A Theoretical Study of Cross-Frequency Blanking for Pulsed Sinusoidal Radio Frequency Interference Detection

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Radio Frequency Interference (RFI) limits the sensitivity of passive remote sensing systems to environmental parameters. Increasing accuracy requirements in these systems have caused a surge in research that aims to alleviate the RFI concerns. The approaches considered for this purpose in earth remote sensing can be divided into three main groups: Pulse detection, cross-frequency detection and testing the measured fields for normality.

Pulse detection methods rely on the fact that RFI increases the observed brightness. Therefore, samples of observed fields in time domain that are abnormally large in amplitude are detected as RFI in this technique. As a result, pulse detection is most effective against RFI sources with low duty cycles that can be resolved in time. Cross-frequency detection requires a radiometer with multiple frequency channels. This method searches for outliers in frequency domain. Hence, it is most effective against narrowband sources. Since thermal radiation has a Gaussian distribution and anthropogenic emissions disrupt normality, it is also possible to detect RFI by testing the measured fields for normality. There are a variety of statistical tests that can be used for this purpose, including a kurtosis test. A kurtosis detector is advantageous in applications where a variety of RFI sources with different characteristics may be encountered. It is possible to increase the performance of the kurtosis detector by subsampling in time and frequency domains (i.e. a "spectral kurtosis" method).

In this presentation, a theoretical study of the performance of cross-frequency detector against pulsed sinusoidal RFI will be performed. This RFI type is chosen as a representative of pulsed radars and continuous sinusoidal sources. However, the theoretical results presented can be applied to any RFI source with a known frequency distribution. Effects of varying RFI strength and duty cycle will be analyzed. It is of importance to be able to compare the detection performance of different RFI detection techniques to find the best performing detector for the RFI environment of interest. Therefore results will be compared with those of the pulse and spectral kurtosis algorithms as well.