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A New Fractional-Order Three-Dimensional Chaotic Flows with Identical Eigenvalues

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Abstract: This paper deals with certain new fractional-order three-dimensional chaotic systems. These autonomous systems are the fractional version of dynamical systems introduced recently by Faghani et al. [6]. The feature property of these systems is the presence of fractional order derivatives as well as equality of their eigenvalues. Numerical investigations on the dynamics of these systems have been carried out using a systematic computer search. Some simple fractional chaotic systems with identical eigenvalues were obtained, and their dynamical properties have been analyzed by means of the Lyapunov exponents.

Keywords: *fractional order derivative; chaotic system; Lyapunov exponents.*

Mathematics Subject Classification (2010): 34C28, 37D45, 37M22, 70K42, 93D05.

1 Introduction

Chaos systems have been receiving much attention from scientific community in the study of dynamical systems due to their applications in ecology, engineering and secure communications [3, 20]. Since the publication of Lorenz's seminal paper in 1963, there is no theory that allows us to predict chaotic solutions.The relationship between chaotic systems and their strange attractors is still unknown. Thanks to numerical simulations, we have been studying chaos, it was the essential tool by which many works have been done to study chaos in dynamical systems. Chaotic systems can be categorized as systems with self-excited attractors and systems with hidden attractors. The basin of attraction for the chaotic system with self-excited attractor intersects with an unstable equilibrium, while the chaotic system with hidden attractors has a basin of attraction which does not

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