Spectral Dual-Polarization Characteristics of Wind Turbine Clutter and a Wind Turbine Clutter Suppression Technique

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A comprehensive description of the dual-polarization response of wind turbine clutter (WTC) is presented with a new and promising filter technique for suppressing wind turbine clutter. Other implementations of WTC filters use techniques to detect WTC and, if positively detected, spatial filter methods are applied to estimate the precipitation spectrum of the contaminated cell using neighboring uncontaminated cells. Spatial filtering cannot accurately capture meteorological events contaminated by wind farms that exceed convective scales. The technique presented here directly operates on the range cell containing WTC and therefore no loss of spatial resolution is incurred.

The dual-polarization spectral products and standard radar moments of wind turbines are discussed. The salient features of the wind turbine signature are presented in context of precipitation and ground clutter radar observations. The differentiating features of wind turbine clutter are motivated by physical properties and a desire to separate the turbine signature from ground clutter and precipitation. The unique features of precipitation, ground clutter, and the dynamic wind turbine signature allow more effective suppression of the wind turbine signal component over standard clutter filter algorithms.

The technique introduced here for wind turbine clutter suppression requires only the observation of a turbine in a contaminated range cell. The optimum integration time for Doppler spectral processing is determined from wind turbine observations. The distinguishing features of wind turbines enable suppression of the wind turbine signature based on prevailing observations. The filter performance is compared to other techniques, such as the Radon transform filter method, and characterized using standard radar moments with and without precipitation.