ICRAMCS 2026

THE EIGHTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 23-24-25, 2026 | Marrakech, Morocco

New Criteria for Approximate Controllability of Fractional Nonlocal Evolution Equations in Banach Spaces

Communication Info

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Keywords:
(1) ψ-Caputo fractional derivative
(2) Approximate controllability
(3)Krasnoselskii's fixed point
(4) q-order cosine family

Abstract

This article examines the approximate controllability of a class of fractional differential equations with nonlocal conditions in Banach spaces, focusing on fractional orders $q \in (1,2)$. We derive explicit and verifiable criteria ensuring the approximate controllability of the associated control system. The analysis combines the framework of resolvent operators, key techniques from fractional calculus, and Krasnosel'skii's fixed point theorem, assuming that the corresponding linear system already satisfies approximate controllability. The results obtained not only refine but also generalize several existing contributions in the literature. An illustrative example is included to demonstrate the effectiveness and applicability of the proposed theoretical approach.

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