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Approximate fundamental solution for space–time fractional diffusion equation

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We consider the solutions of a space–time fractional diffusion equation on the interval [−1, 1]. The equation is obtained from the standard diffusion equation by replacing the second-order space derivative by a Riemann–Liouville fractional derivative of order between one and two, and the first-order time derivative by a Caputo fractional derivative of order between zero and one. As the fundamental solution of this fractional equation is unknown (if exists), an eigenfunction approach is applied to obtain approximate fundamental solutions which are then used to solve the space–time fractional diffusion equation with initial and boundary values. Numerical results are presented to demonstrate the effectiveness of the proposed method in long time simulations.

Keywords: Approximate fundamental solution; Riemann–Liouville fractional derivative; Jacobi-collocation