

ABSTRACT

Radio Frequency Interference (RFI) can adversely impact microwave passive remote sensing measurements, and prohibits passive observations outside protected portions of the radio frequency spectrum. A microwave radiometer including a digital back-end with a simple real-time RFI mitigation technique for reducing pulsed RFI has been developed to address this issue; the process is termed “asynchronous pulse blanking” (APB). The idea of this technique is to remove incoming data whose power exceeds the mean power by a specified number of standard deviations. Although successful performance of this algorithm has been qualitatively demonstrated through local experiments with the digital radiometer, a detailed quantitative assessment of its performance in a variety of RFI environments has not been reported.

To address this issue, a simulation study of the APB algorithm was initiated using data obtained from the L-Band Interference Surveyor/Analyzer (LISA), an airborne instrument developed for observing the RFI in the region 1200-1700 MHz. LISA was deployed on NASA’s P3-B aircraft to observe RFI in flights in the US and Japan. This data set is very useful for assessing the APB algorithm, since many RFI environments were observed that include multiple sources of interference. Several aspects of algorithm use and performance have been studied, including means for choosing the algorithm’s parameters and the robustness of the method in a realistic RFI environment. Effects of the blanking process on the final output are also examined.

In order to further quantitatively demonstrate the performance of the system, a series of L-band sky observations was performed. These experiments were based on the predictable brightness of the cold sky background, so that long-term measurements of instrument performance are possible. The results reported in this thesis confirm stability of the system for six hours of observation. In addition, post-processing techniques proposed for removing other types of RFI have been tested.

While the algorithm is conceptually simple, developing a process that is both automatic and robust requires careful consideration of the implementation details. Issues regarding implementation in field-programmable gate array (FPGA) devices are also discussed in this thesis.