

NPSAT1 Environmental Test

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 a lithium-ion battery, 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 visual imager (VISIM), and some micro-electromechanical systems (MEMS)-based rate sensors.

Description of Thesis Topic

The NPSAT1 spacecraft is configured to launch aboard the evolved expendable launch vehicle (EELV) using the EELV secondary payload adapter (ESPA). Structural integrity verification is required firstly using finite element analysis (FEA) tools and secondly through modal test, thereby validating the FEA results. This study would concentrate on determining the fundamental dynamic modes of the structure by modal test. An engineering test structure would be designed and built to duplicate the load-bearing structure which may include spare or flight parts. The test structure would be outfitted with accelerometers and suspended over a vibration shaker system for force inputs (excitation). Measurements would be taken and data processed to determine the modal frequencies and shapes of the structure. These results would be used to validate the finite element model. Agreement within 10% is generally sufficient. Errors in both the test structure setup and analytical model should be considered.

Proposed Outline

- NPSAT1 Introduction
- Secondary Payloads Requirements
- Brief Description of Structural Dynamics and Modal Testing
- Description of Test Setup
- Test Results and Correlation
- Conclusions & Recommendations
- Appendix of Results

Suggested References

- *Modal Testing: Theory and Practice*, D. J. Ewins, John Wiley & Sons, Inc., New York, 1984.
- *Structural Design, Analysis, and Modal Testing of the Petite Amateur Navy Satellite*, D. J. Sakoda, NPS Master's Thesis, Monterey, California, 1992.
- I-DEAS Test On-line Documentation.