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A transformed $L_1$ method for solving the multi-term time-fractional diffusion problem.
(English) [Zbl 07442893]

Summary: In this paper, we present a novel scheme for solving a time-fractional initial-boundary value problem, where the equation contains a sum of Caputo derivatives with orders between 0 and 1. In order to overcome the difficulty of initial layer, we introduce a change of variable in the temporal direction and investigate the regularity of the solutions of the resulting system. A modified $L_1$ approximation is used to approximate the Caputo derivatives and a standard Galerkin-Spectral method is applied to approximate the spatial derivatives. Unconditional stability and convergence of the fully-discrete scheme are proved by applying a novel discrete fractional Grönwall inequality. Finally, numerical examples are given to confirm our theoretical results.

MSC:
65-XX Numerical analysis
35-XX Partial differential equations

Keywords:
multi-term time-fractional equation; modified $L_1$ scheme; Chebyshev-Galerkin spectral method; error estimates

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References:

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