THE CUBESAT RADIOMETER RADIO FREQUENCY INTERFERENCE TECHNOLOGY VALIDATION (CUBERRT) MISSION

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The CubeSat Radiometer Radio Frequency Interference Technology Validation (CubeRRT) mission is developing a 6U CubeSat system to demonstrate radio frequency interference (RFI) detection and mitigation technologies for future microwave radiometer remote sensing missions. CubeRRT will perform observations of Earth brightness temperatures in 1 GHz channels tunable from 6-40 GHz, and will demonstrate on-board real-time RFI processing.

Passive remote sensing measurements below 40 GHz have shown an increase in man-made RFI, having a degenerative impact on important geophysical retrievals, including soil moisture, atmospheric water vapor, sea surface temperature, sea surface winds, and many others. Due to current shared spectrum allocations and the accelerating demand for bands to be open for general commercial use, microwave radiometers must co-exist with terrestrial RFI sources. As these RFI sources expand over larger areas and occupy additional spectrum, it will be increasingly difficult to perform radiometry without an RFI filtering capability. RFI processing on the ground is not possible because the data volumes for raw signals are prohibitive for downlink. Real-time on-board RFI processing is therefore an important technology needed for future missions.

To demonstrate on-board, real-time RFI processing from 6-40 GHz, the CubeRRT mission has been selected under NASA's In-space Validation of Earth Science Technologies (InVEST) program. The CubeRRT payload consists of three subsystems: a wideband antenna subsystem, a tunable analog radiometer subsystem, and a digital backend processor performing real-time RFI detection and filtering. Initial progress in RFI filtering technologies for microwave radiometry has been achieved in the Soil Moisture Active Passive (SMAP) mission, which has a 24 MHz bandwidth centered in the protected 1413 MHz band. RFI subsystems for higher frequency microwave radiometry over the range 6-40 GHz require a larger bandwidth, so the capabilities of RFI filtering processors must also increase in terms of bandwidth, processing power, and onboard operation. The enabling CubeRRT technology is a digital Field-Programmable Gate Array-based spectrometer with a bandwidth of 1 GHz that is capable of implementing advanced RFI filtering algorithms that use the kurtosis and cross-frequency RFI detection methods in real-time on board the spacecraft. The system is currently under development, with launch expected in 2018 followed by a one year period of on-orbit operations.