



Method Article

A new spline technique for the time fractional diffusion-wave equation

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Method name:

Spline Collocation Method

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Caputo-derivative

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ABSTRACT

The current research article proposes an approximate solution of the fractional diffusion wave equation (FDWE) by using a new collocation method based on the cubic B-splines. The fractional derivative in the time direction is considered in Caputo form. The theoretical research of the proposed algorithm is discussed with L_∞ and H^1 norms. The method presented in this article is found to be of order $(\Delta t^{3-\alpha} + h^4)$. The highlights of the current technique proposed in this article are as under:

- The method is high-order collocation and uses a compact stencil. The error analysis is discussed to authenticate the order of convergence of the proposed numerical approximation.
- The comparisons of errors with the already existing methods are done and observed that our method produces more accurate results than the methods presented in the literature.

Specification table

Subject area;	Mathematics
More specific subject area;	Fractional Partial Differential Equations
Name of your method;	Spline Collocation Method
Name and reference of original method;	1. D.ARCHER (1977), An $o(h^4)$ Cubic Spline Collocation Method for Quasilinear Parabolic Equations, SIAM Journal on Numerical Analysis, Vol.14, pp.620–637. 2. S.SINGH, S.SINGH AND A.AGGARWAL (2017), Fourth-Order Cubic B-Spline Collocation Method For Hyperbolic Telegraph Equation, Mathematical Sciences, https://doi.org/10.1007/s40096-021-00428-y .
Resource availability;	MATLAB

Method details

Scientific mathematical background

In this article, we solve the fractional diffusion wave equation, numerically. This equation has been found by Einstein long back ago, but because of its viable number of applications in many fields of science, social science, and engineering problems this equation is wooing the attention of numerous scholars in the current period of time. The fractional diffusion wave equation (FDWE) has found its application in electrical networking, signal processing, electromagnetics, viscoelasticity, etc. Verily there are so many problems in science that can be modeled more accurately by fractional derivatives. By changing the time directional derivative with a fractional

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