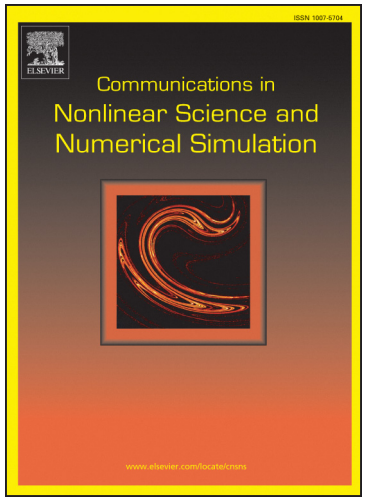

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Stability and resonance conditions of the non-commensurate elementary fractional transfer functions of the second kind

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Abstract

This paper deals with stability and resonance conditions of the non-commensurate elementary fractional transfer function of the second kind. This transfer function is a generalization of the elementary fractional transfer function of the second kind to a arbitrary order. It is written in the canonical form and characterized by a non-commensurate order, a pseudo-damping factor and a natural frequency. Stability and resonance analysis is done in terms of the pseudo-damping factor and the non-commensurate order. Also, an overall study of frequency-domain and time-domain performances of the considered system is done. Therefore many time-domain and frequency-domain curves are presented to help obtaining system parameters for a specified fractional order. Many illustrative examples show the efficiency of this study. Also, an application to the control of a spherical tank is also presented to present the usefulness of this study.

Keywords: Fractional system, time-domain, frequency-domain, resonance, stability

1. Introduction

Recently, fractional order calculus has gained a considerable importance in various fields as physics and engineering (see [3] and references therein for more details). In fact, the dynamic behavior of many physical systems can be described by a fractional order system theory which has been used in several applications, such as viscoelasticity, diffusion, modeling, and control [2, 14]. Motivated by the need of time-domain and frequency-domain analysis

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