

MINIMUM NORM TIME-OPTIMAL CONTROL OF LINEAR DISCRETE-TIME PERIODIC SYSTEMS BY PARAMETERIZATION OF STATE FEEDBACK

HOJAT AHSANI TEHRANI¹ AND SEYED MEHDI KARBASSI²

¹Department of Mathematics
Shahrood University of Technology
Shahrood, 36155-316, Iran
hahsani@shahroodut.ac.ir

²Faculty of Mathematics
Yazd University
Yazd, 89195-741, Iran
smkarbassi@yazduni.ac.ir

Received February 2008; revised September 2008

ABSTRACT. *Time-optimal control of linear multivariable discrete-time periodic systems by state feedback is considered. This is achieved by controlling the alternating states by parametric controllers such that the controllability of the resulting system is preserved and its poles are located at the origin of the complex plane with the aim that a minimum norm time-optimal controller gain matrix for the system is designed. A numerical example illustrates the effectiveness of the proposed approach.*

Keywords: Discrete-time systems, Time-optimal control, Parameterization, Norm minimization

1. Introduction. The study of discrete-time periodic systems has received considerable attention in recent years by many authors; for example, see [1-17]. Different approaches such as Lyapunov [16], Sylvester [12], Kalman decompositions [17], LQ and Schur methods [13, 14] have been extensively used. In this paper, the idea of parameterization of time-optimal controllers for standard linear multivariable discrete-time systems [18] is extended to the case of discrete-time periodic systems. The Simulation of linear discrete-time periodic systems to standard systems form is presented nowhere so far and for the first time it will be examined in this paper, also the settling time formula for linear discrete-time periodic systems is computed here. As a result, minimization of the norm of the resulting controllers [19, 20] which leads to better performance is achieved easily. The free parameters which do not affect the time-optimality can be adjusted to obtain better performance responses. An illustrative example is provided to show how norm minimization can improve the time response of the inputs of a periodic system.

2. Problem Statement. Consider the linear discrete-time periodic system of the form

$$x_{k+1} = A_k x_k + B_k u_k \quad (1)$$

where the matrices $A_k \in \mathbb{R}^{n \times n}$ and $B_k \in \mathbb{R}^{n \times m}$ are periodic with period $K \geq 1$, i.e. , $A_{k+K} = A_k$, $B_{k+K} = B_k$. Suppose that the periodic matrix pair (A_k, B_k) are completely [8, 17] reachable then the problem of time-optimal control of the periodic system leads