ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics - Part 2 (6)

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MODULAR SIMULATION AND VISUALISATION APPLICATION FOR SATELLITE ATTITUDE CONTROL

Abstract

The development of an attitude control system for a satellite relies heavily on simulation. In the conceptual design phase simulation is required to determine requirements of the attitude control system and this drives the selection of sensors and actuators as well as their specifications. Simulation is also an integral part of testing of the attitude control subsystem. The integrated attitude control components can only be efficiently tested by setting their inputs from a simulated space environment.

This paper describes a modular simulation application with a visualisation aspect that can be used from the conceptual phase of a mission throughout development and testing of the integrated system.

The application uses a modular approach with the ability to customize simulation objects. Objects in the simulation can be simulated either as pure high-level software modules or as interfaces to other processes or external hardware. The "pluggable" modularity allows for a pure software simulation at design phase with the ability to replace modules with hardware interfaces later on in the development. In this way, a hardware-in-the-loop (HIL) simulation can be performed using the same environment and simulation parameters as the initial design phase simulation and the requirements that were gathered initially can be verified on the integrated system.

The application will be demonstrated on the hand of the STRaND (Surrey Training Research and Nanosatellite Demonstration) mission. STRaND is a collaborative project between the Surrey Space Centre and SSTL that will demonstrate new key technologies for nano-satellites on a 3U CubeSat platform. These include a miniaturized 3-axis attitude control system, a high-performance computing platform and micro Pulsed Plasma Thrusters (PPT). It will also have as payload a modern smartphone. The STRaND attitude control system will enable future nano-satellite missions that have a demand for high precision attitude control.

It will be shown how the presented application was used during the development of the STRaND attitude estimation and control algorithms (in the design phase), and how the attitude control requirements are verified with hardware-in-the-loop testing. For the latter test, the attitude control processor module that was represented as a software simulation object initially will be replaced by an interface to the hardware module, and exercised from the simulation environment.

It will also be shown how the visualisation aspect can be used to demonstrate orbits, attitude control concepts and attitude control modes without requiring extensive technical background on the subject.