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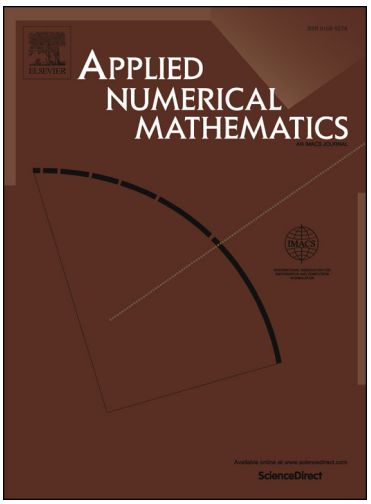

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Fractional PDE Constrained Optimization: an optimize–then–discretize approach with L–BFGS and Approximate Inverse Preconditioning

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Abstract

In this paper, using an *optimize–then–discretize* approach, we address the numerical solution of two Fraction Partial Differential Equation constrained optimization problems: the *Fractional Advection Dispersion Equation* (FADE) and the two–dimensional *semilinear Riesz Space Fractional Diffusion equation*. Both a theoretical and experimental analysis of the problem is carried out. The algorithmic framework is based on the L–BFGS method coupled with a Krylov subspace solver. A suitable preconditioning strategy by approximate inverses is taken into account. Graphics Processing Unit (GPU) accelerator is used in the construction of the preconditioners. The numerical experiments are performed with benchmarked software/libraries enforcing the reproducibility of the results.

Keywords: Fractional Differential Equation, Constrained Optimization, Approximate Inverse Preconditioners
2010 MSC: 93B40, 65F08, 65F10

1. Introduction and Problem Statement

Among the key ingredients for the success of PDE constrained optimization there is surely the wide set of possible applications, from fluid dynamic to control of heat–transfer processes, e.g, see [1, 2, 3]. To further extend the set of possible applications, we are interested in dealing with the numerical treatment of a non standard class of PDE constrained problem: considering the use of quadratic objective functionals in the so called class of *tracking type* costs functionals (see

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