Abstracts

Optimal Signal Processing of Frequency-Stepped CW Radar Data

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An optimal signal processing algorithm is derived for estimating the time delay and amplitude of each scatterer reflection using a frequency-stepped CW system. The channel is assumed to be composed of abrupt changes in the reflection coefficient profile. The optimization technique is intended to maximize the target range resolution achievable from any set of frequency-stepped CW radar measurements made in such an environment. The algorithm is composed of an iterative two-step procedure. First, the amplitudes of the echoes are optimized by solving an overdetermined least squares set of equations. Then, a nonlinear objective function is scanned iu an organized fashion to find its global minimum. The result is a set of echo strengths and time delay estimates. Although this paper addresses the specific problem of resolving the time delay between the first two echoes, the derivation is general in the number of echoes. Performance of the optimization approach is illustrated using measured data obtained from an HP-8510 network analyzer. It is demonstrated that the optimization approach offers a significant resolution enhancement over the standard processing approach that employs an IFFT. Degradation in the performance of the algorithm due to suboptimal model order selection and the effects of additive white Gaussion noise are addressed.

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