

46th STUDENT CONFERENCE (E2)
Student Team Competition (3-GTS.4)

Author: Mr. Harrison Handley
Simon Fraser University, Canada

Mr. Richard Arthurs
Simon Fraser University, Canada

Mr. Tobi Shires Nakamura
Simon Fraser University, Canada

DESIGN AND BUILDING OF A CUBESAT FOR RADIO TELESCOPE CALIBRATION

Abstract

The Simon Fraser University Satellite Design Team is competing in the Canadian Satellite Design Challenge. Where undergraduate and graduate students are designing and building a space grade CubeSat for the calibration of the Canadian Hydrogen Intensity Mapping Experiment Radio Telescope. The current method of using astronomical objects can only calibrate in the East to West direction and other options for North to South calibration using drones and high altitude balloons aren't substantial far enough away for far-field calibration. These restraints have proved that the application of a CubeSat at minimum 49 inclination for North-South calibration of the radio telescope is ideal. Additional constraints on the design is the requirement of positional data accuracy to be within 3.5km for ISS orbit and for the satellite antennas to be well-characterized. To accommodate these requirements the CubeSat radio is designed to transmit a calibration signal of 435MHz to 790MHz modulated by Gold code with half wave dipole antennas. This radio and antenna combination was designed in house by the students at SFU. In addition, to accommodate operation in vacuum and high radiation environment the on-board computer and power distribution boards were designed in house using flight proven and radiation hardened hardware. The boards were exposed to radiation testing equivalent to 2 years in low earth orbit, passing the tests without issue.

The rest of the satellite systems were also developed in house with the CubeSat structure being based off flight proven CubeSat designs. The Attitude Determination and Control System used a passive system with a permanent magnet and hysteresis rods. Finally, the power harvesting and storage system utilized 4 18650 cells with 18 solar cells. The overall system design focused on robustness and simplicity to assure continuous operation during the mission.

The expected launch date of the SFU Satellite Design Team launch is in the year 2020 from the ISS. It is planned to operate for up to two years in low earth orbit and continuously calibrate the Canadian Hydrogen Intensity Mapping Experiment over those two years. This is Simon Fraser University's first launched satellite completely designed, funded and built by students. The skills developed by the students during the design process will translate well into the aerospace industry after graduation.