Robust Stabilization of Fractional-Order Uncertain Systems with Multiple Delays in State

Masoumeh Nazari and Saeed Balochian

1 Department of Electrical Engineering, Gonabad Branch, Islamic Azad University, Gonabad, Iran

Abstract: In this paper, a sliding mode control law is designed for stabilization of specific class of linear systems of fractional order despite of multi delays in the state system. A fractional order sliding surface is proposed, and using the variable structure control theorem, control law is introduced. A numerical simulation is given to show the effectiveness of the proposed design approach.

Keywords: sliding mode control (SMC); Lyapunov stability analysis; fractional order system.

Mathematics Subject Classification (2010): 93C35, 93D05, 93D15.

1 Introduction

Recently, time delays inevitably exist in systems and processes due to poor performance, undesirable system transient responses, and instabilities so that as a result, most systems may include a delay term. In general, the time-delay is believed to have a negative impact on the control system performance. To compensate for this impact, Smith predictor schemes work fine for slow processes. In the last two decades, the theory of fractional calculus has attracted researchers, because of its wide use in different areas of sciences and engineering, such as viscoelastic systems, sinusoidal oscillators, electromagnetic theory, and bioengineering. The sliding mode control (SMC) approach is one of the most important methods and this approach can be used in many systems because of its robustness to parameter uncertainties and insensitivity to external disturbances. Sliding mode control (SMC) is based on the theory of variable structure systems. The main feature of SMC is to cause states from initial...