计算数学所系列报告

Title: Adaptive finite element algorithms in CFD

报告人：Prof. Roland Beker

(Institution University of Pau-Laboratoire de Mathématiques Appliquées, France)

邀请人：袁礼 研究员

Time Schedule:

#1: July 30, 8:30-11:10am, take break at 9:30-9:45

#2: August 4, 2:30-5:10pm, take break at 3:30-3:45

#3: August 5, 2:30-5:10pm

#4: August 6, 2:30-5:10pm

地点：科技综合楼 3 层 301 报告厅

Abstract The subjects of these lectures are adaptive finite element methods (AFEM) for computational fluid dynamics (CFD). These methods have become an important tool for numerical simulations, since they provide efficient algorithms under less restrictive regularity assumptions than classical approaches based on uniform grid refinement. In addition, a posteriori error estimators can be used to predict the uncertainties caused by numerical approximation and modeling errors. They are closely related to the estimation of sensitivities, which provide a means to quantify the influence of physical and numerical parameters such as boundary conditions and state equations. The four parts of lectures give an overview on recent progress in the analysis of AFEM, introduce some stabilized finite element methods for incompressible flow problems, present iterative solution algorithms for the resulting discrete systems of equations, and discuss the implementation in the context of the Concha library

(a software project supported by the French national institute INRIA).

The first part is concerned with scalar equations. We present the basic concepts of AFEM, report on convergence and complexity results in the framework of continuous, mixed, and nonconforming approximations. In addition we discuss goal-oriented error estimators, which form the basis of our approach to error estimation for CFD.

The second part is devoted to incompressible flow problems. Here we introduce some robust methods in order to deal with the stiff velocity-pressure coupling and with convection dominated flows. We focus on stabilized conforming and nonconforming methods. At the same time we introduce multigrid methods and discuss parallelization as practical tools to solve the discrete equations. Extensions to viscoelastic and compressible flows will be presented.

In the third part we concentrate on error estimation for CFD problems. The main purpose is to provide tools to predict the influence of uncertainties arising in engineering practice. To our point of view, quantification should be done with respect to target functionals, which are given in a specific application. Examples are the drag and lift coefficient of an immersed body, or the heat transfer coefficient on part of the boundary.

Finally, the fourth part discusses the implementation of the algorithms introduced before and presents the concepts of the Concha library.

欢迎大家参加！