Matychyn, Ivan; Onyshchenko, Viktoriia

Summary: Problem of time-optimal control of linear systems with fractional Caputo derivatives is examined using technique of attainability sets and their support functions.

A method to construct a control function that brings trajectory of the system to a strictly convex terminal set in the shortest time is elaborated. The proposed method uses technique of set-valued maps and represents a fractional version of Pontryagin’s maximum principle.

A special emphasis is placed upon the problem of computing of the matrix Mittag-Leffler function, which plays a key role in the proposed methods. A technique for computing matrix Mittag-Leffler function using Jordan canonical form is discussed, which is implemented in the form of a MATLAB routine.

Theoretical results are supported by examples, in which the optimal control functions, in particular of the “bang-bang” type, are obtained.

MSC:
49N05 Linear optimal control problems
49K15 Optimality conditions for problems involving ordinary differential equations
26A33 Fractional derivatives and integrals
34A08 Fractional ordinary differential equations
49J53 Set-valued and variational analysis
49J30 Existence of optimal solutions belonging to restricted classes (Lipschitz controls, bang-bang controls, etc.)

Keywords:
fractional calculus; fractional differential equations; matrix Mittag-Leffler function; optimal control

Software:
mftoolbox; ML; Matlab

Full Text: DOI

References:

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