A Unified Transform Framework for Solving Fractional Differential Models Involving Multiple Fractional Operators

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Abstract

This work uses a generalized integral transform approach for analysing a number of fractional-order mathematical models, which include Newton's law of cooling, the logistic equation, and the blood alcohol content model. Several fractional derivatives, like the Caputo, Caputo–Fabrizio (CF), modified Atangana–Baleanu–Caputo (mABC), and constant proportional Caputo (CPC) derivatives are used to formulate the models. We obtain analytical solutions and demonstrate the findings graphically for several fractional orders by employing the general transform method. The results corroborate previous findings for specific cases as well as underscore the effectiveness and versatility of the generalized transform in dealing with diverse fractional operators. Its ability to provide deep insights into the dynamics of real-world systems controlled by fractional differential equations is evident.

Keywords: Integral transform; Caputo derivative; Caputo–Fabrizio derivative; modified ABC derivative; CPC derivative; Newton's law of cooling; Population growth; Logistic equation.

1. **Funding:** No funding Agency.
2. **Conflict of Interest**: There is no conflict of interest
3. **Authors' Contribution**: All authors have equal contributions
4. **Availability of Data and Materials**: Not required

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