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ADAPTIVE IIR IDENTIFICATION OF STOCHASTIC SYSTEMS WITH NOISY INPUT-OUTPUT DATA

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Abstract. This paper is concerned with adaptive IIR filtering for linear systems with noisy input and output measurements. A new and numerically efficient procedure for estimating the variances of the white input and output noises is established so that the adaptive IIR filter based on the bias-eliminated least-squares algorithm can be efficiently implemented. This new adaptive IIR filter can achieve a substantial reduction in the computational effort, and meantime it can retain almost the same parameter estimation accuracy.

Numerical results that illustrate the attractive properties of the new adaptive IIR filter are presented.
Keywords. Stochastic systems, System identification, Parameter Estimation, Adaptive systems, Least squares methods, Filtering.

AMS (MOS) subject classification: 93E03, 93E12, 93E10, 93E24, 68T05, 93E11.

1 Introduction

Adaptive filters find applications in various domains, for example, noise cancellation, channel equalization, beamforming, and signal detection [5]. In recent years there has been growing interest in adaptive infinite impulse response (IIR) filters that adjust rational transfer functions (see [7] and references therein). The strength of adaptive IIR filters is their versatile and powerful modeling

capabilities, thus having great potential to achieve significant performance improvements.

This paper is concerned with adaptive IIR filtering for linear systems where both the system output and the system input are contaminated by white measurement errors. The aim is to consistently identify the parameters of the system transfer function by the use of noisy input-output measurements. Note that the adaptive IIR filter based on the standard recursive least-squares (LS) algorithm is unable to produce unbiased parameter estimates for such noisy input-output systems [8]. Among the existing unbiased parameter estimators, there are, for instance, the Koopmans-Levin (KL) method [4], the joint-output (JO) method [9], and the bias-eliminated least-squares (BELS) algorithm [10]. From the viewpoint of adaptive IIR filtering, the major drawback with the KL method and the JO method is