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Existence results for a coupled system of nonlinear neutral fractional differential equations*

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Abstract
Applying the monotone iterative method, we investigate the existence of solutions for a coupled system of nonlinear neutral fractional differential equations, which involves Riemann-Liouville derivatives of different fractional orders. As an application, an example is presented to illustrate the main results.
Keywords: Nonlinear neutral fractional differential equations; Coupled systems; Monotone iterative technique

1 Introduction

Fractional calculus provides an excellent tool to describe the hereditary properties of various materials and processes. Concerning the development of theory, method and application of fractional calculus, we refer to the books [1]-[5] and recent papers [6]-[11]. Systems of fractional differential equations arise in various problems of applied nature, for example, see [12]-[22]. In this paper, we consider the following system of nonlinear neutral fractional differential equations with different fractional derivatives:

$$\begin{cases} D^{\alpha}u(t) = f(t, D^{\alpha}u(t), D^{\alpha}v(t), D^{\alpha}u(\theta(t)), D^{\beta}u(t), u(t), v(t)), & t \in (0,T], \\ D^{\alpha}v(t) = g(t, D^{\alpha}v(t), D^{\alpha}u(t), D^{\alpha}v(\theta(t)), D^{\beta}v(t), v(t), u(t)), & t \in (0,T], \\ t^{1-\alpha}u(t)|_{t=0} = 0, \quad t^{1-\alpha}v(t)|_{t=0} = 0, \end{cases} \tag{1.1}$$

where $J = [0,T](0 < T < \infty)$, D^{α}, D^{β} are the standard Riemann-Liouville fractional derivatives, and $0 < \beta \leq \alpha \leq 1$.

In order to obtain the solutions of systems of nonlinear neutral fractional differential equations (1.1), we employ the monotone iterative method. The advantage and importance of the method needs no special emphasis [23]. There have appeared some excellent results dealing with nonlinear fractional differential equations by using the monotone iterative method, which can be found in papers [24]-[37] and the references cited therein. To the best of our knowledge, this method has not been yet applied to the systems of nonlinear neutral fractional differential equations.

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