

CONVERGENCE AND OPTIMALITY OF STOCHASTIC ADAPTIVE CONTROL SCHEME WHEN THE DISTURBANCE IS NON-GAUSSIAN

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Abstract : This paper considers properties of Astrom-Wittenmark self tuning tracker for MIMO systems described with the ARMX model. It is supposed that the stochastic noise has the non-Gaussian distribution. System under consideration is minimum phase with different dimensions for input and output vectors. Using concept of Kronecker product it is possible to represent unknown parameters in the form of vector. So is avoided tensor calculus. Global stability is proved without any modification of matrix gain in the recursive algorithm. Also, in the paper is discussed relation of assumption about the absolutely continuous finite-dimensional distributions and different modification of high frequency gain. *Copyright © 1999 IFAC*

Key words: ARMAX model, non-Gaussian disturbance, self-tuning regulators, stability, optimality

1. INTRODUCTION

Analysis of adaptive controllers is a very important topic in the control area (Astrom and Wittenmark, 1973). In this reference is showed that if the least squares parameters estimates converge to some limit then the adaptive controller must be optimal but, as noted, it very difficult to prove that the estimates are indeed convergent. After that has been drawn much attention to establish the global stability and the asymptotic optimality for adaptive controllers. Significant progress in this direction was made in (Goodwin et al., 1981) where global convergence has been established for a class of stochastic adaptive control algorithm based on stochastic approximation method. Next important step is a result which is presented in (Sin and Goodwin, 1982). Namely, from the practical point of view, least squares generally has superior rate of convergence in comparison with the stochastic approximation algorithm. But, in that case, it was necessary to modify gain matrix for global

convergence of algorithm. In (Kumar, 1990) was made attempt to remove above restriction. For minimum phase system where noise is i.i.d. and Gaussian, using Bayesian embedding method and properties of normal equation, least squares based adaptive tracker converges outside an exceptional set of Lebesgue measure zero in the parameter space. In this approach restrictions are: Gaussianity and independency of noise and exceptional set. Very important result are presented in (Guo and Chen, 1991) where Astrom-Wittenmark self-tuning regulator and ELS-based adaptive tracker is considered. It is shown by a careful analysis of growth rates how to avoid the need to establish parameter convergence. Also, rigorously is proven convergence of the original Astrom-Wittenmark self-tuning regulator. Using ideas from (Kumar, 1990; Guo and Chen, 1991) in (Ren and Kumar, 1994) is presented a more comprehensive theory of stochastic adaptive filtering, control and identification. Also is established that the parameters converge to the null space of a certain matrix. Results from (Ren and Kumar, 1994) is used

