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ORIGINAL PAPER

Dual Combination Combination Anti Synchronization of Eight Fractional Order Chaotic Systems.

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Abstract
In this paper a new three dimensional fractional order system having three nonlinear terms is introduced. The chaos in the nature of the system is investigated by examining the Lyapunov exponents, graphing the phase potraits and time series of state vectors. The equilibrium points of the system are studied and it is observed that all three equilibrium points are unstable in nature. The scheme of dual combination - combination anti synchronization has been discussed for fractional order systems. To verify the results the novel system is synchronized with the fractional order chaotic Rössler system and fractional order chaotic Lü system. We have achieved dual combination combination anti synchronization between eight fractional order systems of same dimensions using the stability criteria for fractional order systems. Suitable controllers have been designed to perceive the desired synchronization between the drive and response systems. Numerical simulations are performed using MATLAB to signify the effectiveness of the applied method.

Keywords Chaotic system · Synchronization · Dual synchronization · Combination synchronization · Anti synchronization · Fractional order

Mathematics Subject Classification 34A08 · 34D06 · 34H10 · 34H15

Introduction

Many natural phenomena around us can be formulated mathematically in terms of nonlinear system of equations. Almost every nonlinear system is chaotic in nature. These systems are highly unpredictable. A small change in their initial conditions leads to drastic changes in their future behaviour. Therefore, controlling these systems becomes extremely necessary to predict their likely behaviour. Synchronization is a process wherein two or more (either identical or non - identical) chaotic systems are forced or coupled together to follow a same path of motion. Due to its applications in physics, secure communication, information pro-

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