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A hyperchaotic memristor oscillator with fuzzy based chaos control and LQR based chaos synchronization

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Abstract

Chaotic and hyperchaotic systems with interesting behaviors have been of interest in the recent years. In this paper we introduce a hyperchaotic memristor oscillator which shows both stable and unstable fixed points. Such systems have been less investigated in the literatures. It should also to be noted that the proposed hyperchaotic system has only one nonlinearity which is a flux controlled memristor. Depending on the control parameter, the system displays different behaviors and coexisting attractors. A linear quadratic regulator based synchronization of the proposed hyperchaotic system is designed and numerically analyzed. We also design such a fuzzy based PID controller for chaos control in such a memristor oscillator.

Keywords: Memristor, chaos, fuzzy, control, synchronization

1. Introduction

Rössler explicated that the presence of positive Lyapunov exponents more than one indicates the intricacy of the system (Rossler 1979). Prologue of Rössler system laid a platform in nonlinear system research called “Hyperchaos”. Many complicated systems prefer hyperchaos more than chaos since the hyperchaotic system holds interesting properties such as high capacity, high security, high efficiency (Vaidyanathan). It has been intensively studied in the last few years and widely explored in a variety of fields including image encryption, cryptography, and imitation of neural system. After Rossler system Chen and Dong formulated a hyperchaotic Chen system

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