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This work was supported by the NASA Earth Science Technology Office (ESTO). The design, development and test of the CubeRRT spacecraft bus is by Blue Canyon Technologies. The radiometer front end is developed by NASA Goddard Space Flight Center, and the radiometer digital backend is developed by NASA Jet Propulsion Laboratory.

RFI PROBLEM FOR MICROWAVE RADIOMETRY
Images from NASA’s GMI radiometer (above) at 10.65 and 18.7 GHz show the clear corrupting influence of RFI. Ideally, radiometers avoid RFI by operating in bands where transmission is prohibited. In practice, radiometers must co-exist with RFI sources due to shared spectrum allocations or operation in unprotected bands. Co-existence in some cases may be possible provided that a subsystem for mitigating RFI is included in future systems.

Spectrum allocations 6-40 GHz

The success of CubeRRT’s RDB paves the way for its adoption as an essential component of future Earth observing microwave radiometers to enable continued operation in the presence of RFI.

CURRENT STATUS AND CONCLUSIONS
CubeRRT has successfully met its mission objectives by demonstrating the RFI processor for over 400 hours of measurements in orbit with no evidence of radiation induced degradation. This is an important milestone for the use of COTS FPGA systems for radiometer RFI processing in space.

CubeRRT’s RFE ceased operation on September 8th, 2018, limiting the range of observed RDB inputs to a self generated “test pattern”. Ground processing nevertheless confirms that successful on-board flag generation by the RDB continues.

The first light dataset was acquired on September 5th, 2018, and demonstrates successful real-time onboard RFI flagging for the first time in space!

CUBE RRT MISSION
The CubeRRT mission’s primary objective is to demonstrate an RFI processor for future spaceborne microwave radiometers that provides real-time, onboard RFI filtering. CubeRRT's first light dataset was acquired on September 5th, 2018, and demonstrates successful real-time onboard RFI flagging for the first time in space!

CUBE RRT PAYLOAD SUBSYSTEMS
Subsystems include the 6-40 GHz antenna (ANT), the Radiometer Front End (RFE), and the Radiometer Digital Backend RFI (RDB) processor. CubeRRT’s payload antenna (left) includes 3 tapered helix elements to cover 6-40 GHz with gain 7 to 21 dBi in a 0.25U, 116g package. CubeRRT’s RFE (right) tunes 6-40 GHz signals to 1-2 RF GHz IF of RDB. CubeRRT’s RDB (below, ~ 0.25U, 170g, 10W) is the key technology, and is implemented using a Zynq 7100 COTS FPGA plus power and A/D components. The RDB implements both kurtosis and cross-frequency methods for RFI detection using 128 frequency sub-channels.