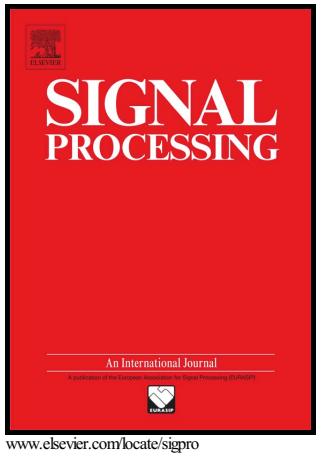

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Nonparametric Frequency Response Function Estimates for Switching Piecewise Linear Systems

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Abstract

This paper proposes two algorithms (ATIRMM and ALPM) for estimating the time-varying behavior of single input single output (SISO) switching piecewise linear systems. Walsh basis functions are used to capture the non-smooth fast varying dynamics. The piecewise time-varying frequency response function (TV-FRF) is approximated by the sum of a series of LTI FRFs multiplied with a set of Walsh functions. The best linear time invariant approximation (BLTIA) of the TV-FRF is estimated with small uncertainty. Besides the BLTIA, the two methods are capable of estimating the noise power spectrum and the TV-FRF. The error analysis shows that ATIRMM delivers more accurate TV-FRF and BLTIA estimations, while ALPM has better performance in noise power spectrum estimation. The conclusions are illustrated by simulations.

Keywords: frequency response function, switching piecewise time-varying system, nonparametric identification, estimation uncertainty

1 Introduction

The linear time-invariant (LTI) model has been generally accepted to be an effective approximation of many physical systems in practice. Nonparametric frequency response function (FRF) describes the steady-state response of a LTI dynamic model in the frequency domain. It provides a fast and easy approach to: (a) get the first impression of model dynamic properties such as stability; (b) evaluate the quality (Signal to noise ratio, SNR) of