A SVD-based transient error method for analyzing noisy multicomponent exponential signals

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Abstract

The problem of estimating the parameters of noisy multicomponent signals using parametric modeling technique is considered in this paper. The multicomponent signal of interest is formed by a superposition of basic functions having the same location in time but different widths and amplitudes. Based on the modified Gardner transformation, some samples of deconvolved data are derived from the multicomponent signals. The deconvolved data are then modeled using a special nonstationary autoregressive moving average (ARMA) process in which the parameters of the ARMA model are obtained by linear least-squares procedure. The least-squares procedure is based on the singular value decomposition (SVD) to overcome the limitations of the transient error method (TEM) of analysis that uses cholesky decomposition to determine its AR coefficients. The moving average (MA) coefficients corresponds to the initial residual error sequences so as to account for the nonstationary noise in the deconvolved data. This new method of analysis, termed the SVD-based transient error method, produces high resolution estimates of the exponents of multicomponent signals at both low and high signal to noise (SNR) ratios.

Keywords: Transient analysis, Error analysis, Signal analysis, Parameter estimation, Signal resolution, Autoregressive processes, Signal to noise ratio, Magnetic analysis, Shape, Frequency estimation

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