PAR

P17 Automated Real-Time Mitigation of Ground Clutter Contamination for Dual-Polarization Doppler Weather Radars Using the Alternating Transmission Mode

WSR-88D

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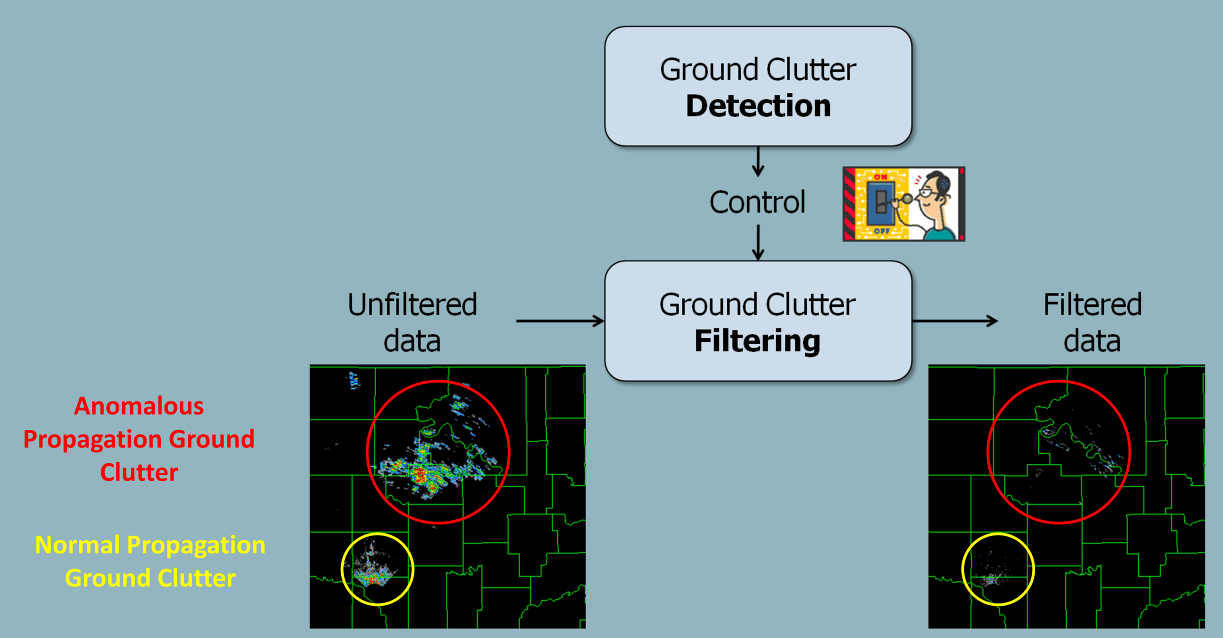
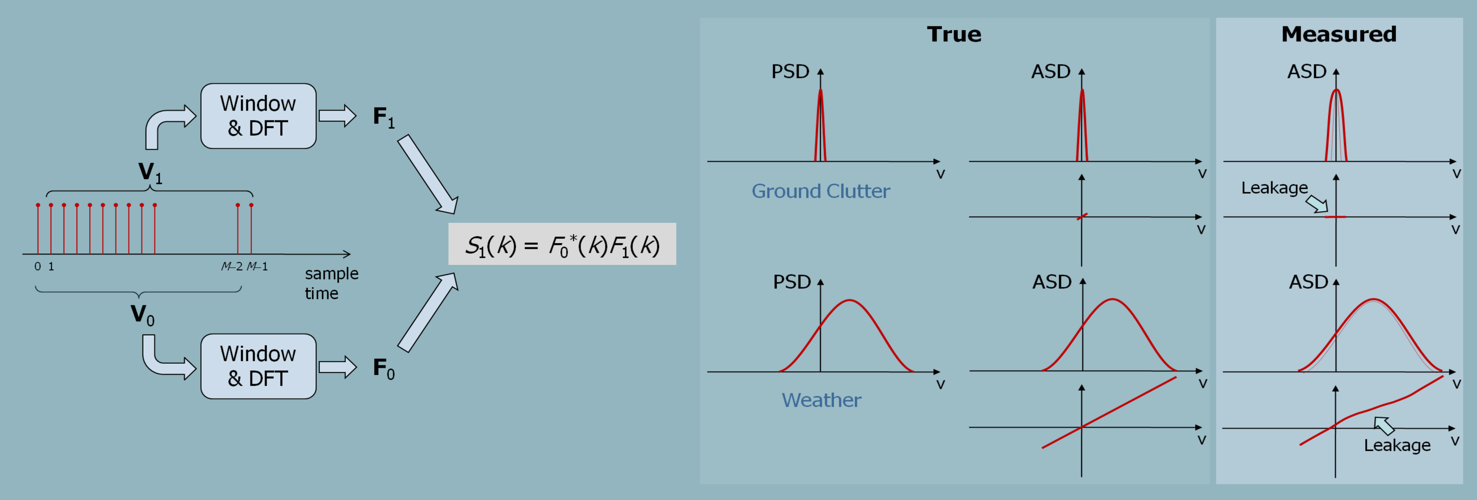
Motivation

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 **CL**utter **E**nvironment **AN**alysis using **A**daptive **P**rocessing (**CLEAN-AP**).

CLEAN-AP Detect and Filter Ground Clutter



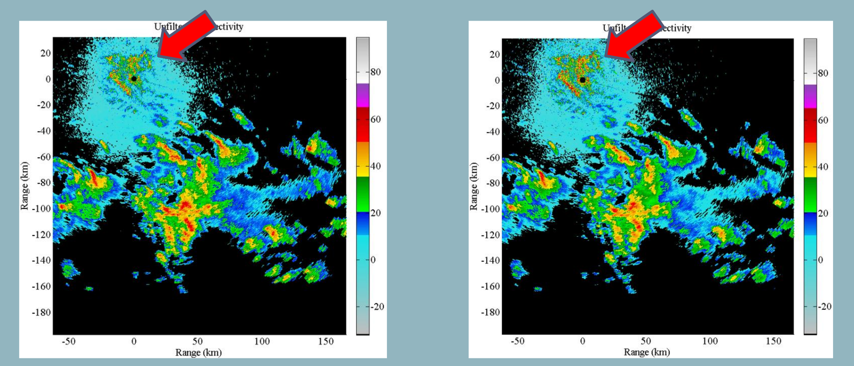
Lag-1 auto-correlation spectral density



SHV AHV

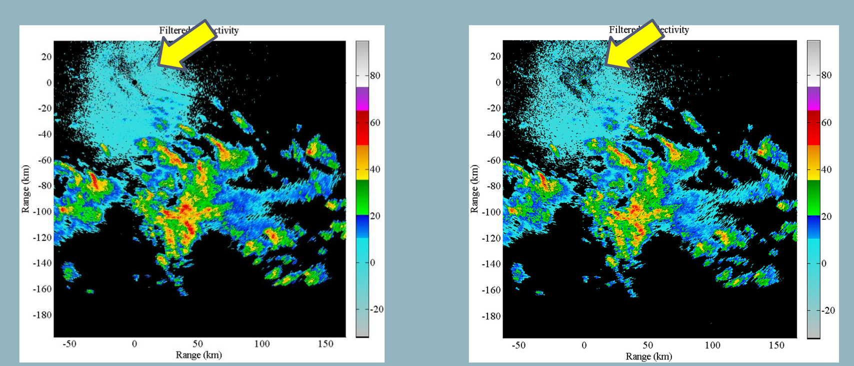
Unfiltered Reflectivity

Digitized receiver signals captured on the WSR-88D test bed in Norman, OK is processed in SHV and AVH 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 (40 – 60 dBZ) near the radar.



Filtered Reflectivity

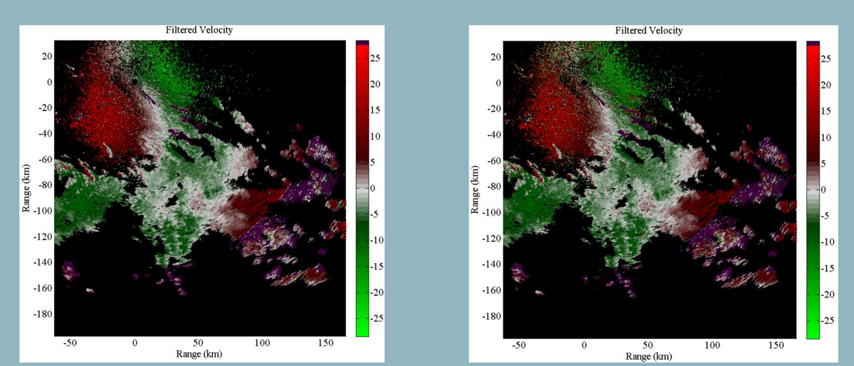
The CLEAN-AP filter is used to automatically detect and filter the digitized receiver signals. The ground clutter suppression of this filter easily removes the strong ground clutter near the radar while preserving the weather estimates. Yellow arrows show where strong ground clutter is mitigated.



Filtered Velocity

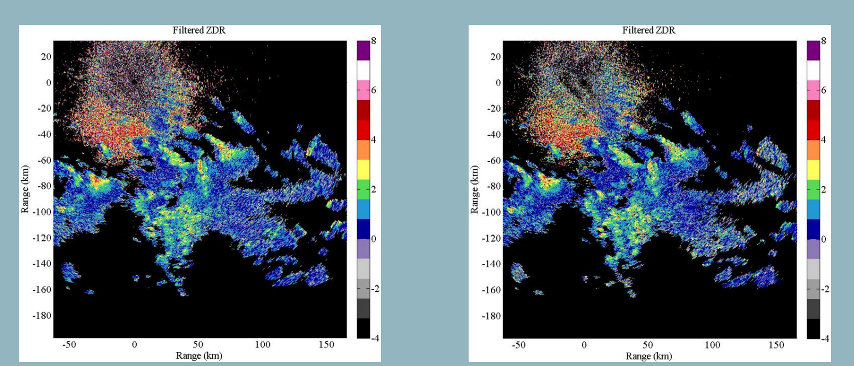
Velocity estimates in the AHV mode must be decoupled from the differential propagation phase to ensure velocity estimates are not aliased (see panel to the right titled: “CLEAN-AP Processing for AHV mode”). Velocity estimate errors increase in weak signal regions in the AHV mode due to smaller samples available for processing.

Note: Some increases in estimate errors for these examples in AHV mode are due to using the SHV collected data (i.e. reduced sensitivity).



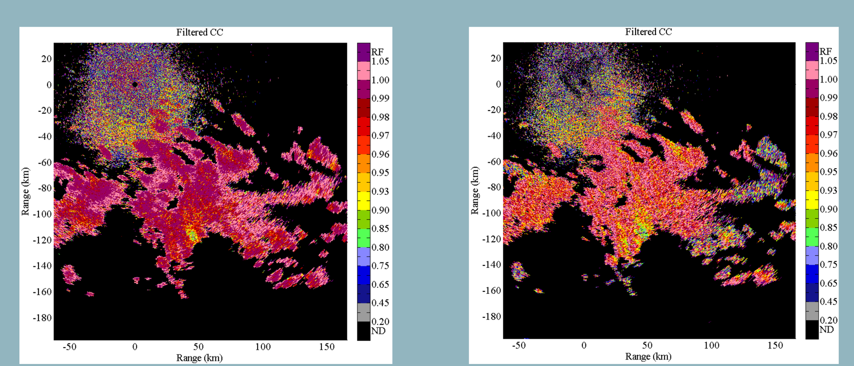
Filtered Differential Reflectivity (ZDR)

Combining the long and short PRT estimates in the AHV mode where no range-overlay occurs provides a better estimate of ZDR: comparable to the SHV mode.



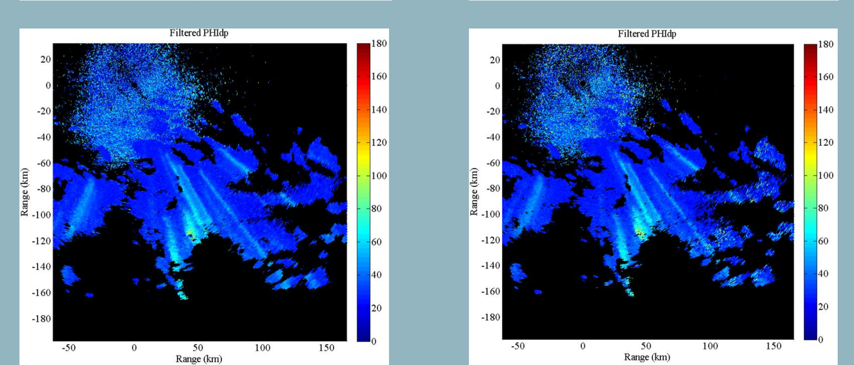
Filtered Correlation Coefficient

Combining the long and short PRT estimates in the AHV mode where no range-overlay occurs provides a better estimate of correlation coefficient . 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 for valid estimates and to decouple from the velocity estimate in AHV mode. An estimate of the initial system differential phase (ISDP) and a update of PHIdp applied to the vertical channel prevents phase wrapping (see panel to right).

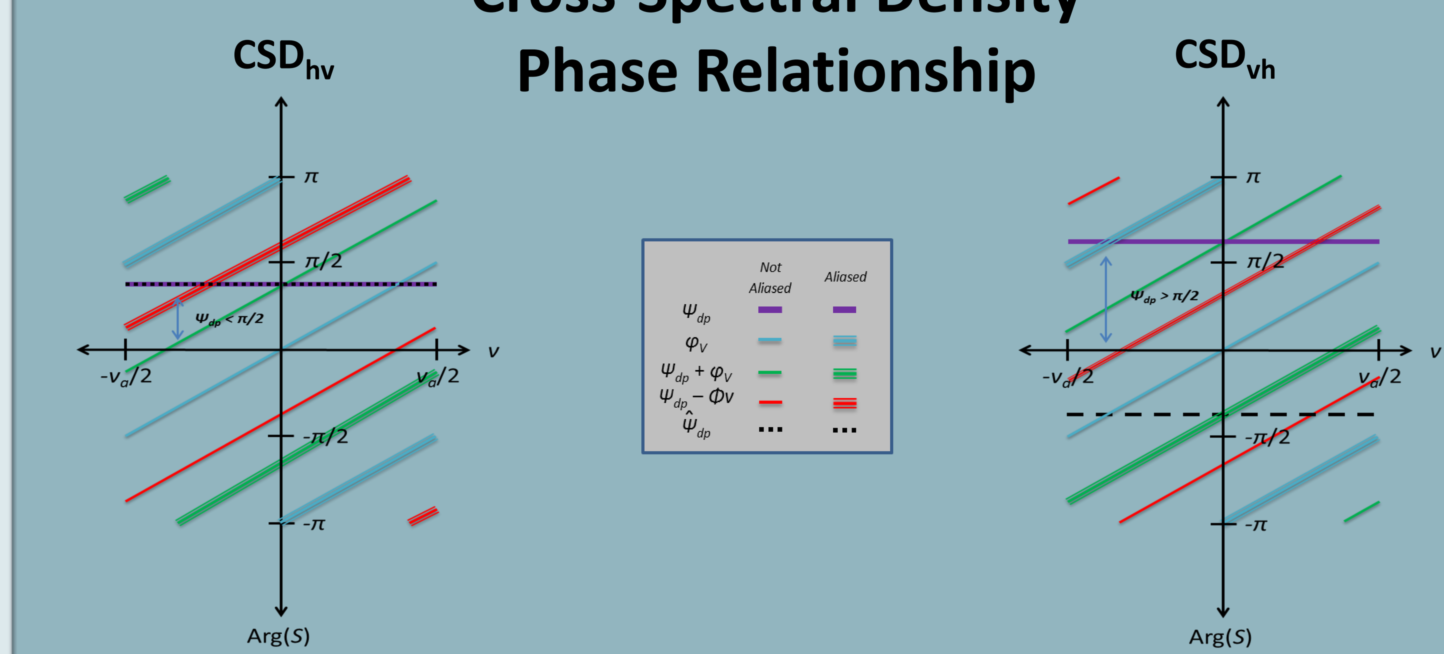


Decoupling Velocity and Differential Phase in AHV

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 Zrnic, 1989, JAOT).

Cross-Spectral Density Phase Relationship



CLEAN-AP Processing for AHV