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Performance Analysis of Root-Music, DML and WSF DOA Estimation Algorithms.

ABSTRACT - Masterthesis

For decades, direction of arrival (DOA) estimation has been an important method in array signal processing. With the rise in demand for smart antenna technology which typically uses DOA estimation to provide accurate information, the need for robust algorithms and their performance evaluation is a challenging area of research. Currently, DOA estimation is being extensively used in the field of sonar, radar, and other various applications.

The main objective of the thesis is to analyze the performance of the three main high-resolution techniques namely, Root-Multiple Signal Classification (MUSIC), Deterministic Maximum Likelihood (DML), and Weighted Subspace Fitting (WSF) using the signal-to-noise ratio (SNR) and the number of snapshots as key performance parameters. The resulting simulation graphs are studied to understand which algorithm performs better under specific conditions. This study is crucial as it helps the antenna designer to understand and choose the efficient DOA estimation algorithm which is significant in the process of smart antenna technology.

The first part of the thesis deals with understanding the mathematical model of the uniform linear array, which is then followed by the study of the narrowband snapshot model. The spectral-based and the parametric-based DOA estimation algorithms which include, classical beamformer, MUSIC, Root-MUSIC, DML, and WSF algorithms are extensively studied. The next part of the thesis concentrates on the performance analysis of the three main high- resolution techniques, viz., Root-MUSIC, DML, and WSF algorithms. The performance is analyzed by considering root mean square error (RMSE) as the metric. Each algorithm is simulated for six different directional-of-arrivals with variation in SNR and the number of snapshots in six different combinations each. Finally, the thesis brings out the performance analysis of the DOA estimation algorithms which serve as the basis for smart antenna technology systems.