Calcolo Scientifico e Modelli Matematici, 29-31 Gennaio 2024, Napoli, Italia

Numerical approximation of the space-time fractional diffusion problem

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Fractional diffusion equations are partial differential equations that involve fractional derivatives in both space and time. They are useful to model real phenomena, and in particular anomalous diffusion, in various fields of sciences (e.g. biology, physics, mechanics, economics, control theory, etc) [1, 2].

We consider the discretization of the space-time fractional diffusion problem, where the fractional derivative in time is considered in the Caputo sense, and the fractional diffusion is represented by the Riesz-Caputo derivative. Exploiting analytical properties of the Riesz-Caputo operator [3], we propose a collocation method based on a B-spline representation of the solution, where the symmetry properties of both the spline basis functions and the Riesz–Caputo operator are used to provide an efficient method for solving the proposed fractional differential problem. Numerical experiments will be presented to show the effectiveness of the proposed method and the theoretical findings.

References

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