Multi-Scale Phenomena in Complex Fluids

Modeling, Analysis and Numerical Simulation

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editors

Thomas Y Hou

California Institute of Technology, USA

Chun Liu

Penn State University, USA

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University of Maryland, USA

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Thomas Y Hou

Applied Mathematics 217-50
California Institute of Technology
Pasadena, CA 91125
USA

Chun Liu

Department of Mathematics
The Penn State University
University Park, PA 16802
USA

Jian-Guo Liu

Department of Mathematics
University of Maryland
College Park, MD 20742-4015
USA

Editorial Assistant: Zhou Chun-Lian

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Preface

This volume is a collection of lecture notes generated from the first two series of mini-courses of “Shanghai Summer School on Analysis and Numerics in Modern Sciences” held during the summers of 2004 and 2006 at Fudan University, Shanghai, China. The summer school programs attracted more than 130 participants each year, including graduate students, postdoctors, and junior faculty members from more than 30 universities in China and USA.

The purpose of the summer school is to promote the interaction and collaboration of researchers with expertise in scientific modeling, mathematical analysis and numerical simulations. The focus of the year 2004’s program was on the study of the multi-scale phenomena in complex fluids. The focus of the year 2006’s program was on multi-scale analysis in nonlinear partial differential equations and their applications.

The summer school hosted several mini-courses each year. During the summer of 2004, the instructors are Weizhu Bao (National University of Singapore), Thomas Hou (California Institute of Technology, USA), Chun Liu (Penn State University, USA), Jianguo Liu (University of Maryland, USA), Tiehu Qin (Fudan University, PRC) and Qi Wang (Florida State University, USA). During the summer of 2006, the mini-courses were taught by Zhaojun Bai and Albert Fannjiang (University of California at Davis, USA), Thomas Hou, Wenbin Chen and Feng Qiu (Fudan University, PRC), Chun Liu, and Xiaoming Wang (Florida State University, USA). There are also short lectures given by many distinguished visitors from around the world.

There are five chapters in this volume, covering a wide range of topics in both analysis and numerical simulation methods, as well as their applications.

Chapter 1, by Zhaojun Bai, Wenbin Chen, Richard Scalettar and Ichitaro Yamazaki, is on the numerical methods for quantum Monte Carlo simulations of the Hubbard Models.

Chapter 2, by Albert Fannjiang, is on the wave propagation and imaging in random media.

Chapter 3, by Thomas Hou, is on multi-scale computations for flow and transport in porous media.

Chapter 4, by Chun Liu, is on the energetic variational approaches of elastic complex fluids.

Chapter 5, by Qi Wang, is on the kinetic theories of complex fluids.

We would like to express our gratitude to all the authors for their contributions to this volume, all the instructors for their contributions to the Shanghai Summer Schools in 2004 and 2006 and, in particular, thanks also go to all the participants in the Summer School programs. We want to thank Ms. Chunlian Zhou for her assistance, without which will be impossible for the success of the Summer School. The editors are grateful to Fudan University, the Mathematical Center of Ministry of Education of China, the National Natural Science Foundation of China (NSFC) and the Institut Sino-Francais de Mathematiques Appliquees (ISFMA) for their help and support. Finally, the editor wish to thank Tianfu Zhao (Senior Editor, Higher Education Press) for his patience and professional assistance.

Tomas Y. Hou, Chun Liu and Jianguo Liu

Editors

April 2008

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