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Analysis of Frequency Estimation MSE for All-pass-Based Adaptive IIR Notch Filters With Normalized Lattice Structure

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Abstract

This paper theoretically analyzes the Mean Square Error (MSE) on the steady-state frequency estimation realized by the all-pass-based adaptive notch filtering algorithms with the normalized lattice structure. The adaptive algorithms to be considered are the Simplified Lattice Algorithm (SLA) proposed by Regalia and the Affine Combination Lattice Algorithm (ACLA) proposed by the authors. For these two algorithms, we derive the frequency estimation MSE in closed-form. The derivation is based on construction of a linear time-invariant model for generation of frequency estimation error, and division of this model into two submodels of which output signals are statistically uncorrelated to each other. This strategy leads to more accurate theoretical MSE expressions than the direct use of the existing analysis methods. Simulation results demonstrate that our theoretical MSE expressions are in very good agreement with the simulated MSE values.

Keywords: adaptive notch filter, all-pass filter, normalized lattice structure, mean square error, simplified lattice algorithm, Affine combination lattice algorithm

1. Introduction

Adaptive notch filters [1] are the time-variant notch filters of which frequency characteristics, e.g. notch frequency, are controlled by adaptive al-

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