NPSAT1 Overall Test Plan

Introduction

NPSAT1 is a low-cost, technology demonstration satellite hosting a number of experiments. Commercial, off-the-shelf (COTS)-based technology will be implemented with custom designs to offer a low-cost command and data handling (C&DH) subsystem building on commercial, desktop PC architecture and standards-based specifications. In addition to an experimental C&DH subsystem, NPSAT1 will demonstrate the use of non-volatile ferroelectric RAM which is inherently radiation-tolerant and lithium-ion polymer batteries, state-of-the-art technology that will be employed offering high energy density (Watt-hr/kg) for space applications.

Experiments on-board NPSAT1 include two Naval Research Laboratory (NRL) payloads. The coherent electromagnetic radio tomography (CERTO) experiment and a Langmuir probe. The CERTO experiment is a radio beacon which, in concert with ground station receivers, is used to measure total-electron-content (TEC) in the ionosphere. The Langmuir probe will augment CERTO data by providing on-orbit measurements. The other experiments are of NPS origin. These include a novel design for a spacecraft computer board, a COTS visible wavelength imager (VISIM), and some micro-electromechanical systems (MEMS)-based rate sensors.

Description of Thesis Topic

NPSAT1 will be launched as a secondary payload on the Evolved Expendable Launch Vehicle (EELV) Delta IV. The Delta IV will provide a medium lift capability in the EELV class of launch vehicles. NPSAT1 will be mated to the Delta IV using the EELV Secondary Payload Adapter (ESPA) and a Lightband separation system. While attached the launch carrier, mechanical switches inhibit spacecraft operation. After NPSAT1 separates from the launch carrier, the switches close the circuit for the solar array power and the startup events begin that will provide the initial mode of operations for the space vehicle until communications from the NPS ground station occur. However, there is no way of knowing with certainty at what time and where the spacecraft will be activated since launch delays may occur.

The scope of the thesis is to define the actual startup events that will take place onboard the NPSAT1 space vehicle after separation. In general terms, the spacecraft electrical power subsystem (EPS) will boot and perform its initialization sequence and power up the command and data handling (C&DH) subsystem and possibly the VISIM experiment to take some early pictures of the Delta IV payload stack. To be determined are what events should occur to ensure the greatest possibility of success. Questions to be addressed include how the communications antennas are to be used since there a zenith-pointing antennas for contingency; what information should be stored onboard for spacecraft startup; what contingency operations should be built-in to the startup procedures?

Proposed Outline

- NPSAT1 Introduction
- NPSAT1 Deployment Scenario
- Baseline Startup Procedure
- Space Vehicle Autonomous Contingency Operations
- NPS Ground Operations
- Recommended Test Flow
- Conclusions & Recommendations

Suggested References

- NPSAT1 CDR and Delta-CDR Slides
- Chuck Reuer Thesis on NPSAT1
- "Overview of the NPSAT1 Spacecraft Architecture and Technology Demonstration Satellite," D. Sakoda and J. Horning, Paper SSC02-I-4, 16th Annual AIAA/USU Conference on Small Satellites, Logan, UT 2002.
- "NPSAT1 Magnetic Attitude Control System," B. Leonard, Paper SSC02-V-7, 16th Annual AIAA/USU Conference on Small Satellites, Logan, UT 2002.