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CONSTRAINED PARAMETER ESTIMATION OF DYNAMICAL SYSTEMS

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Abstract. In this paper, a recursive least square estimator is developed to handle the problem of constrained parameter estimation of linear dynamical systems. The system is assumed to be corrupted with zero mean white noise, and its parameters (deterministic or random) are assumed to satisfy a set of linear inequality constraints. The developed algorithm differentiates between two cases: the case of strictly satisfied constraints and the case when some of the constraints are violated. In the first case, the obtained estimator is the standard least square estimator. However, in the second one, using the active set method, a set of equality constraints is formulated; where the number of constraints equals to the number of violated constraints. This set of equations is treated as a new set of noise free measurements. Then, the least square estimator is extended recursively to handle the assumed new set of measurements rather than formulating a quadratic optimization problem to be solved in order to satisfy the violated constraints. This leads to an estimator which satisfies the constraints imposed on the system parameters. To show the effectiveness of the developed technique, two illustrative examples are presented. Simulation results show the applicability of the proposed procedure to identify system parameters subject to a set of inequality constraints.

Keywords. Dynamical systems, system identification, constrained parameters, least square estimator, recursive algorithm.

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

1 Introduction

System identification is very important in many fields such that system analysis and control. Several works deal with system identification, see for examples [11], [13], [19], [32], and [38]. In many applications of linear parameter estimation problems, some of the parameters of the system may be constrained. This problem has attracted many researchers who developed different techniques to handle the constrained system identification problem. For example, see [1]- [38] and the references within for some of the recent works on constrained parameter estimation. The following paragraphs survey some of the works on this subject.