数学与系统科学研究院

计算数学所学术报告

报告人：　　**Dr. Kaibo Hu**

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报告题目：

Finite elements, cohomology and structure-preservation

邀请人：　周爱辉 研究员

报告时间：**2020** 年 **1** 月 **2** 日（周四）

上午 **9:00-10:00**

报告地点：　　数学院南楼二层

202 教室

Abstract:

Many challenging computational problems call for preservation of the underlying mathematical and physical structures on the continuous level. In this talk, we show how investigating and mimicking intrinsic geometric and topological structures can lead to reliable and efficient algorithms for fluid, solid mechanics and multi-physics systems. Continuous and discrete differential complexes and their cohomology theory, as described in the Finite Element Exterior Calculus, play a key role in our study.

The desire for designing structure-preserving numerical algorithms also inspires development in fundamental mathematics. As an example, we show how an algebraic tool, the Bernstein-Gelfand-Gelfand construction, is used to derive complexes from complexes and establish their analytic properties. With this rather different approach, we give new proofs for classical results in applied analysis, e.g., the Korn inequality. More importantly, we prove new results with applications in continuum incompatibility theories, geometry and relativity; we derive Poincaré type operators, generalizing Cesàro and Voterra's classical results in 1906 and 1907 for elasticity. Thus we lay the foundation of FEEC for a large variety of problems, and construct the first conforming finite element for discretizing metric and linearized curvature.

We conclude with an outlook to a structure-preserving approach for numerical general relativity, and the interplay between finite elements, discrete geometry and physics.

欢迎大家参加！