

## ROBUST ESTIMATION IN THE PRESENCE OF NOISE UNCERTAINTY AND UNMODELED DYNAMICS

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**ABSTRACT:** This paper considers robust identification for discrete-time stochastic system consisting of a modeled part which is described with ARMAX process and unmodeled dynamics. The noise distribution belongs to a specified class of distributions and such assumption introduces in recursive algorithm nonlinear transformation of prediction error. Under the standard conditions imposed on the modeled system part, it is shown that the estimation error converges to a limit which explicitly depends on the unmodeled dynamics.

**Keywords:** Recursive estimation, non-Gaussian processes, modelling errors, convergence analysis

### 1. INTRODUCTION

In a large number of control systems design problems absent detailed model of the plant, either because it is too complex or because its dynamics are not completely understood (Boyd and Barratt, 1991). Because it is a great importance to analyze the influence of unmodeled dynamics contained in a system. It is shown that unmodeled dynamics or small bounded disturbance can cause many adaptive control algorithm to go unstable (Sastry and Bodson, 1989). As a result of this discovery, the issue of robustness of adaptive system has received a great deal of attention within the adaptive systems community. In order to guarantee stability, a variety of modifications of the algorithms originally designed for the ideal case have been proposed:  $\sigma$  and  $\epsilon_1$  modification, relative dead-zone, signal normalization and projection of the parameter estimates (Bitmead, Gewers and Wertz, 1990; Anderson et al., 1986; Narendra and Annaswamy, 1989). Identification problem in deterministic context is

considered in (Bitmead and Johnson, 1986; Johnson, 1988). In all the above mentioned approaches in deterministic frame crucially assumption is the a priori boundedness of the external noise disturbance. In a context of identification of stochastic systems problems with unmodeled dynamic received much less attention. For the ideal case theory of system identification and adaptive control are reached high level (Caines, 1988; Chen and Guo, 1991; Lay and Wey, 1982; Ljung, 1987). In the stochastic frame noise is an essential feature of the system and not necessarily bounded. Systems can rarely be modeled as the exact ARMAX process. Because of the complexity of the system unmodeled dynamics is always present. Therefore, from the practical point of view, it is very important to analyse robustness properties of identification and adaptive control in the presence of unmodeled dynamics.

In this paper we will consider robust identification of linear SISO discrete systems when we have two kinds of uncertainty. The first one is noise un-









