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STABILITY OF CONTINUOUS TIME JUMP LINEAR SYSTEMS

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Abstract. In this paper, we study almost sure and moment stability of continuous time jump linear systems with a finite state Markov jump form process. We prove that the concepts of $\delta-$moment stability, exponential $\delta-$moment stability and stochastic $\delta-$moment stability are equivalent and that each of these implies almost sure (sample path) stability. We also show that for sufficiently small δ, almost sure exponential stability and $\delta-$moment stability are equivalent and that the region of $\delta-$moment stability converges monotonically to the almost sure stability region as $\delta \downarrow 0^+$. Sufficient conditions for δ-moment stability and almost sure stability are developed.

Keywords. Jump linear systems, Almost sure stability, $\delta-$moment stability, Lyapunov exponent.

AMS (MOS) subject classification: This is optional. But please supply them whenever possible.

1 Introduction

Consider the continuous-time jump linear system of the form

$$\dot{x}(t) = A(\sigma_t)x(t) \tag{1.1}$$

where σ_t is a finite state random process (step process), usually a finite state, time homogeneous, Markov process. The model (1.1) can be used to analyze the closed-loop stability of control systems with communication delays ([22],[11]) or the stability of control systems subject to abrupt changes in system structure such as component and interconnection failures ([8]). The stability analysis of (1.1) is therefore very important in the design and analysis of control systems. Stability analysis of systems of this type can be traced back to the work of Rosenbloom ([27]), who was interested in moment stability properties. Bellman ([3]) was the first to study the moment stability of (1.2) with an iid form process using the Kronnecker matrix product. Bergen ([4]) used a similar idea to study the moment stability properties of system (1.1) with a piecewise constant form process $\{\sigma_t\}$. Later, Bhuracha ([6]) used Bellman's idea developed in [3] to generalize Bergen's results and studied both