

# DSFD 2013

The 22nd Annual International Conference  
on the Discrete Simulation of Fluid Dynamics

Yerevan, Armenia, 15-19 July 2013

Version 1.4a, July 13, 2013



# Introduction

## History of the DSFD conferences

It is a pleasure to welcome you to Yerevan, Armenia, on the occasion of the 22nd annual conference on the Discrete Simulation of Fluid Dynamics – DSFD 2013. This conference began in Los Alamos in 1986, and subsequent DSFD conferences have been held in Torino (1988), Los Alamos (1989), Nice (1992), Toronto (1993), Princeton (1994), Boston (1996), Oxford (1998), Tokyo (1999), Santa Fe (2000), Cargese (2001), Shanghai (2002), Beirut (2003), Boston (2004), Kyoto (2005), Geneva (2006), Banff (2007), Florianópolis (2008), Beijing (2009), Rome (2010), Fargo (2011) and Bangalore (2012). Over the years, the DSFD conferences have emerged as the premiere forum for researchers in the field, and many exciting new discoveries in discrete models of fluid dynamics have been first announced at these conferences.

The purpose of the DSFD conferences is to stimulate research in and promote discrete algorithms for the simulation of fluid dynamics. This is not a new endeavor. It might well be argued that the Helmholtz-Kirchhoff point-vortex model, dating to the 1870s, was the first algorithm for describing an Euler fluid with a finite number of degrees of freedom.

The field received further impetus by the observation in the 1980s that the bulk behavior of a certain class of cellular automata, known as lattice gas automata, obeyed the Navier-Stokes equations. Lattice-gas models for multiphase and other complex fluids soon followed, and the utility of the approach expanded.

The lattice Boltzmann model was first formulated in the early 1980s as the Boltzmann equation describing lattice gases. While less grounded in microscopic physics than lattice gas models, the LB equation was far superior for the purposes of computational fluid dynamics (CFD). The utility of lattice gases for complex fluids was replicated in the LB equation, and the method has become one of the principal approaches to modern CFD.

In the meantime, progress was made on lattice-free discrete models, including discrete velocity methods (DVM), dissipative particle dynamics (DPD), smoothed-particle hydrodynamics (SPH), direct simulation Monte Carlo (DSMC), stochastic rotation dynamics (SRD), molecular dynamics (MD), and hybrid methods of all of the above.

DSFD conferences include sessions on advances in both theory and computation, on engineering applications of discrete fluid algorithms, and on fundamental issues in statistical mechanics, kinetic theory and hydrodynamics and their applications in Micro, Nano and Multiscale Physics for emerging technologies. Other topics of interest also include theoretical and experimental work on interfacial phenomena, droplets, free-surface flow, and micro and nanofluidics.

## **Organization**

DSFD 2013 is sponsored by the College of Engineering of the American University of Armenia. It will include invited talks, contributed talks and poster sessions. The schedule of talks follows.

### **Scientific Committee**

- Alexander Wagner (chair), North Dakota State University, USA
- Jens Harting, Technische Universiteit Eindhoven, the Netherlands
- Bastien Chopard, University of Geneva, Switzerland
- Ilia Karlin, Swiss Federal Institute of Technology, Switzerland
- Jean Pierre Boon, Université Libre de Bruxelles, Belgium
- Nicolai Brilliantov, University of Leicester, UK
- Paulo Cesar Philippi, Federal University of Santa Catarina, Brazil
- Paul Dellar, University of Oxford, UK
- Santosh Ansumali, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India
- Sauro Succi, CNR, Italy
- Shiyi Chen, Peking University, China & Johns Hopkins University, USA
- Takaji Inamuro, Kyoto University, Japan
- Xiaowen Shan, Exa Corporation, USA

### **Local Organizing Committee**

- Bruce M. Boghosian, President of the American University of Armenia
- Aram Hajian, Dean College of Science and Engineering, AUA
- Suren Khachatryan, Assistant Professor, Computer and Information Science, AUA
- Rubina Danilova, Conference Secretary

## Logistical Details

### Conference Location and Facilities

The opening session of the conference on Monday morning will be held in Manoogian Hall located on the first floor (above the ground floor) of Paramaz Avedisian Building (PAB) of AUA. All remaining sessions will be held in Room 208E located on the second floor of PAB. Coffee breaks will be held in the hallway outside Room 208E. There, you will also find the Conference Secretariat desk, where you can seek information or help as needed. For speaker preparation, please use room 207E. Lunches will be held in the main cafeteria, which is located on the second floor of the main building. You can find the ArtBridge Caf on the first floor of PAB, just outside of Manoogian Hall, and the ArtBridge bookstore in the mezzanine (half way up the stairs from the ground floor).

WiFi service is provided in both PAB and the Main Building of the University. The required login information is:

<b>Wifi information</b>	
Account name:	dsfdguest
Password:	dsfd2013

Use of the WiFi requires a setup of your computer. Please see the conference secretariat for help with this if you need it.

In order to save paper, tutorials and other conference information is provided using Google Docs. The required login information is:

<b>Google drive</b>	
URL:	<a href="http://drive.google.com">http://drive.google.com</a>
User:	dsfdguest@aua.am
Password:	dsfd2013

Again, please see the conference secretariat for help with this if you need it <sup>1</sup>.

### Presentation Time

This is a conference for specialists in the discrete simulation of fluids. As such, it is desirable to have plenty of time for discussion. For this reason, each contributed presentation will be limited to 20 minutes with 5 additional minutes for Q&A and discussion. Invited presentations will be limited to 30 minutes with 5 additional minutes of Q&A and discussion. Additional time is allocated at the end of each session for broader discussion about all presentations in the session. Session chairs are asked to strictly follow these time limits.

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<sup>1</sup>Note that only “Google Drive” service is enabled for the dsfdguest@aua.am account. Other services like Mail, Calendar, Sites, Groups and Contacts are disabled for this account.

## Brief History of AUA

On December 7, 1988, an earthquake measuring 6.9 on the Richter scale rolled through the former Soviet Republic of Armenia, killing 25,000 people and leaving another 500,000 homeless. The human tragedy and economic devastation shocked the world and opened the Republic to unprecedented international humanitarian and technical assistance. Many Western specialists in the field of earthquake engineering visited Armenia and interacted with their Armenian counterparts. It was during one such meeting in 1989 that the idea of an American-style technical university in Armenia was proposed by Dr. Yuri Sarkissian, then rector of the Yerevan Polytechnic Institute, to Dr. Armen Der Kiureghian, Professor of Civil Engineering at the University of California, Berkeley. Der Kiureghian pursued this idea and sought collaboration from his American-Armenian colleagues Dr. Mihran Agbabian of the University of Southern California and Dr. Stepan Karamardian of the University of California at Riverside. The team then approached the Armenian government and several organizations seeking support for the development of an American university in Armenia.

The American University of Armenia became a reality thanks to the steadfast support of the Armenian and United States governments and two major institutions in the United States: the Armenian General Benevolent Union (AGBU) and the University of California (UC). On the fourth floor of PAB, on the Founders Wall, you will find pictures of the Armenian and American individuals who played decisive roles in founding of the University.

AUA opened its doors as a university on September 21, 1991, the very same day that Armenia declared its independence from the Soviet Union. Its first graduating class held its 20th reunion just a few days before the DSFD meeting. Today, AUA provides masters degree programs in Business and Management, Quantitative Economics, Industrial Engineering & Systems Management, Computer & Information Science, Political Science & International Affairs, Public Health, Law, and Teaching English as a Foreign Language. Parallel to its academic programs, AUA has a number of active research centers, including the Engineering Research Center, the Turpanjian Center for Policy Analysis, the Acopian Center for the Environment, the Center for Health Services Research, the Legal Resource Center, and the Center for Research in Applied Linguistics. All instruction at AUA is in English.

In September of 2013, AUA will, for the first time, begin four-year undergraduate degree programs. These will be a BA in Business, a BS in Computational Sciences, and a BA in English & Communications. These will be the first American-accredited undergraduate degree programs in the FSU.

The American University of Armenia is accredited by the Accrediting Commission for Senior Colleges and Universities of the Western Association of Schools and Colleges (WASC), which is one of six agencies recognized by the US Department of Education for the accreditation of higher education. Furthermore, AUA has a special affiliation agreement with the University of California, approved by the UC Regents.

## Conference Program

All sessions are held in Paramaz Avedisian Building (PAB)

### Sunday 14 July

17:30-20:00          Registration and Reception (Akian Gallery)  
Musical renditions, **Lilit Pipoyan**

### Monday 15 July

8:30                    Registration  
9:00-9:20            **Opening Session** (Manoogian Hall)  
**Bruce Boghosian**, President, AUA  
**Aram Hajian**, Dean, College of Science and Engineering, AUA  
Representative of Scientific Committee

9:20-10:30          **Session I-A** (Manoogian Hall)  
**Jean Pierre Boon**, Session Chair  
**Xiaowen Shan**, Topics in kinetic theory (30 min.)  
**Eric Foard**, Thermo-hydrodynamics of vapor bubbles in sheared flow (20 min.)  
**Eric Lorenz**, Strong anisotropy in shear-induced RBC-enhanced platelet diffusion (20 min.)

10:30-11:00        **Coffee Break** (2nd Floor Hallway)

11:00-12:30        **Session I-B** (Manoogian Hall)  
**Xiaowen Shan**, Session Chair  
**Paulo Cesar Philippi**, Tutorial: Recent aspects and challenges in the LB description of immiscible flows in porous media (50 min.)  
**Florian Janoschek**, Accurate lubrication corrections for the simulation of suspensions of aspherical particles (20 min.)  
**Gary Davies**, Modelling colloidal particles in binary liquids (20 min.)

- 12:30-14:00      **Lunch** (Main cafeteria)
- 14:00-15:30      **Session I-C** (Manoogian Hall)  
**Santosh Ansumali**, Session Chair  
**Marisol Ripoll**, Induced flow fields in colloidal systems with temperature gradients (30 min.)  
**Giuseppe Gonella**, Aggregation properties of self-propelled dumbbells (20 min.)  
**Hamlet Badalyan**, Computer simulation of phase transition in isotropic fluid – lyotropic liquid crystal (20 min.)  
**Hesameddin Safari**, Numerical simulation of evaporating sessile droplet on a heated substrate with multiphase lattice Boltzmann method (20 min.)
- 15:30-16:00      **Coffee Break** (2nd Floor Hallway)
- 16:00-17:30      **Session I-D** (Manoogian Hall)  
**Ilya Karlin**, Session Chair  
**Jean Pierre Boon**, Generalized reaction-diffusion: A microscopic approach (30 min.)  
**Janez Perko**, Solution of advective-diffusive problems with large diffusion coefficient variations using lattice Boltzmann methods (20 min.)  
**Mohammad Hassan Rahimian**, Numerical Simulation of evaporation of a liquid drop moving on a hot surface by the lattice Boltzmann method (20 min.)  
Discussion of Monday sessions (20 min.)
- 19:00-21:00      **Cultural event** "Nuance" Ethno Jazz band at the MEZZO Classic House Club, with Garik Saribekyan (musician director). See the [web page](#) for details.

## Tuesday 16 July

- 9:00-10:20      **Session II-A** (Manoogian Hall)  
**Sauro Succi**, Session Chair  
**Aiguo Xu**, Lattice Boltzmann modeling of compressible fluids: non-equilibrium effects (30 min.)  
**Victor E. Ambrus**, Lattice Boltzmann models based on Gauss quadratures (20 min.)  
**Takaji Inamuro**, An improved lattice Boltzmann method for incompressible two-phase flows with large density differences (30 min.)
- 10:20-11:00      **Coffee Break** (2nd Floor Hallway)
- 11:00-12:30      **Session II-B** (Manoogian Hall)  
**Giacomo Falcucci**, Session Chair  
**Alexander Wagner**, Tutorial: Fluctuations in discrete-fluid simulations: Lattice gas to lattice Boltzmann (and back?) (50 min.)  
**Peter Tilke**, A multicore numerical framework for assessing the permeability of reservoir rocks (20 min.)  
**Philippe Seil**, Modelling lateral motion of finite-size buoyancy-free particles in shear flow (20 min.)
- 12:30-12:45      **Group photo** (Location to be announced)
- 12:45-14:00      **Lunch** (Main cafeteria)



- 14:00-15:30      **Session II-C** (Manoogian Hall)  
**Alexander Wagner**, Session Chair  
**Jens Harting**, Mesoscale simulations in microfluidics: Recent applications and open challenges (30 min.)  
**Alexandr Rassadin**, The transformation of nonlinear internal waves in three-dimensionally inhomogeneous ocean (20 min.)  
**Michal Januszewski**, Sailfish: Massively parallel LBM simulations with open-source software on GPUs (20 min.)  
**Stefano Ubertini**, Lattice Boltzmann simulation of hull slamming (20 min., to be presented by Giacomo Falcucci)
- 15:30-16:00      **Coffee Break** (2nd Floor Hallway)
- 16:00-17:40      **Session II-D** (Manoogian Hall)  
**Jens Harting**, Session Chair  
**Paul Dellar**, Tutorial: Quantum lattice Boltzmann models (50 min.)  
**Peter Love**, Quantum cellular automata and quantum lattice gases (30 min.)  
**Miller Mendoza Jimenez**, Fluid dynamics and wave propagation in manifolds using lattice Boltzmann (20 min.)
- 18:30-22:00      **Conference Banquet**

### Wednesday 17 July

- 9:00-10:30      **Session III-A** (Manoogian Hall)  
**Paul Dellar**, Session Chair  
**Bruce Boghosian**, The kinetics of wealth (30 min.)  
**Spencer Smith**, Topological classification of periodic solutions to the point-vortex model (30 min.)  
**Gianluca Caterina**, Can Hattori-Takesue cellular automata be used to simulate hydrodynamics? (30 min.)
- 10:30-11:00      **Coffee Break** (2nd Floor Hallway)

- 11:00-12:30      **Session III-B** (Manoogian Hall)  
**Peter Love**, Session Chair  
**Sauro Succi**, Tutorial: Relativistic lattice Boltzmann models (50 min.)  
**Ebrahim Jahanshahi Javaran**, Investigating rheological behavior of particulate suspensions using combined lattice Boltzmann, smoothed profile and Lees-Edwards boundary conditions (20 min.)  
**Kosuke Suzuki**, Free-flight simulations of a butterfly-like flapping wing by the immersed boundary lattice Boltzmann method (20 min.)
- 12:30-14:00      **Lunch** (Main cafeteria)
- 14:00-15:30      **Session III-C** (Manoogian Hall)  
**Gianluca Caterina**, Session Chair  
**Federico Toschi**, Dense suspensions of non-colloidal ellipsoids via lattice Boltzmann simulations (30 min.)  
**Lampros Mountrakis**, Shape memory and membrane fluctuations of an RBC in shear flow (20 min.)  
**Mohamad Zalzale**, A three-dimensional partial bounce-back method applied to cementitious materials (20 min.)  
**Simon Bogner**, Simulation of particles in free-surface flows with lattice Boltzmann (20 min.)
- 15:30-16:00      **Coffee Break** (2nd Floor Hallway)
- 16:00-17:30      **Session III-D** (Manoogian Hall)  
**Marisol Ripoll**, Session Chair  
**Santosh Ansumali**, Tutorial: The lattice Fokker-Planck method (50 min.)  
**Regina Ammer**, Validation experiments for LBM simulations of electron beam melting (20 min.)  
**Sebastian Schmieschek**, Application of a hybrid simulation model for mixtures of rarefied gases (20 min.)

18:30-22:00      **Cultural event** Talalyan Brothers 5th Annual Festival Evening with Tigran Mansuryan (Tigran Mansurian, piano; Julietta Vardanyan, piano; Irina Zakyan, soprano; Yana Daryan, viola; Nelly Manukyan, flute; Hovhannes Mokatsian, violin; Aram Talalyan, cello)

## Thursday 18 July

9:00-10:30      **Session IV-A** (Manoogian Hall)  
**Paulo Cesar Philippi**, Session Chair  
**Giacomo Falcucci**, Lattice Boltzmann pseudo potential approach for the investigation of cavitation phenomena (30 min.)  
**Victor K. Ohanyan**, Pattern recognition by covariogram (20 min.)  
**Boris Nahapetyan**, The solution of Dobrushin's problem, and a new point of view on the theory of Gibbs random fields (20 min.)  
**Linda Khachatryan**, Martingale method in the theory of limit theorems for Gibbs random fields (20 min.)

10:30-11:00      **Coffee Break** (2nd Floor Hallway)

11:00-12:30      **Session IV-B** (Manoogian Hall)  
**Takaji Inamuro**, Session Chair  
**Ilya Karlin**, Tutorial: Turbulence and entropic lattice Boltzmann methods (50 min.)  
**Kevin Stratford**, Rare events driven by fluctuating hydrodynamics (20 min.)  
**Zheng Ran**, Lattice Boltzmann models based on Gauss quadratures (20 min.)

12:30-13:00      **Poster Sessions** (Lobby outside Manoogian Auditorium)  
These will be on display continuously after Monday, but this allows some special time to examine the posters.

13:00-14:00      **Lunch** (Main cafeteria)

14:00-19:00      **Visit to Tsitsernakaberd (Armenian Genocide Memorial and Museum), Cafesjian Center for the Arts, and Garni Temple and Geghart Monastery**  
Bus will leave from AUA right after lunch. Bring a hat for protection from the sun. The temple and monastery are located about 45 minutes outside the city in a spectacular mountain setting, with basalt columns, ancient ceramics, rooms carved into solid stone mountains, etc.

### Friday 19 July

9:00-10:30      **Session V-A** (Manoogian Hall)  
**Ali Najafi**, Session Chair  
**Reza Ejtehad**i, Contribution of hydrodynamic interactions in dynamics of the polyelectrolytes in non-uniform electric fields (30 min.)  
**Debanik Bhattacharjee**, Recent developments in Lattice Boltzmann methods: A survey (20 min.)  
**François Dubois**, Simulation of strong nonlinear waves with vectorial lattice Boltzmann schemes (20 min.)  
**Changho Kim**, Time correlation functions of Brownian motion in the near-Brownian-limit regime and evaluation of friction coefficient (20 min.)

10:30-11:00      **Coffee Break** (2nd Floor Hallway)

11:00-12:30      **Session V-B** (Manoogian Hall)  
**Reza Ejtehad**i, Session Chair  
**Ali Najafi**, Directed navigation at low Reynolds condition (30 min.)  
**Mohammad Hassan Rahimian**, Thermal behavior of a two-dimensional droplet within the porous media (20 min.)  
Discussion of morning session (40 min.)

- 12:30-13:00      **Poster Sessions** (Lobby outside Manoogian Auditorium)  
These will be on display continuously after Monday, but this allows some special time to examine the posters.
- 13:00-14:00      **Lunch** (Main cafeteria)
- 14:00-19:00      **Visit to Etchmiadzin, and Khor Virap Monastery**  
Bus will leave from AUA right after lunch. Bring a hat for protection from the sun. Etchmiadzin is about 30 minutes from Yerevan, and Khor Virap is an hour away.

## Notes



