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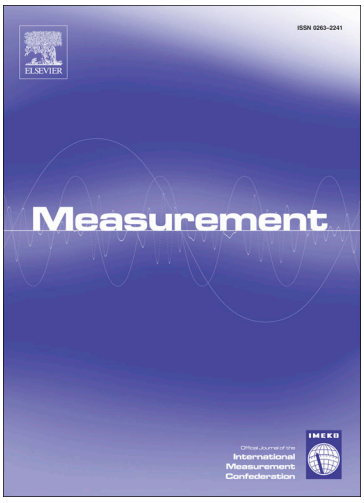

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Accurate Frequency Estimation of a Noisy Sine-wave by Means of an Interpolated Discrete-Time Fourier Transform Algorithm

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Abstract *— This paper investigates the accuracy of a recently proposed sine-wave frequency estimator based on the interpolation of Discrete-Time Fourier Transform (DTFT) spectrum samples located one frequency bin apart. Specifically, an analytical expression for the variance of the Interpolated DTFT (IpDTFT) frequency estimator due to additive wide-band noise is derived in the case when the acquired sine-wave samples are weighted by a Maximum Sidelobe Decay (MSD) window. The derived expression enables the identification of an iterative algorithm, called IpDTFT-NR procedure, that ensures the maximum Noise Rejection on the IpDTFT frequency estimator. Moreover, the accuracy of the IpDTFT-NR procedure is compared with that of another algorithm, called IpDTFT-IR procedure, which ensures the maximum Image component interference Rejection on the IpDTFT frequency estimator. To this aim, accurate expressions for the Mean Square Errors (MSEs) of the two frequency estimators are derived. Also, the value of the Signal-to-Noise Ratio (SNR) up to which the IpDTFT-NR procedure outperforms the*

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