute, and error due to time delay. While the errors in angular velocity due to differences between average and real speed, resolution error, loose in installation of angular sensor, and synchronization errors. The friction torque is presented in the model include the different feature of friction phenomena: steady velocity friction, static friction and break-away torque, and frictional lag. The model response is compared with the experimental torque and frequency-response characteristics of tested RWs. Based on the created RW model, some criteria of optimization based control torque allocation problem can be recommended like: avoiding the zero speed crossing, bias angular velocity, or preventing wheel from running on the same angular velocity.

Keywords : friction torque, reaction wheels modeling, software in the loop, spacecraft attitude control
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