



复旦大学数学科学学院 数学综合报告会

报告题目: **Modeling and fast numerical methods for fractional PDEs**

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摘要: Fractional PDEs provide a powerful tool for modeling challenging phenomena including anomalous transport, and long range time memory or spatial interactions. However, FPDEs present new mathematical and numerical difficulties that have not been encountered in the context of integer-order PDEs.

Computationally, because of the nonlocal property of fractional differential operators, the numerical methods for FPDEs often generate dense stiffness matrices. Traditionally, direct methods were used to solve these problems, which require $O(N^3)$ computations (per time step) and $O(N^2)$ memory, where N is the number of unknowns (at the current time step for time-dependent problems). In addition, the numerical schemes may also present long tails in the time direction in the context of space-time fractional PDEs, which further increases the computational cost and memory requirement. This renders the three-dimensional FPDE modeling and simulations computationally intractable.

We go over the recent development of accurate and efficient numerical methods for fractional PDEs, which has an optimal order storage and almost linear computational complexity. Finally, We will address open problems and our future direction of research.

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