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A STABILITY RESULT FOR SWITCHED SYSTEMS WITH MULTIPLE EQUILIBRIA

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Abstract. This paper studies stability properties of general switched systems with multiple distinct equilibria. It is shown that, if the dwell time of the switching events is greater than a certain lower bound, then the trajectory of a general switched system with multiple distinct equilibria, where each system is exponentially stable, globally converges to a superset of those equilibria and remains in that superset.

Keywords. Nonlinear systems, switched systems, dwell time, Lyapunov theory, stability analysis.

AMS (MOS) subject classification: 34K34, 93D05.

1 Introduction

A switched system consists of a family of continuous-time dynamical (sub)systems and a switching rule or signal that governs the switching between them [9]. Switched systems, which are closely related to hybrid systems, are encountered in many applications ranging from mechanical and power systems to automotive and aerospace industries. Consequently, switched/hybrid systems theory has become an important subfield of systems and control theory in recent years. Applications of switched systems approach include study of power control in wireless networks [2], robustness of congestion control schemes in wired networks [1], and dynamic bipedal locomotion [4].

Heretofore the stability analysis of switched systems has generally been restricted to a single equilibrium point common to all subsystems. Stability results within such a framework have been reported in [5, 8, 9]. However, these results do not apply to the more general framework where each subsystem has its own (distinct) equilibrium point. Such cases arise, for example, in game theoretical models where each switching event corresponds to a different game, with each such game having a unique Nash equilibrium [3]. Then, the equilibrium point of the overall game shifts with each switching event.

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