Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **10 (2003)** 865-872

ON GLOBAL SYNCHRONIZATION OF CHAOTIC SYSTEMS

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Abstract. This paper discusses the basic problem of chaos synchronization and derives some simple yet explicit conditions for its global convergence.

Keywords. Chaos, synchronization, Chen system, Lorenz system

1 Introduction

Chaos synchronization has been a familiar topic of intensive research in the past decade (see, for example, [1-6] and the references therein).

It has been noticed that many studies of chaos synchronization only provide local convergence analysis via the Lyapunov first method for autonomous systems, i.e., using the local Jacobian analysis. Although some of the studies employ global analysis based on the Lyapunov second method, i.e., utilizing Lyapunov function approach, they either deduced some sufficient conditions that are difficult to verify or reformulated the problem to be in a rather conservative form such as a Linear Matrix Inequality (LMI). If possible, some simpler, less conservative, and more efficient criteria for global chaos synchronization are still desirable particularly regarding engineering applications.

In this paper, we revisit the basic problem of chaos synchronization and take a different approach to derive some simple yet explicit algebraic conditions that can be easily verify for its global convergence.

2 A General Chaos Synchronization Problem

It is well known that many chaos control or synchronization systems, after a suitable subtraction of corresponding variables, can be reformulated as a nonlinear, perhaps non-autonomous, system of error dynamics. Then, two chaotic systems synchronize if the zero solution of this error-dynamics system is asymptotically stable [2]. Therefore, we start with a rather general form of error-dynamics system and provide some simple, explicit, and easily-verified conditions for the global and exponential stability of its zero solution. To this end, the theoretical results will be applied to two typical chaos synchronization systems.