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ATTITUDE DETERMINATION FOR CUBESATS THROUGH I-V MEASUREMENTS ON MAIN SOLAR PANELS

Abstract

Attitude determination is a key issue for all satellites and particularly so for CubeSats. In this paper, an approach to determine the attitude of a Cubesat only using the main solar panels will be presented. The study case will be the 6S Cubesat by PoliSpace, a student association of Politecnico di Milano and part of ESA's "Fly Your Satellite! Design Booster" program.

6S is a 1U satellite the design of which presents body-mounted solar panels on five faces, and which plans to use sun sensors as well as magnetometers for attitude determination.

This study aims to present a secondary option for attitude determination, both as a failure mitigation procedure in case of problems with the main sensors, as well as a possible cost cutting measure for future missions.

By using the electrical measurements for each of the main solar panels and appropriate measurement filtering techniques, the position of the sun with respect to the satellite can be estimated, and knowing the orbital position thanks to ground communication and the on-board orbit propagator, the attitude of the satellite can be determined.

The method will be tested and refined in a multi-domain simulation environment which takes into account the electrical power system, a thermal simulation and a rigid body motion for the satellite, offering an appropriate basis to determine accurate results and develop the technique which will be tested in-flight in the near future. Through Montecarlo analysis, the accuracy of this estimation will be studied, to understand the maximum attitude determination error obtained with this method.

To avoid a few of the typical problems encountered in solar panel measurements, such as their dependence on degradation and temperature, only differential measurements will be used, thanks to a set of assumptions on the thermal model of the satellite, made possible by an accurate thermal analysis.

This research could bring a significant step to CubeSat design by introducing a double functionality for solar panels (traditionally used only for power generation) and setting a new precedent for resource efficiency in space technology.