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：

Implementing mathematics: domain specific languages and automated computing

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311 报告厅

Abstract:

Computer simulation is today an indispensable tool for scientists and engineers in modeling, understanding and predicting nature. Having emerged as a complement to theory and experimentation, it is becoming increasingly more important as a result of advancements in hardware, software and algorithms.

However, in spite of its success and ever increasing importance, simulation software is still largely written by hand, following a primitive, outdated and unsustainable pipeline: first express a model in the language of mathematics, then translate this model - using pen and paper - to a complex system of data structures and algorithms, then express those data structures and algorithms in a programming language. Even if those algorithms can today be expressed in high level programming languages, the pipeline still involves the translation (obfuscation) of the mathematical model to computer code.

In this talk, I will argue that we should not strive to translate mathematical models or methods to computer code. Instead, we should strive to develop exact computer representations of mathematics that make the original mathematical model or method native to the mathematical programming language.

I will highlight three examples of ongoing work in this direction. First, the FEniCS Project, an ongoing effort to develop a domain specific language for expression and solution of partial differential equations; second, an application of the domain specific language of FEniCS for expressing the Einstein-Vlasov equations and computing the mass distribution of galaxies; third, a new effort to implement the abstractions of exterior calculus in a functional programming language (Haskell) to express and thereby compute all elements of the periodic table of finite elements.

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欢迎大家参加！