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Performance Characterization of the SMAP RFI mitigation algorithm using direct-sampled SMAPVEX 2012 data

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In recent years passive microwave measurements made by space-borne and air-borne missions have been corrupted by man-made Radio Frequency Interference (RFI) sources. Measurements from satellite missions such as SMOS and Aquarius show that even the protected 21cm hydrogen line is affected by RFI (Balling et al., TGRS 2010). The following talk will focus on the digital RFI mitigation algorithm implemented on the SMAP Radiometer Digital Electronics (RDE) subsystem and its performance with respect to real RFI data. This data at passive microwave L-band frequencies was obtained from flights over Denver during Summer 2012 using a direct sampling digital backend behind the Passive/Active L/S Band (PALS) system.

The direct-sampling digital backend developed under a JPL R&TD demonstrator program is the key technology that gives insight and knowledge into the characteristics of incoming RFI that would be useful for algorithm testing. The backend measures raw radiometer pre-detection voltages at a high sampling rate and full observed bandwidth. This data set allows the implementation of any RFI detection algorithm in post-processing at variable radiometer integration periods and acts as "ground-truth" to the system/algorithm under test (like the SMAP RDE).

RFI data obtained from the airborne mission will be used to aid SMAP RFI algorithm performance analysis in different ways. Different types of data sets will be selected from the airborne campaign to test different characteristics of the algorithm that employs a combined spectral, temporal and statistical flagging. Different types of RFI from the data will also be combined to simulate what a SMAP footprint might see, such as multiple sources. The primary analysis will involve feeding in different RFI test suites to a modeled SMAP RDE digital signal processing unit. The algorithm model (developed by GSFC) includes effects such as digital quantization to completely simulate the SMAP RDE. The data can also be tested directly on the Engineering Testing Unit or actual flight hardware RDE via an Arbitrary Wave-form Generator (AWG) at GSFC. This will provide a valuable set of results for characterizing the performance of the SMAP digital RFI mitigation algorithm with real RFI data.

A brief description of the SMAPVEX flight campaign and digital direct detect hardware will be presented. Results from the RFI analysis will be discussed comparing the performance of SMAP detection and mitigation algorithms. Further work based on the obtained results will also be discussed.