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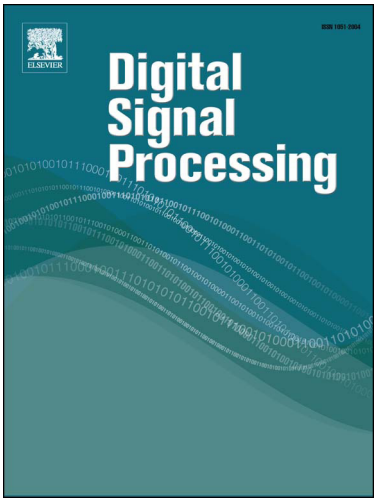

Real-Valued Single-Tone Frequency Estimation Using Half-Length Autocorrelation

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Real-Valued Single-Tone Frequency Estimation Using Half-Length Autocorrelation

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Abstract

In this paper a new autocorrelation method called half-length autocorrelation (HLA) is introduced. Unlike regular (biased or unbiased) autocorrelations, the exact statistical characteristics of the HLA can be calculated, which makes the analytical calculation of the variance of the frequency estimator possible. The HLA is also used in two different frequency estimation methods namely, Modified Covariance (MC) and Modified Pisarenko Harmonic Decomposition (MPHD). It is shown that the application of the HLA in these frequency estimators improves their performance, particularly in lower signal-to-noise ratios (SNR). The analytical calculation of the variance (mean square error) of the estimators is also provided in this paper. Simulation results are in agreement with the theoretical calculations. For the MPHD estimator using the HLA (MPHD-HLA), the estimated frequency is very close to the theoretical calculations for SNRs as low as -2dB.

Keywords: Frequency Estimation; Autocorrelation; Half-length Autocorrelation; Cramer-Rao Lower Bound

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