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Original article

Adaptive–impulsive synchronization of chaotic systems

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Abstract

In this paper, we investigate nonlinear adaptive–impulsive synchronization of chaotic systems. The core of adaptive–impulsive synchronization of chaotic systems is to design suitable nonlinear adaptive–impulsive controllers to attain certain aims. Based on invariant principle of impulsive dynamical systems, nonlinear adaptive–impulsive controllers are derived to make the state of chaotic systems synchronized. Accordingly, concrete nonlinear adaptive–impulsive control scheme is designed for quantum cellular neural network (Quantum-CNN). Moreover, numerical simulations are presented to illustrate the effectiveness of the proposed nonlinear controllers, which is more effective than that in the previous literature.

Keywords: Adaptive; Impulsive; Synchronization; Chaos

1. Introduction

Synchronization of chaotic systems has been researched both theoretically and experimentally since 17th century. From then on, synchronization has been widely explored in a variety of fields, such as secure communication, physics, chemistry, kinematics, and engineering. Chaos synchronization, due to it's high value in application, has become a hot topic (e.g., see [2,5–13,15,16,18–20] and the references therein). There are various results on synchronization, such as projective synchronization [5], generalized synchronization [11], clock synchronization [12], robust synchronization [18], partial synchronization [19], and pinning synchronization [20]. Adaptive synchronization and [2,9,10,13] impulsive synchronization [6,8,15] have been abundantly investigated. To make the dynamical system synchronize more efficiently, adaptive–impulsive controllers [7,16] are taken into consideration by comparing principle of impulsive systems.

In recent years, there is an increasing interest in adaptive–impulsive control for synchronization of chaotic systems due to its theoretical and practical significance. However, to the best of our knowledge, there are very few results dealing with nonlinear adaptive–impulsive control for synchronization problem, which motivates the current study. In this paper, we design a nonlinear adaptive–impulsive control scheme to synchronize chaotic systems using invariant principle of impulsive dynamical systems [1].

Recently, the Quantum-CNN oscillators have attracted attention of scientists and engineers as nano-scale chaos generators. Quantum-CNN oscillator equations are derived from a Schrö dinger equation taking quantum dot cellular automata structures into account, to which in the last decade a wide interest has been devoted, with particular attention

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