Adaptive Null-Forming for the Spy-1A at the National Weather Radar Testbed

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Risk reduction for the MPAR program necessitates the development of technologies that support Radio Frequency Interference (RFI) mitigation for phased arrays, ideally in real-time.. The intermittent RFI introduced by government mandated shared spectrum could have impacts on the MPAR program, especially its aircraft detection and atmospheric observation missions. Key motivations are as follows: (1) Previously known beam-forming and null-forming algorithms have been studied in the past, yet their real-time implementation remains a challenge; and (2) RFI is an ever increasing problem to radar imaging systems, high resolution radar modes, cognitive radio systems, impulsive radars, passive radars, compressive radars, and other systems that operate over wide bandwidths.

RFI signals may be transient and can be difficult to mitigate. Their non-stationary behavior suggests that analog RF filtering is not a viable approach and that real-time digital filtering could be a better approach. A sample-by-sample method of RFI mitigation, the Interference Spike Detection Algorithm (ISDA), was explored in 2013-2014 to address the interference in the time domain. In contrast, the adaptive null-forming approach is a type of spatial filter, and our focus will be the efficacy and efficiency of this kind of technique.

With a multichannel receiver, a linearly constrained minimum power beamformer can be designed for adaptive null-forming. This beamformer leverages the signal data, in particular the inverse of the covariance matrix of the receiving channels, to introduce nulls in the directions of interference. While this type of beamforming has shown its effectiveness in eliminating interference from jammers and other noise sources, it has not been applied to meteorological data. Our research explores the effects of the application of several implementations of this type of beamformer on meteorological data.