Motivation
A promising replacement for the WSR-88D is the phased array radar (PAR). A prominent factor in the PAR design considerations is the antenna cross-polar isolation which may dictate alternate horizontal and vertical (AHV) transmission over simultaneous horizontal and vertical (SHV) transmission. Engineering challenges exist with either approach. Here we examine the ground clutter mitigation of AHV using CLutter Environment ANalysis using Adaptive Processing (CLEAN-AP).

Decoupling Velocity and Differential Phase in AHV
The differential phase and velocity estimates are coupled such that phase shifts greater than 90 degrees in differential phase create velocity aliasing. Since the expected phase shift of differential phase is monotonic increasing in range, it can be tracked to mitigate velocity aliasing caused by differential phase (Ref: Sachidananda and Zmic, 1989, JAOT).

Unfiltered Reflectivity
Digital receiver signals captured on the WSR-88D test bed in Norman, OK is processed in SHV and AHV modes. The AHV mode is created by resampling the SHV mode (i.e. using every other sample of each channel). Red arrows point to strong ground clutter (41.5° < 90°) near the radar.

Filtered Reflectivity
The CLEAN-AP filter is used to automatically detect and filter the digitized receiver signals. The ground clutter suppression of this filter easily removes the strong ground clutter near the radar while preserving the weaker signals, as shown where strong ground clutter is mitigated.

Filtered Velocity
Velocity estimates in the AHV mode must be decoupled from the differential propagation phase to ensure velocity estimates are not aliased. Two panels in the right display the SHV mode (left panel) and AHV mode (right panel). AHV mode estimates increase in weak signal regions in the SHV mode due to fewer samples available for processing.

Filtered Differential Reflectivity (ZDR)
Combining the long and short PRT estimates in the AHV mode where no range-overlap occurs provides a better estimate of ZDR comparable to the SHV mode.

Filtered Correlation Coefficient
Combining the long and short PRT estimates in the AHV mode results in weaker correlation coefficients. Still, the AHV mode has slightly increased values in the correlation coefficient estimates for this data.

Filtered Differential Propagation Phase (PHidp)
Constant monitoring of PHidp is required in order to estimate and decouple from the velocity estimates in AHV mode. An estimate of the initial system differential phase (SCDP) input upates of PHidp applied to the vertical channel prevents phase wrapping (see panel to right).

CLEAN-AP Detect and Filter Ground Clutter

CLEAN-AP Processing for AHV

Cross-Spectral Density Phase Relationship

Lag-1 auto-correlation spectral density

Par

WSR-88D