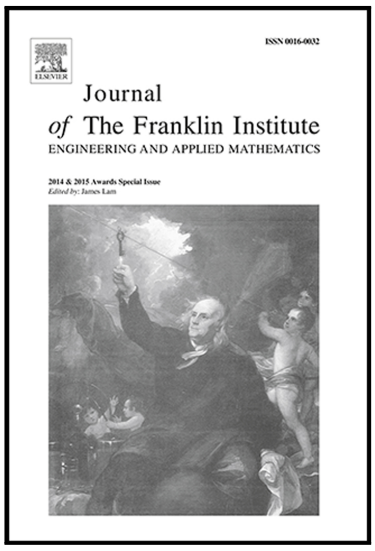


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# Robust asymptotic stability of interval fractional-order nonlinear systems with time-delay

Penghua Li[a], Liping Chen*[b], Ranchao Wu[c], J. A. Tenreiro Machado[d], António M. Lopes[e], Liguo Yuan[f]

[a]*Automotive Electronics Engineering Research Center, College of Automation, Chongqing University of Posts and Telecommunications, Chongqing, 400065, China*
[b]*School of Electrical Engineering and Automation, Hefei University of Technology, Hefei 230009, China*
[c]*School of Mathematics, Anhui University, Hefei 230601, China*
[d]*Institute of Engineering, Polytechnic of Porto, Department of Electrical Engineering, R. Dr. António Bernardino de Almeida, 431, 4249-015 Porto, Portugal*
[e]*UISPA–LAETA/INEGI, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal*
[f]*School of Mathematics and Informatics, South China Agricultural University, Guangzhou, 510642, China*

**Abstract**

This paper studies the global asymptotic stability of a class of interval fractional-order (FO) nonlinear systems with time-delay. First, a new lemma for the Caputo fractional derivative is presented. It extends the FO Lyapunov direct method allowing the stability analysis and synthesis of fractional order nonlinear systems with time-delay. Second, by employing FO Razumikhin theorem, a new delay-independent stability criterion, in the form of linear matrix inequality is established for ensuring that a system, is globally asymptotically stable. It is shown that the new criterion is simple, easy to use and valid for the FO or integer-order interval neural networks with time-delay. Finally, the feasibility and effectiveness of the proposed scheme are tested with a numerical example.

*Keywords:* Fractional-order systems; Interval nonlinear systems; Asymptotic stability; Delay

## 1. Introduction

In the last decades, the theory and application of fractional calculus (FC) verified a considerable development. FC was proved to be an effective tool for describing systems exhibiting long-range memory and hereditary properties that occur in phenomena such as viscoelastic, electrode-electrolyte, biological electric conductance, neural systems and others [1, 2, 3, 4, 5, 6]. With further fractional mathematical descriptions emerging in the scientific arena, namely the fractional order (FO) versions of viscoelasticity [7], Maxwell [8], predator-prey [9], heat conduction [10], DC-DC converter [11], and SEIR [12] models, their properties became increasingly relevant. Motivated by these scientific advances, the stability was recognized to be a fundamental issue in dynamical systems and control theory. Time-delays are often found and unavoidable

*Email address:* lip_chen@hfut.edu.cn (Liping Chen*)