Improved Correlation Coefficient Estimator

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The cross-correlation coefficient (herein referred to as correlation coefficient) is one of the main polarimetric variables, and is used for classification of radar echoes, such as separation of returns from rain and snow. Accurate discrimination of hydrometeor types requires precise measurements of the correlation coefficient in areas with low and moderate signal-to-noise (SNR) ratios. Correlation coefficient estimates are unusable when they become larger than one, which is common when the number of samples per dwell is small and in areas with signal-to-noise ratios lower than 15 dB. In addition to the inherent fluctuation of estimates, this can be caused by the mismeasurement of noise powers in the horizontal and vertical channels which causes the incorrect scaling of the cross-correlation moduli estimates in regions where SNRs are diminished if the conventional lag-0 estimator is used. Other cause is the inherent positive bias in the conventional lag-0 and lag-1 correlation coefficient estimators. This bias increases exponentially as signal-to-noise ratio decreases which is an effect more pronounced when the number of samples per dwell is small. Positive biases in correlation coefficient estimates contribute to an increased number of invalid estimates (i.e., values larger than one) which are qualitatively described as “pink fringe” in the WSR-88D fields of correlation coefficient. Consequently, positive biases coupled with the exceptionally high standard deviations of correlation coefficient estimates render correlation coefficient fields noisy with large areas of pink fringe in regions of low to moderate signal SNRs. Herein, a novel correlation coefficient estimator is presented which has a potential of being less biased than the conventional lag-0 and lag-1 estimators.