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Hybrid Projective Synchronization of Fractional Order Chaotic Systems with Fractional Order in the Interval (1,2)

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Abstract: A hybrid projective synchronization scheme for two identical fractional-order chaotic systems with fractional order $1 < q < 2$ has been discussed in this paper. Based on the stability theory of fractional-order systems, a controller for the synchronization of two identical fractional-order chaotic systems is designed. To illustrate the effectiveness of the proposed scheme, we discuss two examples: (i) the fractional-order Lorenz chaotic system with fractional-order $q = 1.17$, (ii) the fractional-order Lu chaotic system with fractional-order q = 1.13. The numerical simulations exhibit the validity and feasibility of the proposed scheme.

Keywords: *fractional order in the interval (1,2); chaotic systems; hybrid projective synchronization.*

Mathematics Subject Classification (2010): 37B25, 37D45, 37N30, 37N35, 70K99.

1 Introduction

The theory of derivatives of fractional order, i.e., non-integer order, goes back to Leibniz's note in his list to L'Hopital, dated 30 September 1695, in which the meaning of derivative of order one half was discussed. Fractional calculus is a 300 year old mathematical topic. Although it has a long history, the applications of fractional calculus to physics and engineering are just a recent focus of interest [1] and [2]. It was found that many systems in interdisciplinary fields can be elegantly described with the help of fractional derivatives. Many systems are known to display fractional-order dynamics, such as viscoelastic systems [3], dielectric polarization [4], electrode–electrolyte polarization [5], electromagnetic waves [6], quantitative finance [7], and quantum evolution of complex systems [8]. In recent years, chaotic phenomenon has been found in many

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