Dynamics of Continuous, Discrete and Impulsive Systems
Series **A:** *Mathematical Analysis* **11 (2004)** 301-319

OVERLAPPING QUADRATIC OPTIMAL CONTROL OF TIME-VARYING DISCRETE-TIME SYSTEMS

L. Bakule [1] and J. Rodellar [2] and J.M. Rossell [3]

[1]Institute of Information Theory and Automation,
Academy of Sciences of the Czech Republic,182 08 Prague 8, Czech Republic
[2]Department of Applied Mathematics III
Universitat Politècnica de Catalunya (UPC), Campus Nord, C-2, 08034-Barcelona, Spain
[3]Department of Applied Mathematics III
Universitat Politècnica de Catalunya (UPC), Campus Manresa, 08240-Manresa, Spain

Abstract. Overlapping quadratic optimal control of linear time-invariant systems and a commutative class of continuous-time time-varying systems has been recently developed by using a generalized structure of complementary matrices. It has been shown that these structures offer a powerful and effective mean for decentralized control design for these classes of systems. In this paper, these structures are presented for general linear time-varying discrete-time systems. The results presented here concern the transition matrices and explicit conditions on complementary matrices for this class of systems. It essentially differs from continuous-time linear time-varying systems, where general results hold only for aggregations and restrictions. A guideline for their selection is given. The effectiveness of this generalized structure is illustrated by a numerical example of overlapping decentralized control design.

Keywords. Decentralized control, large-scale systems, linear systems, discrete–time systems, time–varying systems, overlapping decompositions, optimal control.
AMS (MOS) subject classification: 93A14, 93A15, 93B17, 93C05, 93C35, 93C50

1 Introduction

Whenever possible, a model simplification in large-scale systems modelling, which results in smaller dimensional models keeping the most important features of the original system, is always a preferable and desirable procedure. One way to follow this line is a mathematical framework for comparing two dynamic systems known as *Inclusion Principle*. It states relations between two dynamic systems with different dimensions under which solutions of the system with larger dimension include solutions of the system with smaller dimension. An original system with common shared parts (*overlapping*) may be expanded into a larger space in order to become disjoint. Thereby, well-established decentralized control methods for disjoint subsystems may be used in the expanded space. Subsequently, such designed controllers are contracted for implementation into the original space.