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On time-optimal control of fractional-order systems

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Abstract

Fractional optimal control problem is treated from convex-analytical viewpoint. Sufficient conditions for time-optimal control similar to that of Pontryagin's maximum principle are obtained for fractional-order systems in the sense of Riemann–Liouville and Caputo. Theoretical results are supported by examples.

Keywords: Fractional differential equation, Riemann–Liouville fractional derivative, Caputo fractional derivative, Fractional optimal control problem
2010 MSC: 34A08, 49N05, 33E12

1. Introduction

Many real-life systems and processes exhibiting properties like long-term memory and self-similarity are often referred to as fractional-order systems and can be adequately modeled by fractional differential equations (FDEs). FDEs involve derivatives of non-integer order, which are characterized by non-locality and other features that make FDEs difficult to deal with. For instance, classical fractional derivatives in the sense of Riemann–Liouville and Caputo do not possess semigroup property. Moreover, the Riemann–Liouville fractional derivatives have singularity at the initial point, which entails that FDEs involving these derivatives require initial conditions of special form, lacking clear physical interpretation. As a consequence, many of the theoretical results and

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