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STABILITY AND STABILIZABILITY OF DISCRETE-TIME SYSTEMS WITH UNKNOWN TRANSITION PROBABILITIES

El-Kébir Boukas*

Mechanical Engineering Department
École Polytechnique de Montréal
P.O. Box 6079, Station Centre-ville, Montréal (Québec) H3C 3A7, Canada

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Abstract. *This paper deals with the class of discrete-time linear systems with random abrupt changes and unknown transition probabilities. The stochastic stability and the stochastic stabilization problems of this class of systems are revisited and new conditions are developed in the LMI setting to either check the stochastic stability or to design the state feedback controller that stochastically stabilizes the system under consideration. It is shown that all the addressed problems can be solved if the corresponding developed linear matrix inequalities (LMIs) are feasible. Numerical examples are employed to show the usefulness of the proposed results.*

Keywords: Markov jump systems, Stochastic systems, Systems with random abrupt changes, Linear matrix inequality, Stability, Stabilizability, State feedback

1. **Introduction.** Deterministic discrete-time systems represent an important class of systems that has received considerable attention for the last decades. Different approaches to tackle the stability and the stabilization problems of this class of systems were proposed and reported in the literature. Among these results, we quote [10, 11, 12] and the references therein.

In the stochastic framework, studies show that Markov jump systems are more appropriate to model some practical systems that we can find in manufacturing systems, power systems, network control systems, etc. The class of Markov jump systems has attracted a lot of researchers from control and operations research communities and more efforts have been done on different subjects related to this class of systems either for continuous-time or discrete-time cases. Most of the control problems for these systems have been tackled and interesting results have been reported in the literature. For more details on this subject, we refer the reader to Boukas [3] for the continuous-time case and Costa et al. [6] for the discrete-time case and the references in these volumes. Other results can be found in [1, 2, 4, 8, 9] and the references therein. Most of the results reported in the literature assumed the complete knowledge of the dynamics of the Markov process that describes the switching between the system modes, except in few continuous-time cases [1, 9, 7] where uncertainties (norm bounded and polytopic) were considered on the transition rates. For the discrete-time case, only results with complete knowledge of the transition probabilities were reported. But practically, the availability of all the transition probabilities is not realistic since it is very difficult and more expensive to know exactly all the transition probabilities for the discrete-time case, for instance, and therefore the results developed earlier can not be applied to practical systems.

*Professor El-Kébir Boukas passed away on January 19, 2010. He published a number of high quality papers in IJICIC and ICIC-EL, which have been widely cited and highly respected by people working in the areas. He will be deeply missed by our community.