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OPTIMIZATION OF CONVEX CONSTRAINED LINEAR DYNAMICAL SYSTEMS

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Abstract. Optimization of linear dynamic control problems with system constraints and convex, not necessary quadratic, cost function is considered. An approach is developed to solve such a problem in which a coordinating variable is introduced and used to overcome the non-quadratic nature of the problem as well as to satisfy system constraints. Under the assumption that the system is stabilizable and has a feasible solution, the proposed procedure leads to the optimal solution while satisfying system constraints. Illustrative examples are provided to show the performance of the proposed algorithm.

Keywords. Linear dynamical systems, optimization theory, system constraints, computational algorithms, convex problems.

AMS (MOS) subject classification: 49J15, 49N05, 80M30, 80M50.

1 Introduction

An important class of physical control systems is working under imposed constraints which must not be violated during operation. These constraints are often due to physical limitations and/or to insure reliable and safe system operation. Such type of constraints renders the system to be nonlinear, either if it is represented by linear dynamic model.

Solving constrained optimization problems can be achieved, in principle, using classical optimization theory [12] through the utilization of Kuhn-Tacker parameters. Although control constraints are easy to handle [12], state constraints are more difficult. Other approaches have been proposed in the literature to solve this problem. For example, Kirk [12] suggested a procedure in which the given set of state inequality constraints can be transformed into a single equality constraint and then augment the performance measure by this constraint. However, the problem is still difficult to handle numerically. In another procedure, the value of the weighting matrices associated with the cost function can be changed such that the response of the closed loop system satisfies system constraints implicitly. However, in many practical cases, this procedure may not be recommended since it may not match with the physical meaning of the cost function or it may lead to other undesirable transient response specifications.