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Synchronization of Distributed Fractional-Order Nonlinear Dynamical Systems

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We provide an approach for designing dynamical distributed controllers for the synchronisation problem of systems governed by integer and fractional order partial differential equations in this paper. We analyse fractional systems with integer order space derivatives and fractional commensurate order temporal derivatives. The methodology is based on the discovery of canonical forms via a variable change, allowing a distributed controller to be developed naturally in the form of a chain of integrators. We propose to employ spectral and semi-group theory for infinite dimensional Hilbert spaces to investigate the stability of the integer order closed loop system [1].

Synchronization, which implies "things happen at the same time or work together," has piqued scientists' curiosity in recent years, particularly in fractional-order chaotic systems [2,3].

Many systems in interdisciplinary domains, including as viscoelastic materials, electrical circuits, population models, and financial systems, can be succinctly described by fractional-order differential equations, as has been realised [4,5].

Meanwhile, the majority of valuable research has revealed that some fractional-order systems exhibit chaotic behaviour.

Fractional-order chaotic behaviour, in particular, has a wide range of potential applications in data encryption, image processing, secure communication, and so on.

As a result, fractional chaotic system synchronisation is gaining popularity due to its vast range of applications, as opposed to classical (integer order) chaotic synchronisation, which has a limited number of uses.

As a result, fractional chaotic system synchronisation is gaining popularity due to its wide range of applications, such as classical (integer order) chaotic synchronisation, which has been utilised in secure communication, complicated dynamical networks, and so on.

The drive-response pattern is a basic configuration for chaos synchronisation, in which the chaotic system's response must follow the drive chaotic trajectory.

Some approaches based on this configuration have been achieved to achieve chaos synchronisation in fractional-order chaotic systems, such as Pecora and Carroll (PC) control, active control, adaptive control, sliding mode control (SMC), and a scalar transmitted signal method, in which the sliding mode controller has some appealing advantages.

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