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Two recursive least squares parameter estimation algorithms for multirate multiple-input systems by using the auxiliary model☆

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Abstract

This paper considers identification problems of multirate multiple-input output error systems, derives the input-output representations by using the state space models of the multirate systems, and presents two auxiliary model based recursive least squares algorithms for the corresponding output error models with each subsystem having different or same denominator polynomials. The simulation results show the effectiveness of the proposed algorithms.

Keywords: Multirate systems; Least squares; Output error methods; Multi-innovation identification theory; Auxiliary model identification idea

1. Introduction

This paper focuses on a class of multirate systems, where the inputs are performed at several different sampling rates and every output is measured at the same sampling rate. Such multirate systems are abundant in practical applications [3,5]. For example, in the area of communication, the crosstalk between multiple services transmitting through the same telephone cable is the limitation to digital subscriber line (DSL) services. When the signals constituting the crosstalk are transmitted at different rates in xDSL systems, the multirate models of the xDSL systems arise [40,41]. Obviously, the conventional single-rate systems cannot be used to model such systems and thus multirate system modelling must be studied.

The traditional identification methods, such as the least squares (LS) algorithm [8,9,12,45], the stochastic gradient algorithm [7,11,13,16,20,31], the maximum likelihood method [1,18,19,25,27,43,44,47,48], can be used to identify the conventional single-rate systems. However, these methods cannot be directly applied to multirate systems. How to use the LS method to estimate parameters of the multirate multiple-input systems is the focus of this paper.

For decades the multirate system identification has been received much attention. Raghavan et al. considered the identification for the dynamic models in chemical processes with fast inputs and slow irregular outputs using the

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