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Dynamic Analysis of a New Hyperchaotic System with Infinite Equilibria and Its Synchronization

Yasmina Ghettout [1], Lotfi Meddour [2*], Tayeb Hamaizia [2] and Rabiaa Ouahabi [2]

[1] *Laboratory of Differential Equations, Department of Mathematics, Faculty of Exact Sciences, University of Mentouri Brothers, Constantine, Algeria.*
[2] *Department of Mathematics, Faculty of Exact Sciences, University of Mentouri Brothers, Constantine, Algeria.*

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Abstract: In this paper, a new 4D autonomous hyperchaotic system with an infinite number of equilibrium points is introduced and analyzed. This hyperchaotic system is constructed by introducing an additional dimension with a linear state feedback controller to the third equation in the Lorenz system. The dynamical properties of the new hyperchaotic system are discussed by means of dissipation, symmetry, Lyapunov exponents, bifurcation diagrams, equilibrium points and coexisting attractors. Finally, the synchronization of the novel hyperchaotic system is discussed.

Keywords: *Lorenz system; hyperchaos; infinite equilibria; Lyapunov exponent; synchronization.*

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1 Introduction

A hyperchaotic system is a type of the dynamical system that exhibits chaotic behavior with at least two positive Lyapunov exponents, and the minimal dimension of the phase space that embeds the hyperchaotic attractor should be at least four. In 1963, Lorenz proposed a three-dimensional system with two scrolls, which is recognized as the first chaotic model reported in literature [10], it has been the subject of many studies (see, for example, [11]). Subsequently, in 1976, Rossler proposed another chaotic system like the Lorenz one, in 1979, Rossler put forward the concept of hyperchaos and proposed the

* Corresponding author: mailto:meddour_lotfi@umc.edu.dz