Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Algorithms and Applications* **11 (2004)** 569-588

CONNECTIVE PRACTICAL STABILIZATION OF LARGE-SCALE DECENTRALIZED CONTROLLED STOCHASTIC SYSTEMS

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ABSTRACT: In this paper, the concept of practical stability and suboptimal decentralized control is formulated to study the effects of interactions on performance of systems which are composed of locally optimal and stable subsystems. The concept of vector Lyapunov-like functions coupled with the decomposition-aggregation techniques are utilized to develop a comparison principle which allows us to compute the stabilizing controller for the system under the stochastic structural perturbations caused by the on-and-off operations of interconnections among the subsystems. It is shown how one can construct suboptimal control and obtain connective practical stability of a given large-scale system from the complete controllability and practical stabilizability of the simpler reduced subsystems.

AMS(MOS) subject classifications : 93E15, 93E20, 93A15, 34D20.

1 Introduction

Distributed, embedded, software based control is a key ingredient of future highly versatile systems, which range from microscopic sensors and actuators embedded in our environment to networked home and office appliances to large-scale distributed systems such as aircraft, economic, power systems and manufacturing systems. One of the foremost challenges to system theory in this regard is to overcome the increasing size and complexity of the corresponding mathematical models [3, 6, 13, 14]. In this paper, we study the large-scale system reliability in the context of stability.

Stability analysis of both deterministic and stochastic systems in the Lyapunov sense is well established and is widely used in the real world problems [5, 6, 7]. In practice, for a dynamic system, one is frequently interested not only in the qualitative type of information obtainable from the Lyapunov stability, but also in the quantitative data, such as specific trajectory bounds and transient behavior [8, 9]. A system could, for example, be stable and still be completely useless because it may exhibit undesirable transient characteristics (eg., it may exceed certain limits imposed on the trajectory bounds).