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Preface

Special Issue for the 18th International Conference on Discrete Simulation of Fluid Dynamics (DSFD)

This special issue contains contributions of selected papers presented at the 18th international Conference on Discrete Simulation of Fluid Mechanics (DSFD). This conference was held in Beijing, July 6-10, 2009. The simulation methods that are the focus of the conference are models where the hydrodynamic behavior is emerging from a physical, if simplified, model. Prominent examples of these methods include both lattice based models, like lattice gases and lattice Boltzmann methods, and continuous models like multi particle collision dynamics, smoothed particle hydrodynamics, dissipative particle dynamics or discrete simulation Monte Carlo methods. However, recently the single most popular of these methods has been the lattice Boltzmann method. The purpose of this annual conference is to bring together researchers who report on advances in the model development and researchers that report on application of these methods in a steadily increasing number of fields. More information on the conference can be found on the web at `http://dsfd.org`.

At the conference 67 papers were presented. Of the submitted contributions 24 passed the peer review process and were published in this special. Of these papers 22 focus on the lattice Boltzmann method. The two exceptions are the paper by S. C. Fu et al. [1] which describes a novel discrete flux scheme based on the Boltzmann method for the simulation of the Navier-Stokes equations and the paper by Q.-D. Cai et al. [2] which focuses on technical advances in spectral methods for the simulation of turbulence.

About half of the remaining papers describe advances in the development of the lattice Boltzmann method. These papers re-examine the Enskog extension for non-ideal gases [3], examine the outflow boundary conditions [4] and re-express the lattice Boltzmann equation in a local reference frame [5]. Other contributions are focusing on multiphase lattice Boltzmann methods where the difference between numerical an physical interfaces is examined [6], the equilibrium contact angle for the Shan-Chen model is analyzed [7], new boundary conditions for capillary filling are developed [8] and novel multi-speed methods are employed to examine droplet collisions [9].

Recently several papers have focused on re-introducing fluctuations into a Boltzmann scheme and these methods are critically evaluated by Kaehler et al. [10]. Lastly Tsunematsu et al. [11] compares lattice Boltzmann and lattice Gas methods for a geologically relevant diffusion problem and find, bucking the recent trend towards lattice Boltzmann, that lattice Gas methods may be advantageous here.

Another contribution, which combines two methods, immersed boundary and lattice Boltzmann [12]. In a different approach, Succi et al. suggest to apply the lattice Boltzmann method, not to simulate the Navier Stokes equation, but instead to simulate many body quantum mechanics in a way analogous to the Car-Parinello ab initio molecular dynamics [13].

The remaining papers focus on applications of the lattice Boltzmann method. A direct application for lattice Boltzmann combined with immersed boundary methods can be found in the contribution by Murayama et al. where they examine drops encased in a viscoelastic membrane [14]. Inamuro et al. [15] consider rigid bodies suspended in a pipe flow and find interesting differences in the final distribution of particles, depending on their shape.

A considerable number of papers examine multi-phase phenomena. Foard et al. examine patterns found in the wake of an imposed phase-separation front [16] and Tanaka et al. [17] examine boiling phenomena. The Inamuro group examines two different phenomena in polymer electrolyte fuel cells [18, 19]. Liu et al. consider the formation of drops in a microfluidic device [20] while Zhang et al. [21] examine superhydrophobicity and the related phenomena of trapped gas and moving contact lines.

The dynamics of a reaction mediated by a catalytic surface is examined by De Prisco et al. [22]. Since the Boltzmann equation is also valid in the regime of rarefied flow, it has recently been applied to flows with finite Knudson number. In this issue there are two contributions examining hight Knudson number flows. The first examines a technical problem of examining Knudson effects on boundaries not aligned with the lattice [23] where as the second is an application of the method to microflows.

These papers give a flavor of the fundamental work still going on in developing extensions of the lattice Boltzmann method. We also saw a small selection of the wide variety of applications that are accessible to lattice Boltzmann method. All the papers in this special issue were peer-reviewed. We thank the referees for their diligent reviewing and support.

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