A First Look at the ATD Data Corrections

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The Advanced Technology Demonstrator (ATD) is an S-band planar polarimetric phased array radar (PPPAR) being funded through a joint collaboration of the National Oceanic and Atmospheric Administration and the Federal Aviation Administration and developed by the National Severe Storms Laboratory (NSSL), MIT Lincoln Laboratory, and General Dynamics. It serves as a testbed for evaluating the suitability of PPPAR technology for weather observations. The major challenge on this path is the calibration needed to achieve PPPAR measurements comparable to those of the systems using parabolic-reflector antennas. This is due to the existence of significant cross-polar antenna patterns, as well as the scan-dependent measurement biases, inherent to PPPAR. The former induces cross coupling between returns from the horizontally and vertically oriented fields resulting in the biases of polarimetric variable estimates. Furthermore, the inductive and capacitive coupling in hardware may exacerbate the cross-coupling effects. Pulse-to-pulse phase coding in either the horizontal or vertical ports of the transmission elements has been proposed to mitigate the cross-coupling effects. However, it does not address the scan-dependent system biases in PPPAR estimates. These are caused by the horizontal (H) and vertical (V) copolar antenna patterns which vary with beamsteering direction. The effects of these variations must be addressed via corrections using appropriate values at each boresight location. If the cross-coupling effects are sufficiently suppressed with pulse-to-pulse phase coding and given sufficiently narrow antenna main beam, the corrections can be conducted using only the beam peak values of the copolar patterns. But, the cross coupling mitigation from pulse-to-pulse phase coding is inversely proportional to the cross-polar pattern levels. Thus, at boresight locations where the cross-polar pattern levels are too high, the corrections using the beam peak values of both the copolar and cross-polar patterns need to be conducted. Furthermore, the effects of active electronic components in transmit and receive paths in PPPAR systems can result in significant differences between transmit and receive patterns. For this reason, it is important to characterize the peaks of both transmit as well as receive copolar and cross-polar antenna patterns. In this work, a first look at the beam-peak-based corrections using data from ATD system is presented.

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