

TIME TABLE

TIME	Monday July 9	Tuesday July 10	Wednesday July 11	Thursday July 12	Friday July 13
9.00 - 9.45	Registration	Natalini	Carillo	Carillo	Tosin
9.45 - 10.30	Doering	Natalini	Carillo	Carillo	Tosin
11.00 - 11.45	Doering	Maury	Tosin	Tosin	Muntean
11.45 - 12.30	Maury	Maury	Tosin	Tosin	Muntean/Cirillo
14.00 - 14.45	Maury	Doering	Carillo	Carillo	
14.45 - 15.30	Natalini	Doering	Carillo	Carillo/Vecil	
16.00 - 16.45	Natalini	Maury	Doering	Tosin	
16.45 - 17.30	Muntean	Maury	Doering	Tosin	
17.30 - 18.30	Poster Session	Poster Session	Muntean	Doering	

ADMISSION AND ACCOMMODATION

Applicants must contact CISM Secretariat at least one month before the beginning of the course. Application forms should be sent on-line through our web site: <http://www.cism.it> or by post.

A message of confirmation will be sent to accepted participants. If you need assistance for registration please contact our secretariat.

The 700,00 Euro registration fee includes a complimentary bag, four fixed menu buffet lunches (Friday not included), hot beverages, on-line/downloadable lecture notes and wi-fi internet access.

A limited number of participants from universities and research centres who are not supported by their own institutions can be offered board and/or lodging in a reasonably priced hotel. Requests should be sent to CISM Secretariat by **May 9, 2012** along with the applicant's curriculum and a letter of recommendation by the head of the department or a supervisor confirming that the institute cannot provide funding. Preference will be given to applicants from countries that sponsor CISM.

Information about travel and accommodation is available on our web site, or can be mailed upon request.

For further information please contact:

CISM
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 Piazza Garibaldi 18
 33100 Udine (Italy)
 tel. +39 0432 248511 (6 lines)
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 e-mail: cism@cism.it

Centre International des Sciences Mécaniques
 International Centre for Mechanical Sciences

ACADEMIC YEAR 2012
 The Cercignani Session



ANALYSIS, MODELLING AND SIMULATION OF COLLECTIVE DYNAMICS FROM BACTERIA TO CROWDS

Advanced School
 coordinated by

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 Eindhoven University of Technology
 The Netherlands

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 Eindhoven University of Technology
 The Netherlands

Udine, July 9 - 13, 2012

ANALYSIS, MODELLING AND SIMULATION OF COLLECTIVE DYNAMICS FROM BACTERIA TO CROWDS

The collective motion of individuals (correlated motion of ants or migration of bacteria, flocks of birds, just to mention but a few) is a fascinating phenomenon capturing our attention. Besides the aesthetic aspects induced by such an expression of collective behavior, there are many crucial aspects of practical nature that attracted the interest of various scientific communities ranging from logistics, theoretical biology, and ecology to statistical physics and mathematics. On one hand, we wish to better understand, for instance, the formation of swimming patterns in large communities of fish to improve large scale fishing strategies. On the other hand, in congested flows, pedestrians display significantly different behaviors from those typical to situations when they are walking in free conditions. If panic situations occur, then small microscopic (individual-level) interactions can lead to disastrous macroscopic patterns (e.g. shock-like waves) leading to the jamming of a desired evacuation option or even to losses of human lives.

The aim of this school is to present, by means of 6 mini-courses, the state-of-the-art of the theoretical (statistical mechanics and mathematics) understanding of collective motions of crowds. The topics we include here are:

- Kinetic models for self-organized collective motion.
- Discrete and continuum dynamics of reacting and interacting individuals.
- Finite-speed propagation models of chemo-tactic movements.
- Modeling with measures:
 - (i) Multiscale modeling of pedestrian motions by time-evolving measures;
 - (ii) Motions and interactions in heterogeneous domains.
- Handling contacts in pedestrian dynamics: On the concept of pressure.

Multiscale models in social (networks) applications, eventually combining mean-field and kinetic equations with either microscopic or macroscopic objects, are

approaches of strongly increasing importance and high potential for future quantitative research. Typically, individual-based models need to be intelligently coarse-grained to translate the relevant microstructure information to a mesoscopic (Boltzmann-level) or to a macroscopic (continuum) level.

Relevant questions include: What is the natural scaling for the averaging? How much microstructure information needs to be kept to capture the specific individual-level interaction responsible for the formation and propagation of the macroscopically-observed pattern (for instance, lane formation in pedestrian counterflow). What are the main microscopic interactions responsible for the macroscopic cross-diffusion transport mechanism sometimes arising in pedestrian's motion?

Within the frame of this school, we emphasize on one hand the role played by measure theory in deriving averaged equations, while

on the other hand we show how measure theory can be used to prove rigorously the mean-field derivation of chemo-tactic movements, e.g. Numerical simulations of generic collective motions as well as experimental findings and simulations of pedestrian flows hosting macroscopic patterns will be pointed out.

The target audience of this summer school are graduate students, PhD candidates and young faculty members in mathematics, applied theoretical physics and biology, as well as (chemical, transportation, mechanical, ...) engineering having a strong research interest in understanding the multiscale complexity of the collective motion behavior. The participants are expected to have a good mathematical background. We hope that everybody will be willing to actively participate in both discussion and poster sessions.

INVITED LECTURERS

José Antonio Carrillo de la Plata - Universitat Autònoma de Barcelona, Bellaterra, Spain
8 lectures on:
Kinetic models for self-organized collective motion.

Charles R. Doering - University of Michigan, MI, USA
7 lectures on:
Discrete and continuum dynamics of reacting and interacting individuals.

Adrian Muntean - Eindhoven University of Technology, The Netherlands
4 lectures on:
Modeling with measures: Capturing collective behaviors in heterogeneous domains.

Andrea Tosin - IAC-CNR, Università di Roma "Tor Vergata", Italy
8 lectures on:
Multiscale modeling of pedestrian motions by time-evolving measures.

Bertrand Maury - Université Paris Sud, France
6 lectures on:
Handling congestion in population dynamics.

Roberto Natalini - IAC-CNR, Università di Roma "Tor Vergata", Italy
4 lectures on:
Finite speed propagation models of chemotactic movements.

PRELIMINARY SUGGESTED READINGS

B. Perthame: Transport Equations in Biology. Frontiers in Mathematics. Birkhäuser Verlag, Basel, 2007.

J.A. Carrillo, M. Fornasier, G. Toscani, F. Vecil, Particle, Kinetic, and Hydrodynamic Models of Swarming, in Naldi, G., Pareschi, L., Toscani, G.(eds.) Mathematical Modeling of Collective Behavior in Socio-Economic and Life Sciences, Series: Modelling and Simulation in Science and Technology, Birkhauser, (2010), 297--336.

Ch. Doering: Modeling complex systems: Stochastic processes, stochastic differential equations, and Fokker-Planck equations, in 1990 Lectures in Complex Systems, Santa Fé Institute Studies in the Sciences of Complexity, Lect. Vol. III, Eds. L. Nadel and D. Stein, Addison-Wesley, 1991.

Ch. Doering, C. Mueller, P. Smereka: Interacting particles, the stochastic Fisher-Kolmogorov-Petrovsky-Piscounov equation, and duality. Physica A 325 (2003), 243-259.

B. Piccoli, A. Tosin: Time-evolving measures and macroscopic modeling of pedestrian flow, ARMA 199 (2011), 707-738.

LECTURES

All lectures will be given in English. Lecture notes can be downloaded from CISM web site, instructions will be sent to accepted participants.

**ANALYSIS, MODELLING AND SIMULATION OF COLLECTIVE
DYNAMICS FROM BACTERIA TO CROWDS**

Udine, July 9 - 13, 2012

Application Form

(Please print or type)

Surname _____

Name _____

Affiliation _____

Address _____

E-mail _____

Phone _____ Fax _____

Method of payment upon receipt of confirmation (Please check the box)

The fee of Euro 700,00 includes IVA/VAT tax and excludes bank charges

I shall send a check of Euro _____

Payment will be made to CISM - Bank Account N° 094570210900,
VENETO BANCA - Udine (CAB 12300 - ABI 05035 - SWIFT/BIC VEBHIT2M -
IBAN CODE IT46 N 05035 12300 09457 0210900).
Copy of the receipt should be sent to the secretariat

I shall pay at the registration counter with check, cash or VISA
Credit Card (Mastercard/Eurocard, Visa, CartaSi)

**IMPORTANT: CISM is obliged to present an invoice for the above sum. Please
indicate to whom the invoice should be addressed.**

Name _____

Address _____

C.F.* _____

VAT/IVA* No. _____

(*) Only for EU residents or foreigners with a permanent business activity in Italy.

Only for Italian Public Companies

I ask for IVA exemption (ex law n. 537/1993 - art. 14 comma 10).

Privacy policy: I understand that data received via this form will be used only to provide
information about CISM and its activities, within the limits set by the Italian legislative
decree no. 196/2003 and subsequent amendments.

Complete information on CISM's privacy policy is available at [http://www.cism.it/courses/
privacy_statement/](http://www.cism.it/courses/privacy_statement/)

I have read the "Admission and Accommodation" terms and conditions and agree.

Date _____ Signature _____