数学与系统科学研究院

计算数学所学术报告

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报告题目：

Second-order approximations for variable order fractional derivatives: Algorithms and applications

邀请人：　　唐贻发 研究员

报告时间：**2014** 年 **10** 月 **30** 日（周四）

下午 **16:00-17:00**

报告地点：　　数学院南楼七层 **702** 会议室

Abstract:

Fractional calculus allows variable-order of fractional operators, which can be exploited in diverse physical and biological applications where rates of change of the quantity of interest may depend on space and/or time. We derive two second-order approximation formulas for the variable-order fractional time derivatives involved in anomalous diffusion and wave propagation. We then present numerical tests that verify the theoretical estimates of convergence rate and also simulations of anomalous sub-diffusion and super-diffusion that demonstrate new localized diffusion rates that depend on the curvature of the variable-order function. Finally, we perform simulations of wave propagation in a truncated domain to demonstrate how erroneous wave reflections at the boundaries can be eliminated by super-diffusion, and also simulations of the Burgers equation that serve as a testbed for studying the loss and recovery of monotonicity using again variable rate diffusion as a function of space and/or time. Taken together, our results demonstrate that variable-order fractional derivatives can be used to model the physics of anomalous transport with spatiotemporal variability but also as new effective numerical tools that can deal with the long-standing issues of outflow boundary conditions and monotonicity of integer-order PDEs.

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