

CONTROLLABILITY OF DISCRETE TIME JUMP LINEAR SYSTEMS

Adam Czornik and Andrzej Swierniak

Department of Automatic Control, Silesian Technical University,
ul. Akademicka 16, 44-101 Gliwice, Poland

Abstract. In this paper we consider a problem of controllability of discrete time linear systems endowed with randomly jumping parameters described by a finite state Markov chain. Necessary and sufficient conditions for existence of a control which governs the state of the system with certain probability to a given neighbourhood of target value at a given time are presented.

Keywords. Controllability, linear system, jump parameter, stabilizability.

AMS (MOS) subject classification: 93B05, 93C55, 93E03, 93C05,60J20.

1 Introduction

Linear dynamical systems with Markovian jumps in parameter values have recently attracted a great deal of interest. The main reason is that such systems may serve as models for a large variety of industrial control processes. One class of examples is given by nonlinear control plants characterized by linearized models corresponding to several operating points which appear due to abrupt changes. Such problems are typical in control systems of a solar thermal central receiver [27], electric load modeling [19], aircraft flight control systems [22] or ship autopilot systems [1]. Markovian jumps in parameter values may also result from random failure/repair processes (see e.g. [24], [28], [23]) and resulting fault prone control systems ([24], [26]). Yet another class of processes with Markov jumps could be met in flexible manufacturing systems (see e.g. [4], [5]). Moreover in [2] Athans suggested that such a model setting has also the potential to become a basic framework in solving control-related issues in battle management, command, and communications systems.

This paper deals with the problem of controllability of linear discrete time dynamical systems with Markovian jumps in the parameter values.

The concept of controllability of dynamical system was introduced to literature by R. E. Kalman in 1960. Since then the problem of controllability has become an object of intensive researches and now there exists huge literature devoted to this problem. For stochastic systems it is not so easy to establish a similar concept. Controllability can be defined depending on the way randomness is taken into account and the goal of control is formulated.