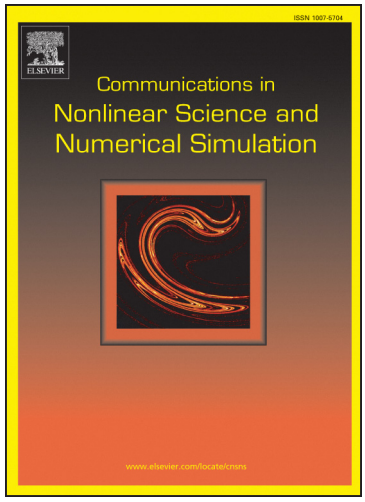

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Solitary travelling auto-waves in fractional reaction-diffusion systems

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Abstract

In this article we study properties of solitary auto-waves in nonlinear fractional reaction-diffusion systems. As an example, the generalized FitzHugh-Nagumo model with time-fractional derivatives is considered. By a linear stability analysis and computer simulation it is shown that the order of the fractional derivative can substantially change the properties of solitary auto-waves and significantly enrich nonlinear system dynamics. The main properties of solitary travelling wave solutions, including the shape of the waves, the domain of their existence, as well as the parameters of their propagation in fractional reaction-diffusion systems, are investigated.

Keywords: reaction-diffusion system, fractional differential equations, instability, dissipative systems, solitary auto-wave, self-organization

1. Introduction

For several decades, dynamical systems with fractional derivatives have been used extensively in modeling processes and phenomena in wide classes of complex media with hereditary, fractal and non-markovian properties [1, 2, 3, 4, 5, 6, 7]. Due to a rapid growth of applications of fractional differential equations we now have to increasingly deal with nonlinear fractional dynamical systems [5, 6, 7, 8, 9, 10, 11], which have also a great theoretical interest [12, 13, 14, 15]. Such systems essentially enlarge the family of classical dynamical systems and actually leads to the formation of the new scientific research field - fractional dynamics [8, 9].

Between nonlinear fractional systems an growing interest has been observed in study of fractional reaction-diffusion systems (RDS), which can demonstrate very complex nonlinear dynamics [16, 17, 18, 19, 20, 21, 22]. It was shown that reaction-diffusion systems with the fractional derivatives can exhibit new types

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