Design of an L-band Microwave Radiometer with Active Mitigation of Interference

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Radio frequency interference (RFI) impairs L-band radiometry outside the protected 20 MHz frequency band around 1413 MHz. However, bandwidths of 100 MHz or more are desired for certain remote sensing applications as well as certain astronomy applications. Because much of the RFI in this band is from radars with pulse lengths on the order of microseconds, traditional radiometers (i.e., those which directly measure total power or power spectral density integrated over time scales of milliseconds or greater) are poorly-suited to this task. Simply reducing integration time and discarding contaminated outputs may not be a practical answer due to the wide variety of modulations and pulse lengths observed in L-band RFI signals, the dynamic and complex nature of the associated propagation channels, and the logistical effort associated with post-measurement data editing. This motivates the design and development of radiometers capable of coherent sampling and adaptive, real-time mitigation of interference.

Such a radiometer will be described in this presentation. This design is capable of coherently-sampling up to 100 MHz bandwidth at L-band. RFI mitigation is implemented in FPGA components so that real-time suppression is achieved. The system currently uses a cascade of basic time- and frequency-domain detection and blanking techniques; more advanced algorithms are under consideration. The modular FPGA-based architecture provides other benefits, such as the ability to implement extremely stable digital filters and the ability to reconfigure the system "on the fly". An overview of the basic design along with on-the-air results from an initial implementation will be provided in the presentation. Related L-band RFI surveys will be described to illustrate the relevance of this approach in a variety of operating conditions.