

## MODIFIED HYBRID SYNCHRONIZATION OF IDENTICAL FRACTIONAL HYPERCHAOTIC SYSTEMS WITH INCOMMENSURATE ORDER

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**Abstract.** In this research work, we introduce a new approach for hybrid synchronization called modified hybrid synchronization (MHS). Specifically, we focus on the MHS of identical fractional hyperchaotic systems with incommensurate order, which is a mixture between complete synchronization, anti-synchronization, projective synchronization and modified projective synchronization. To start, we propose a novel hyperchaotic system and also we analyse some its dynamic behaviors. In addition, we prove the MHS approach for identical fractional-order hyperchaotic systems by using a suitable nonlinear controller and stability theory of fractional-order systems. Finally, we take our fractional system as an example to confirm the effectiveness of the analytical results.

**Keywords.** Hybrid synchronization, Hyperchaotic system, Caputo fractional derivative, Lyapunov exponents, Active control.

**AMS (MOS) subject classification:** 34A34, 35B35, 37C25, 37N30

## 1 Introduction

Dynamics of fractional-order nonlinear systems have become the focus in scientific research. They are more suited and better approach than the usual dynamics of integer-order systems for the description of nonlinear phenomena's memory in many fields of science and technology, such as diffusion modeling [1], viscoelasticity [2], control processing [3], signal transmission [4] and so forth.

Chaos synchronization of fractional-order chaotic systems is a fundamental concept of dynamical system and has applications in several fields of science, such as secure communication [5]. Different synchronization types have been proposed for chaotic systems, such as complete synchronization [6],