Reconstructing the Historical Distribution of Diffusion Equation with Poly-Fractional Operator in Multi-Dimensional Space

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Abstract

The content of the report discusses a research study focusing on the reconstruction of the past distribution for diffusion equations in multidimensional space, involving a poly-fractional operator. The mathematical expression for the operator is displayed as:

Ρα((−Δ)γ

)u := Xm

i=1

 $\alpha i(-\Delta)\gamma iu$,

where $m \in N$, $0 < \gamma 1 \le \cdots \le \gamma m \le 1$ and $\alpha i > 0$ for i = 1, ..., m. This equation is centered on the page and uses LaTeX-style mathematical notation, including symbols like $P\alpha$, Δ (Laplacian), and γ .

The text explains that the problem arises from the superposition of multiple stochastic processes with different scales, such as classical random walks and L'evy flights. It mentions that the problem is extremely ill-posed in the sense of Hadamard. The authors describe using an appropriate filtering method to construct a regularized solution that converges to the original solution in the L 2-sense. Additionally, imposing a Gevrey-type a-priori condition allows for obtaining a H"older convergence rate. The abstract concludes by noting that three numerical examples using MATLAB were performed to demonstrate the ill-posedness of the problem and the effectiveness of the regularization method.

There are no images, graphs, or additional figures in the attachment—just plain text. The font appears to be a standard serif typeface, such as Times New Roman, commonly used in academic publications. The page has standard margins, and there are no visible headers, footers, or page numbers in the visibleportion of the image. The text is dense, with no bullet points or subheadings, maintaining a formal and technical tone throughout.