Contents

Part I Tutorials

Multiscale Methods for Subsurface Flow
Jørg E. Aarnes, Knut–Andreas Lie, Vegard Kippe, Stein Krogstad 3

Multiscale Modelling of Complex Fluids: A Mathematical Initiation
Claude Le Bris, Tony Lelièvre 49

Fast Algorithms for Boundary Integral Equations
Lexing Ying 139

Wavelets and Wavelet Based Numerical Homogenization
Olof Runborg 195

Multiscale Computations for Highly Oscillatory Problems
Gil Ariel, Björn Engquist, Heinz-Otto Kreiss, Richard Tsai 237

Part II Projects

Quantum Mechanics / Classical Mechanics Modeling of Biological Systems
Håkan W. Hugosson, Hans Ågren 291

Multiple Scales in Solid State Physics
Erik Koch, Eva Pavarini 295

Climate Sensitivity and Variability Examined in a Global Climate Model
Heiner Körnich, Erland Källén 299

Coarse-scale Modeling of Flow in Gas-injection Processes for Enhanced Oil Recovery
James V. Lambers 303

Photo-Ionization Dynamics Simulation
Garrelt Mellema 307

Time Scales in Molecular Reaction Dynamics
Yngve Öhrn, Erik Deumens 311

Complex Band Structures of Spintronics Materials
Peter Zahn, Patrik Thunström, Tomas Johnson 317