DOA Estimation Using Temporal and Spatial Processing Based on Direct Data Domain (D^3) Approach.

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ABSTRAT: The purpose of this paper is to estimate the direction of arrival (DOA) of the signal of interest (SOI) in the presence of both coherent and noncoherent interferences multipaths and utilizing a combined temporal and spatial DOA estimation technique based on a direct data domain approach. The number of the signals impinging on the array can be greater than the number of antenna elements in the phased array. In this paper we use the concept of cyclostationarity utilizing the temporal information of the SOI to separate it from the interferences. By exploiting the concept of cyclostationarity we can extract signals with the same cycle frequency and null out the co-channel interferences and additive noise. Hence, the signal detection capability can be significantly increased. Next the spatial processing is implemented to differentiate the various coherent/noncoherent multipaths of the same signal while have the same cycle frequency. The main contribution of the paper is that by combining temporal and spatial processing based on a direct data domain approach one can handle multipath signals under the conditions that the number of signals impinging on the array at all the frequencies can be greater than the number of antenna elements. However, the number of multipaths has to be less than approximately half the number of antenna elements. Since we do not form a covariance matrix of the data, this method is quite suitable for short data lengths or when the environment is quite dynamic. Hence, in the proposed algorithm, while the estimation of the cyclic array covariance matrix is avoided, we develop a new matrix form using extremely short data samples. As a result, the computational load in the proposed approach is relatively reduced and the robustness of the estimation of signal of interest (SOI) is significantly improved when the number of available snapshots is extremely limited. Numerical results are presented to illustrate the efficiency and accuracy of this method.