Abstract

Identification of signals and systems with time-varying characteristics is addressed in this work. The aspects of time-varying system identification addressed include modeling of signals and systems, estimation methods, bounds of estimation error, and estimation of the order of such models.

The parametric representations of non-stationary signals such as time-varying AR and ARMA processes are considered. The time-varying parameters of the signal are further modeled as stationary AR processes. Two techniques are developed to estimate the time-varying parameters and their corresponding models of parameter walk without any quasi-stationary assumptions.

In the first proposed technique, the time-varying parameters of an AR model are initially estimated through an RLS algorithm with a large estimation bandwidth for better tracking ability of fast varying parameters. Since parameters estimated through large estimation bandwidth have high estimation noise, the estimated time-varying parameters are subsequently smoothed using an optimum smoothing FIR filter. The optimum smoothing filter is derived from the stochastic model of time-varying parameter. The optimal filter reduces the amount of estimation noise with out affecting the tracking behavior much.

Performance of the optimum smoothing function is also analyzed in the present work. The expression for the estimation error variance of smoothed time-varying parameters is also derived. The tracking performance of the proposed algorithm is analyzed with the help of mean-square tracking error. The expressions for mean-square tracking error in the case of optimum smoothing function is derived and is compared with that of the RLS algorithm. Simulation studies are also carried out to study the performance of the proposed algorithm.