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DESIGN OF SATELLITE ANTENNA AND GROUND EQUIMENT FOR COMMUNICATION SYSTEM OF A REMOTE SENSING SATELLITE

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ABSTRACT

The SpudNik-1 CubeSat project from the University of Prince Edward Island uses a low-cost design for the satellite communications subsystem and ground station. The project uses resources available in-house to design, manufacture, and test satellite components that are normally obtained commercially. Namely, the unique deployment mechanism of the Flat Turnstile Antenna has been designed and will be manufactured by the UPEI CubeSat team.

The communications subsystem uses frequencies in UHF for Telemetry, Tracking and Command (TT&C) and S-Band to downlink payload data. The UHF antenna on the satellite is a circularly polarized turnstile antenna and consists of an electrical and mechanical subsystem. The mechanical design is a platform used to store 171.4 mm coiled steel tape antennas (¼ wavelength) held in place prior to deployment. The electrical design of the antenna is implemented in a PCB mounted with four U.FL connectors to connect coaxial cable to the ends of the antennas. The board contains RF power splitters to connect the monopole antennas to create a turnstile antenna. The power splitters combine the signal to connect to the MMCX port mounted to the board, which connects coaxial cable to the transceiver for uplink/downlink communications.

The UPEI ground station will use an S-Band Dish antenna for receiving payload data and a single UHF Yagi antenna for uplink and downlink of TT&C data. Both antennas are mounted to a rotator controlling the orientation in azimuth and elevation, with the Yagi connected via a boom. The mode of the UHF ground station link is controlled by a coaxial switch and automated by the ground station operational programming which will determine when a UHF signal is being transmitted or received. A LimeSDR will be used as the ground station transceiver, connected to a computer running SDR Console and GNU Radio Companion software. SDR Console will capture the raw data from the satellite. GNU Radio Companion will demodulate the recorded signal based on Gaussian Frequency-Shift Keying.

This presentation will include a description of the satellite antenna system, the campus ground station, and the communication and link budget. The link budget has a healthy margin for the UHF and S-Band. The margin for the UHF is 11.1 dB for uplink and 11.6 dB for downlink. For the S-Band, the downlink margin is 2.2 dB.

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