Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **13 (2006)** 309-336

NEW ALGORITHM FOR DISCRETE-TIME LINEAR-QUADRATIC CONTROL WITH INEQUALITY CONSTRAINTS

Naif B. Almutairi[1] and Mohamed F. Hassan[2]

[1]Department of Electrical Engineering
College of Engineering and Petroleum
Kuwait University
P. O. Box 5969, Safat 13060, KUWAIT
E-mail: naif@eng.kuniv.edu.kw
[2]Department of Electrical Engineering
College of Engineering and Petroleum
Kuwait University
P. O. Box 5969, Safat 13060, KUWAIT
On leave from Electronic and Communication Department
Faculty of Engineering, Cairo University

Abstract. In this paper we consider the optimal linear-quadratic (LQ) control problem with inequality constraints on controls and states for a linear time-varying discrete-time system. In order to solve such a problem, we derived the necessary conditions of optimality for the equivalent optimization problem, and then we proposed a new algorithm to solve the resulted set of equations. Under the assumption that the original problem has a solution, the convergence behavior of the proposed algorithm is studied. It is shown that the algorithm converges to the optimal solution. Simulation results of a paper-machine system and a magnetic-tape-drive system are given to illustrate the effectiveness of the developed algorithm.

Keywords. Constrained system, discrete-time system, LQ control, Paper-machine system, Magnetic-tape-drive system.

1 Introduction

For many processes, the actuators and the measured variables have to be within certain limits due to safety and operational feasibilities. It is therefore constraint control is an important issue in the process industry to maintain these variables within their limits.

In this paper we will consider the Linear-Quadratic (LQ) control problem with inequality constraints on controls and states for a time-varying linear discrete-time system. This problem has been studied and different approaches are proposed to solve such a problem [3-5,24,28]. The available approaches are fall into either anti-windup class of techniques or Model Predictive Control (MPC). The systematic and automatic synthesis of anti-windup