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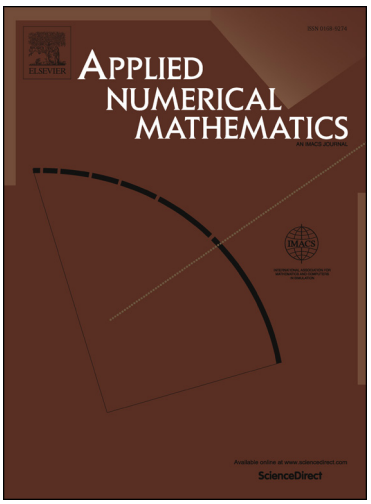

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On fractional backward differential formulas for fractional delay differential equations with periodic and anti-periodic conditions

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Abstract

In this paper, fractional backward differential formulas (FBDF) are presented for the numerical solution of fractional delay differential equations (FDDEs) of the form $\lambda_n {}_0^C D_t^{\alpha_n} y(t) + \lambda_{n-1} {}_0^C D_t^{\alpha_{n-1}} y(t) + \cdots + \lambda_1 {}_0^C D_t^{\alpha_1} y(t) + \lambda_{n+1} y(t-\tau) = f(t)\ ,\ t \in [0,T]$, where $\lambda_i \in \mathbb{R}\,(i = 1, \cdots, n+1)\,,\ \lambda_{n+1} \neq 0,\ 0 \leqslant \alpha_1 < \alpha_2 < \cdots < \alpha_n < 1,\ T > 0$, in Caputo sense. Our investigation is focused on stability properties of the numerical methods and we determine stability regions for the FDDEs. Also we find the Green's functions for this equation corresponding to periodic/ anti-periodic conditions in terms of the functions of Mittag Leffler type. Numerical tests are presented to confirm the strength of the approach under investigation.

Keywords: Fractional backward differential formulas; linear delay differential equations; stability;

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1. Introduction

Fractional differential equations arise in many scientific disciplines as the mathematical models of systems and processes in the fields of physics, polymer rheology, regular variation in thermodynamics, biophysics, blood flow phe-

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