Automatic diagonal-loading scheme for robust adaptive beamforming on atmospheric radars

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This presentation introduces a method to automatically determine the diagonal loading level of the Capon-based diagonal loading beamformer. The developed method balances the degradations of the signal-to-interference ratio with the signal-to-noise ratio to maximize the detectability of the backscattered signals. The radial wind velocities in radar wind profilers are usually estimated from the first moment of the spectrum of backscattered echoes, so both the residual ground clutter and increases in the noise floor level degrade the detectability of atmospheric echoes. The proposed algorithm evaluates the power spectral density of the residual clutter power and increased noise power, and determines the optimal diagonal loading value to balance these two factors. The results of a numerical simulation show that, without the need to specify any user parameters, the proposed algorithm is stable and more effective in maximizing the signal-to-interference ratio than the conventional norm-constrained diagonal loading approach. The stability and clutter suppression capability of the proposed algorithm are also examined using observational data from the PANSY radar in Antarctica.

Key words: adaptive beamforming, wind profiler, diagonal loading, PANSY