Adaptive Interference Cancellation Using an Array Feed Design for Radio Telescopes

Chad Hansen, Karl F. Warnick,[*] and Brian Jeffs
Department of Electrical and Computer Engineering
Brigham Young University
Provo, UT 84602

There has been a great deal of work in the past to eliminate or reduce radio frequency interference (RFI) in radio astronomy observations due to satellite systems such as the Russian Federation Global Navigation Satellite System (GLONASS), which operate near radio astronomy frequency bands of interest. These sources are difficult to deal with because they are non-stationary and emit high power signals. Current approaches to this problem are adaptive filtering, adaptive nulling, and blanking of intermittent interferers. Adaptive filtering and adaptive nulling require at least one auxiliary antenna. For applications where multiple antennas are undesirable, adaptive cancellation can be done on a single dish antenna using an array feed.

Phased array feeds have been used on radio astronomy antennas in the past to compensate for reflector aberrations, improve the efficiency of off-axis beams, and to electronically synthesize multiple scanned beams for rapid sky coverage. Full-sampling focal plane arrays have also been designed using electrically small elements, such as dipoles. This type of an array is a good candidate for use with RFI mitigation because it allows many degrees of freedom. Simulations of an array feed in conjunction with a very large array (VLA) model antenna show that the signal-to-interference ratio can be significantly improved using adaptive beamforming techniques such as linear constrained minimum variance (LCMV). We are also studying how the array design can be optimized for both adaptive cancellation and maximum receiver sensitivity (gain/system temperature).