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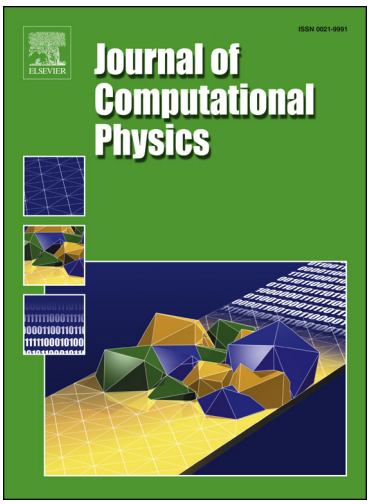

A fast semi-discrete Kansa method to solve the two-dimensional spatiotemporal fractional diffusion equation

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A fast semi-discrete Kansa method to solve the two-dimensional spatiotemporal fractional diffusion equation

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Abstract

Fractional-order diffusion equations (FDEs) extend classical diffusion equations by quantifying anomalous diffusion frequently observed in heterogeneous media. Real-world diffusion can be multi-dimensional, requiring efficient numerical solvers that can handle long-term memory embedded in mass transport. To address this challenge, a semi-discrete Kansa method is developed to approximate the two-dimensional spatiotemporal FDE, where the Kansa approach first discretizes the FDE, then the Gauss-Jacobi quadrature rule solves the corresponding matrix, and finally the Mittag-Leffler function provides an analytical solution for the resultant time-fractional ordinary differential equation. Numerical experiments are then conducted to check how the accuracy and convergence rate of the numerical solution are affected by the distribution mode and number of spatial discretization nodes. Applications further show that the numerical method can efficiently solve two-