Improving Cross Polarization for MPAR via Orthogonal Waveforms

Dr. Yasser Al-Rashid, Dr. Rao Nuthalapati, Mr. Francis X. McGroary, Dr. Charles Kryzak, Dr. Svetlana Bachmann

Background: Multifunction Phased Array Radar (MPAR)

The Department of Commerce / National Weather Service (DoCNWS), the National Weather Service (NWS), the Federal Aviation Administration (FAA), the Department of Defense (DoD), and the National Weather Service (NWS) demonstrate Vertical capability MPAR control radars. WSR-88D networks are comparable with existing MPAR systems. The system upgrades are being tested and analyzed in a series of experiments at the National Weather Service sites. The experiments include a comparison of the new system with the existing MPAR systems.

Orthogonal LFM cross correlation

Orthogonal Linear Frequency Modulated (LFM) methods are based on cross correlation between up-chirp and down-chirp. The benefits of the orthogonal LFM on the x-pol performance were demonstrated via simulation in 2010 (ideal). We validated the performance of a dual-polarized antenna panel that was evaluated in simulations by demonstrating the performance on an existing S-band phased array panel with 144 dual-pol radiating elements (Lab Test). A set of waveforms with different Instantaneous Bandwidth and Pulswidh products were used to assess cross correlation and sidelobe performance. The results indicate that the orthogonal waveforms further improve x-pol.

Conclusions

Antenna cross polarization isolation can be improved using (1) hardware and/or (2) waveforms/processing. The existing subarray designs are available to directly compare x-pol and dual coefficient weightings needed to meet x-pol behavior and steering requirements. Regardless of the hardware/processing approaches, the application of orthogonal waveforms provides additional 14-27 dB improvement on x-pol as demonstrated in simulations in 2010 and testing in the anechoic chamber in 2011. Dual-pol quality suitable for stringent polarization requirements is achievable.