Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **10 (2003)** 403-416

ROBUST IMPULSIVE SYNCHRONIZATION AND APPLICATION TO COMMUNICATION SECURITY

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Abstract. Criteria on uniform equi-boundedness and uniform equi-Lagrange stability of a certain type of impulsive systems have been investigated. These criteria are applied to impulsively synchronize two Lorenz chaotic systems and show how parameter mismatch between them play a fundamental role in influencing system performance. A robust secure communication scheme based on masking and modulating message signals with impulsive synchronization is then proposed. Simulation results are presented to demonstrate the secure scheme.

Keywords. Impulsive systems, equi-boundedness, equi-Lagrange stability, impulsive synchronization, robustness.

1 Introduction

Impulsive systems provide a natural framework for mathematical modeling of many physical phenomena. Examples of such models include some population growth models [9] and maneuvers of spacecraft [12]. In this paper, we are interested in impulsive synchronization of two chaotic systems [10, 14, 19]. This feature was simultaneously investigated for both autonomous and non-autonomous error dynamics between the chaotic systems involved [18]. In addition, a more general format of it was also introduced in [17] using the notion of practical stability. Applications of the feature to communication security was found to be very promising [15, 16]. Since then, many theoretical and experimental studies have been conducted in this field, especially in solving problems arising from the transmission processes of the encrypted signals [4, 5, 6, 7, 13]. However, the problem of robustness has not been addressed in a comprehensible way.

Inaccuracy in designing identical chaotic systems is unavoidable and the robustness of cryptosystems in building a secure communication scheme is considered fundamentally important. Therefore we study impulsive synchronization and its insensitivity to relatively large parameter mismatch between two chaotic systems. In addition, we characterize robustness in terms of