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Dynamical Analysis, Stabilization and Discretization of a Chaotic Financial Model with Fractional Order

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Abstract: In this paper, we use the discretization process of a fractional-order financial system. The conditions of the local asymptotic stability of the equilibrium points of the discretized system are analyzed. Through numerical reproductions, we brighten some dynamical behaviors, such as the chaotic attractor, bifurcation for different values of step size and fractional order parameters. Moreover, the numerical simulations confirm the validity of our theoretical results relative to the time step parameter.

Keywords: *fractional-order differential equations; bifurcation; numerical methods; equilibrium; chaotic behavior; discrete-time systems; asymptotic stability.*

Mathematics Subject Classification (2010): 34A08, 34C23, 49Mxx, 74Gxx, 74H65, 93C55, 93D20.

1 Introduction

In the previous two decades, fractional calculus and its applications have attracted a lot of attention. Many models or systems can be described by the fractional order dynamics, among these are viscoelastic models [16], diffusion wave equations [5], equations of electronic circuits [7], energy supply-request equations [21], muscular blood vessel model [22], equations of seismic tremors [1], image encryption scheme models [15], models for nonlocal scourges [11], and nonlinear dynamical model of finance system [28]. In fact, classical differential equations of integer order are generalized by fractional-order differential equations. Meanwhile, chaos is an important dynamical phenomenon which has received an increased attention of scientists since the pioneering work of Lorenz in 1963 [6]. More recently, chaotic behaviors have been found in some nonlinear fractional-order systems [25]. Moreover, the applications of chaos theory such as synchronization [4, 9] and chaos control of fractional-order hyperchaotic and chaotic systems have recently become central topics for research [10, 29].

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