

Workshop, **November, 29th**

***“Mathematical Methods for Multiscale Description in the Applied Sciences”***

14:15 - 15:00 Andrea Tosin,  
15:00 - 15:45 Massimiliano Rosini  
15:45 - 16:15 *Coffee break*  
16:15 - 17:00 Jacek Banasiak  
17:00 - 17:45 Adam Bobrowski  
17:45 - 18:00 *Coffee break*  
18:00 - 18:15 Grzegorz Jamroz  
18:15 - 18:30 Jędrzej Jablonski  
18:30 - 18:45 Jan Poleszczuk  
18:45 - 19:00 Dorota Kepa

Organizers: Zuzanna Szymanska i Mirosław Lachowicz

Faculty MIM UW, ul. Banacha 2, room 4790 (or alternatively 2180)

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**Andrea Tosin**, Department of Mathematics, Politecnico di Torino,

***“A multiscale look at collective behaviors by time-evolving measures”***:

In this talk I present an approach, stemming from measure and optimal transport theory, for modeling the collective behavior of crowds and swarms under a multiscale viewpoint. The discrete granularity of the agents is incorporated in the continuous flow of the group by means of mass measures featuring a singular and an absolutely continuous part. This way a dynamics coupling the microscopic and the macroscopic scale is obtained, ruled by the continuity equation. I will discuss modeling, analytical, and computational issues.

**Massimiliano D. Rosini**, Interdisciplinary Center for Mathematical and Computational Modelling, University of Warsaw

***“Macroscopic models for pedestrian and vehicular traffic”***

In this talk we present macroscopic models for pedestrian and vehicular traffic flows. We address to both their theoretical and numerical aspects. Finally, we also state and solve related optimal management problems.

**Jacek Banasiak**, School of Mathematical Sciences, University of KwaZulu-Natal, Durban

***“Classical solutions for discrete fragmentation-coagulation equations with unbounded coagulation kernels”***:

So far equations with unbounded coagulation kernels have been considered within the framework of weak solutions. Recently we have proved several results on analyticity of linear fragmentation semigroups and identification of their generators which allow to prove the existence of classical differentiable global in time solutions for problems with coagulation kernels having almost linear growth.

**Adam Bobrowski**, Lublin Technical University

***“A singular perturbation involving boundary conditions”***:

We show that 2004 Aristizabal and Glavinovic's ODE model of synaptic depression may be obtained as a singular perturbation of the recent PDE model of Bielecki and Kalita. The main

role in the passage from one model to the other is played by boundary and transmission conditions.

**Grzegorz Jamroz**, University of Warsaw, Faculty of MIM,  
*“Unification of discrete and continuous cellular dynamics”*:

We show how the discrete and continuous descriptions of cellular dynamics can be in an elegant way unified in the framework of transport equation and its measure-transmission solutions. We discuss analytical problems stemming from the fact that the natural space for solutions is the space of Radon measures.

**Jedrzej Jablonski**, University of Warsaw, Faculty of MIM  
*“Size-structured population model with discontinuous growth rate”*:

Modeling dynamics of copepod population with McKendrick equation requires admitting discontinuous growth rate. Basic problems (such as existence of the solutions, uniqueness, regularity, and finding stable numerical scheme) will be discussed.

**Jan Poleszczuk**, University of Warsaw, Faculty of MIM  
*“Stochastic models of gene expression with delayed degradation”*:

It is a challenge to develop a systematic and rigorous treatment of stochastic dynamics with time delays and to investigate combined effects of stochasticity and delays in concrete models. We propose a new methodology to deal with time delays in biological systems and apply it to simple models of gene expression with delayed degradation. We show that time delay of protein degradation does not cause oscillations as it was recently argued.

**Dorota Kepa**, Lublin MCS University  
*“Coarse-graining and almost sure uniqueness of Gibbs fields on graphs”*:

There is considered a countable graph each vertex of which is given a Polish space, whereas its edges bear continuous functions (potentials) of two variables taking values in the spaces of vertices incident to the edge. Under certain conditions, these objects define a family of Gibbs random fields on the product space. One of the main questions herein is the uniqueness of such fields which often occurs if the potentials are small -- if all of them equal zero there exists only one Gibbs field. The problem gets much more complicated if the potentials are random and unbounded. We consider exactly such a case assuming that the probability distribution of the potentials satisfies a certain condition. By means of a “coarse graining” technique we prove the almost sure uniqueness of Gibbs fields in this case. The key idea of the technique is to pass to the graph the vertices of which are certain subgraphs of the initial graph (we call them  $\psi$ -animals), whereas the edges bear only “small” potentials.