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Spectral Processing for Step Scanning Phased Array Radars

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On phased array radars, scanning is achieved by stepping the beam from one direction to the next direction and dwelling long enough at each direction to achieve acceptable errors of estimates. Combining data from the three directions is suggested to obtain super-resolution similar to that available on the national network of weather radar (Weather Surveillance Radar-1988 Doppler, or WSR-88D). Spectral analysis of such data is addressed and it is demonstrated that Doppler spectra of simply concatenated time series have very strong sidebands due to the discontinuity of the signals from the three beam positions. This artifact degrades performance of the spectral clutter filters and other methods that rely on spectral processing to enhance the weather signal. Special adjustments of the signals at each range location before concatenating (splicing) is proposed to mitigate the effects of discontinuities in time and thus improve clutter filtering. The adjustment is such that the total information contained in the signal can be preserved in subsequent processing. Spectral quality of the concatenated signals is quantified via results from simulations and examples of spectra obtained with the National Weather Radar Testbed (NWRT) are presented to substantiate the predictions. A ground clutter detector/filter accepted by the National Weather Service is applied to the conditioned time series data and the ensuing fields of reflectivity factor and Doppler velocity are compared to the fields from which clutter had not been removed.