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Stabilization of Chaotic h-Difference Systems with Fractional Order

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Abstract: Based on the Lyapunov approach as well as on the properties of the Caputo h-difference operator, a one-dimensional linear control law is intoduced to stabilize the chaotic fractional discrete-time Ushio system. Numerical results are presented throughout the paper to illustrate the findings.

Keywords: *discrete fractional calculus; fractional discrete Ushio system; linear stabilization; Lyapunov approach.*

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1 Introduction

Fractional discrete calculus is a very interesting topic in mathematics with several potential applications in many fields [1]. Namely, since fractional discrete operators are non local, they are suitable for constructing models characterized by memory effect [2]. This is the reason why fractional-order difference systems, when describing engineering phenomena over large periods of time, perform better with respect to integer-order discrete-time systems [3]. Recently, attention has been focused on the presence of chaotic phenomena in fractional-order systems, described by difference equations [4, 5].

One of the important aspects in the study of chaotic systems is the development of control strategies to achieve stabilization. The aim of the stabilization of chaotic systems is to derive a one-dimensional control law such that both of the map trajectories are controlled to zero asymptotically. Recently, the topic of stabilization of fractional discrete chaotic systems started to attract increasing attention [6–10].

This study presents a novel contribution to the topic of stabilization of chaos in Caputo h-difference chaotic systems. After investigating the existence of chaotic behaviors in the fractional Ushio system, a linear scheme is introduced to control the fractional Ushio system.

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