Space-time adaptive processing

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A direct data domain (D3) least-squares space–time adaptive processing (STAP) approach is presented for adaptively enhancing signals in a nonhomogeneous environment. The nonhomogeneous environment may consist of nonstationary clutter and could include blinking jammers. The D3 approach is applied to data collected by an antenna array utilizing space and in time (Doppler) diversity. Conventional STAP generally utilizes statistical methodologies based on estimating a covariance matrix of the interference using data from secondary range cells. As the results are derived from ensemble averages, one filter (optimum in a probabilistic sense) is obtained for the operational environment, assumed to be wide sense stationary. However, for highly transient and inhomogeneous environments the conventional statistical methodology is difficult to apply. Hence, the D3 method is presented as it analyzes the data in space and time over each range cellseparately. The D3 method is deterministic in approach. From an operational standpoint, an optimum method could be a combination of these two diverse methodologies. This paper represents several new D3 approaches. One is based on the computation of a generalized eigenvalue for the signal strength and the others are based on the solution of a set of block Hankel matrix equations. Since the matrix of the system of equations to be solved has a block Hankel structure, the conjugate gradient method and the fast Fourier transform (FFT) can be utilized for efficient solution of the adaptive problem. Illustrative examples presented in this paper use measured data from the multichannel airborne radar measurements (MCARM) database to detect a Sabreliner in the presence of urban, land, and sea clutter. An added advantage for the D3 method in solving real-life problems is that simultaneously many realizations can be obtained for the same solution for the signal of interest (SOI). The degree of variability amongst the different results can provide a confidence level of the processed results. The D3 method may also be used for mobile communications.