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MISSION DESIGN AND TRADE OFF ANALYSIS OF ATTITUDE AND ORBIT CONTROL SYSTEM FOR FORESAIL-2 CUBESAT

Abstract

The FORESAIL-2 mission designed and developed by Finnish Center of Excellence for Research in Sustainable Space will demonstrate feasibility to utilize a small satellite platform for scientific and technology demonstration purposes in a high-radiation environment. The science goal is to use a nano-spacecraft to study the role of Ultra-Low Frequency (ULF) waves in accelerating, transporting, and scattering of electrons in the Earth's radiation belts. Another science objective is to deploy a thin, long charged tether for coulomb drag and scientific plasma measurements. The technological objective is to design a reliable CubeSat platform including the avionic subsystems which can sustain a high radiation environment for a mission life of at least six months. The science instruments put stringent requirements on the platform to achieve and maintain desired spin rate.

This paper presents the mission design and trade off analysis for Attitude and Orbit Control System (AOCS) for FORESAIL 2. It is a 6U spinning CubeSat with Relativistic Electron and Proton Experiment (REPE) and Coulomb Drag Experiment (CDE) payloads designed for Geostationary Transfer Orbit (GTO). The paper includes trade off analysis and selection among various AOCS and platform architectures. The mission phases include multiple thruster burns to raise the apogee while maintaining a perigee altitude. The spin-up and maintenance of the spinning axis are critical mission parts for tether deployment. The spacecraft will face a radiation environment of an unprecedented level due to its high apogee altitude. Therefore, spacecraft and subsystems architecture include mitigation of radiation effects.