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Mitigating the effects of wind turbine clutter on weather radar observations using an observation-based adaptive filter

Evan Ruzanski*(1), and V. Chandrasekar(2)
(1) Vaisala, Inc., Louisville, CO, 80027 USA; e-mail: evan.ruzanski@vaisala.com
(2) Colorado State University, Fort Collins, CO 80523 USA; e-mail: chandra@engr.colostate.edu

The global cumulative installed electricity generation capacity from wind power has steadily increased since 2001. As a result, more wind farms have been deployed worldwide and the size of wind turbines has increased [1]. This growth has created more uniquely challenging sources of interference for weather radars that require new methods to suppress.

This paper presents a method to mitigate the effects of wind turbine interference on weather radar observations. The method treats the wind turbine's radar cross-section and thus the clutter due to rotating blades as a statistical cyclostationary process [2]. This treatment leverages the unique characteristics of clutter due to wind turbine blade rotation allowing separation from stationary ground clutter (due to the wind turbine tower, nacelle and other objects) and precipitation. The filtering approach is done in the spectral domain and relies only on the most recent and short-term period of data collected by the radar. In this method, the filter basis is considered as the Energy Spectral Density (ESD) in this set of most recent observations that most closely fits the ESD of the data observed at the current time [3].

Radar moments estimated using wind turbine clutter filtered data from multiple events collected by the CSU-CHILL S-band radar will be shown and analyzed. Clutter from multiple wind turbines located at the nearby Ponnequin Wind Farm in Northern Colorado coincident with various precipitation intensities were observed in these events. The characteristics of the wind turbine clutter suppression will also be shown and quantified for these events.

1. Global Wind Energy Council, "Global Wind Report 2016—Annual market update," GWEC Technical Paper, http://gwec.net/publications/global-wind-report-2/global-wind-report-2016/

2. R. M. Beauchamp, and V. Chandrasekar, "Dual-polarization radar characteristics of wind turbines with ground clutter and precipitation," *IEEE Trans. Geosci. Remote Sens.*, **54**, 8, August 2016, pp. 4833–4846.

3. R. M. Beauchamp, and V. Chandrasekar, "Suppressing wind turbine signatures in weather radar observations," *IEEE Trans. Geosci. Remote Sens.*, **55**, 5, May 2017, pp. 2546–2562.