



ABCDE



Scientific Report

First name / Family name

Tatiana Ryabukha

Nationality

Ukrainian

Name of the *Host Organisation*

PLERCIM

First Name / family name
of the *Scientific Coordinator*

Mirosław Lachowicz

Period of the fellowship

01/04/2011 to 31/03/2012



I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

I have been affiliated with the Institute of Applied Mathematics and Mechanics of the Faculty of Mathematics, Informatics and Mechanics, at University of Warsaw. Since 2007 the Faculty with almost 250 members and PhD students is a full member of the European Research Consortium for Informatics and Mathematics (ERCIM). The Institute of Applied Mathematics is headed by Professor Mirosław Lachowicz. The biomathematical team headed by Professor Jacek Miekisz is involved in mathematical description of various biological processes and the analysis of mathematical models (ODEs, PDEs, delay equations, integro-differential equations, Markov processes, difference equations) arising in mathematical biology. Before coming to the University of Warsaw, my research interest was concerned with the mathematical methods in statistical mechanics. I have mainly focused on analytical methods for investigation of classical statistical mechanics systems. The study of collective dynamics aims at developing techniques and applying methods and tools of classical non-equilibrium statistical mechanics in order to provide a conceptual framework for various biological, medical and physical phenomena. In particular, appropriate approaches and techniques were applied for the study of population dynamics. In collaboration with Professor Lachowicz I have started research of the complex biological systems in the different levels of description, namely microscopic (individually-based) (Mi), mesoscopic (Me), and macroscopic one. The stationary problem for modified Liouville equation describing the general population dynamics was investigated. In collaboration with Dr. Mariusz Baryło we have written a draft paper deriving the stochastic Liouville Equation with the initial results. After elaboration and more calculation we will disseminate it. Although almost all are mature enough for the objectives we set they are still open to extensions, thus offering basis for future collaborations between me and the group. In addition, there are other directions for further collaborations in related fields which require gained expertise in PDE and functional analysis, such as study of the Cauchy and Stationary Problems for known systems of nonlinear equations in biomathematics, and in general application of developed methods in Ecology, Immunology and cancer research. Besides, the hierarchy of equations in itself and analysis of correlations are still active research area especially for biology systems.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

Title. Equilibrium solutions for Microscopic and Mesoscopic Stochastic Systems in Population Dynamics

Authors. Lachowicz M., and Ryabukha T.

Status. Prepared

Abstract. The paper deals with the problem of existence of equilibrium solutions of equations describing the general population dynamics at the microscopic level of modified Liouville equation (individually based model) corresponding to a Markov jump process. We show the existence of factorized equilibrium solutions and discussed uniqueness. The conditions guaranteeing uniqueness or non-uniqueness are proposed under the assumption of periodic structures.



Title. The Liouville Equation for Stochastic Particle System

Authors. Barylo M., and Ryabukha T.

Status. In preparation

Abstract. The paper studies dynamics of a system of particles interacting through a some kind of smooth repulsive potential. Stochastic perturbation of position and momentum of each particle is provided to the Hamiltonian equations. The modified by the stochastic perturbation Liouville equation is derived as a stochastic equation.

Title. Description of Complex Biological Systems

Author. Ryabukha T.

Status. Published in Book Abstr. Marie Curie Researchers Symposium, Warsaw, 2011. - P. 273

Title. On functionals for mean values of observables in scaling limits

Author. Ryabukha T.

Status. Published in Book Abstr. Int. Conference Stat. Physics, Larnaca, 2011. - P. 139

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

I attended following two seminars at the Faculty of Mathematics, Informatics and Mechanics:

Weekly Seminarium in Biomathematics and the Game Theory: Scientific meeting where department members present their own research and results in turn. I gave three presentations.

Occasionally Seminarium in Numerical Biology and Bioinformatics.

In addition, I attended following conferences and workshops:

Workshop "Biologically inspired mathematics", organized by the Department of Mathematics of Lublin University of Technology in cooperation with Institute of Mathematics of Maria Curie-Skłodowska University in Lublin. It was held in Dom Pracy Twórczej PL, Kazimierz Dolny (Poland), April 28, 2011.

The European Future Technologies Conference and Exhibition fet11, Budapest (Hungary), May 4-6, 2011 (with a talk)

XVII National Conference "Application of Mathematics to Biology and Medicine", Kościelisko-Zakopane (Poland), September 1-6, 2011

8th European Conference on Mathematical and Theoretical Biology - ECMTB 2011, [Kraków \(Poland\), June 28 - July 2, 2011](#)



Marie Curie Researchers Symposium "SCIENCE – Passion, Mission, Responsibilities",
Warsaw (Poland), September 25-27, 2011

3rd summer school of the Large Scale Initiative "FUSION", organized by the INRIA and
was held at UPMC, Paris (France), September 26-30, 2011

IV – RESEARCH EXCHANGE PROGRAMME (REP)

In the framework of the Exchange Research Programme I have visited two ERCIM
organisations:

INRIA (French National Institute for Research in Computer Science and Control)
Domaine de Voluceau-Rocquencourt
B.P. 105
8153 Le Chesnay Cedex
France

Contact Person:

Professor Dirk Dresdo

Tél. +33 1 39 63 5036

Fax +33 1 39 63 5882

Email: dirk.drasdo@inria.fr

<http://www-rocq.inria.fr/bang/DD/drasdo.html>

Duration: September 26 – October 6, 2011

CWI

P.O. Box 94079

1090 GB Amsterdam

the Netherlands

Contact Person: Professor Jason Frank

office: Science Park 123, 1098 XG Amsterdam

room: L116

tel: +31 20 5924096

fax: +31 20 5924199

e-mail: Jason@cw.nl

<http://homepages.cwi.nl/~jason/>

Duration: February 16-22, 2012