High Order Algorithm for the Spatial Riesz Fractional Diffusion Equation

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Abstract

In this paper, we firstly develop the high order numerical algorithms for left and right Riemann-Liouville derivatives. Using these derived schemes, we naturally get the high order algorithms for Riesz fractional derivative. Based on the approximate algorithm of Riesz fractional derivative, we numerically study the spatial Riesz fractional diffusion equation, where a fourth-order scheme is proposed for the spacial Riesz derivative, and where a compact difference scheme is applied to approximating the first-order time derivative. It is shown that the difference scheme is unconditionally stable and convergent. Finally, numerical examples are provided which support the theoretical analysis.

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