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INITIAL FLIGHT RESULTS OF THE RADIO AURORA EXPLORER

Abstract

The Radio Aurora Explorer (RAX) is a 2.8 kg triple CubeSat that was launched November 19, 2010, to study space weather. RAX is the first satellite funded by the U.S. National Science Foundation (NSF). The NSF is exploring the great potential of nanosatellites to gather key scientific information at a relatively low cost and is funding a series of space weather missions. The scientific mission of RAX is to study the microphysics of plasma instabilities that lead to magnetic field-aligned irregularities (FAI) of electron density in the polar lower ionosphere. These plasma instabilities can disrupt satellite communications, which is potentially disastrous for ground-based systems that rely on satellites, such as navigation and communication systems. Due to the local vertical direction of the magnetic field over the North Pole, studying FAI in this region is not possible with ground-based systems alone. RAX utilizes a novel ground-to-space bi-static radar configuration to achieve the science objectives. Ground-based incoherent scatter radar illuminates the irregularities, and the receiver onboard RAX measures the amplitude and phase of the resulting scatter from the irregularities. The ultimate goal of the scientific mission is the ability to develop forecast models for the FAI.

RAX is a collaborative effort between SRI International and the University of Michigan. The radar receiver was designed and built by SRI, and the other subsystems were designed, built, integrated, and tested by students at Michigan. There are many novel aspects of the RAX design. The receiver has a large dynamic range, immunity from satellite-generated noise, and immediate saturation recovery in the event of direct-path radar illumination. A custom electrical power system was designed to meet both the functional requirements and an aggressive development schedule. A position and time subsystem was developed, and the RAX GPS receiver has achieved lock with the GPS constellation on-orbit. Attitude determination is accomplished with sun sensors, magnetometers, and rate gyros, and we employ novel, on-orbit magnetometer calibration techniques to process data from magnetometers embedded in the satellite. The gyros have provided unique data that will facilitate design improvements for future small satellite attitude stabilization systems.

The first RAX mission is currently in orbit and a science experiment has been successfully completed. A second satellite is scheduled to launch in late 2011. In this talk, we will describe the RAX mission, the unique aspects of the satellite design, and provide the current status and results achieved by both RAX missions.