



ROBUST RECURSIVE IDENTIFICATION OF LINEAR SYSTEMS USING PRIOR INFORMATION*

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Abstract. The problem of recursive robust identification of linear discrete-time dynamic stochastic systems, when the *a priori* disturbance statistics are incomplete, is discussed. Min-max robust identification algorithms of stochastic gradient type are derived, making use of *a priori* data, such as the class of distributions to which the unknown disturbance distribution belongs. Making use of prior statistical information on the estimated parameters, the rate of estimates convergence at initial steps is improved. The convergence of the developed algorithms is established theoretically, using the martingale theory. The results of simulation demonstrating the robustness of the proposed algorithms are also included.

Key Words—Identification, recursive algorithms, robustness, convergence, simulation.

1. Introduction

Great attention has been paid to different aspects of parameter estimation in stochastic systems (e.g., Eykhoff, 1974; Ljung and Söderström, 1983; Goodwin and Sin, 1984). Of significant practical interest has been the construction of robust identification algorithms, insensitive to deviations from the supposed operation conditions. The main property of robust estimators is, roughly speaking, a small sensitivity to distribution changes, usually valid locally within a given class (e.g., Huber, 1981). The development of the theory of robust estimation has resulted in many valuable achievements, including system identification, signal processing and adaptive control (e.g., Ershov, 1978; Hogg, 1979; Tsympkin, 1984; Kassam and Poor, 1985). In general, the methodology of designing robust parameter estimation schemes can be divided into at least two main directions: 1) the min-max approach, based on the minimization of the performance index for the least favorable distribution within a given class (e.g., Huber, 1981; Tsympkin, 1984); 2) the qualitative approach, based on the qualitative definition of robustness and the application of the influence function (e.g., Hampel et al., 1986; Martin and Yohai, 1986). Moreover, the achievement of robustness in practice requires a more profound understanding of possible criteria and ways of choosing the form of algorithms, as well as their parameters and initial conditions. Particularly, the initial conditions should be chosen so to improve the accuracy of the estimates at initial steps. This choice should rely on different strategies, such as the application of variable gain factors (e.g., Kushner and Huang, 1981; Benveniste and Ruget, 1982), the optimal design of input signals (e.g., Tsympkin,

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