Scientific Report

First name / Family name
Martin PARISOT

Nationality
French

Name of the Host Organisation
University of Warsaw

First Name / family name of the Scientific Coordinator
Miroslaw LACHOWICZ

Period of the fellowship
01/01/2013 to 31/12/2013
I - SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

My scientific activity during the fellowship was divided into two subjects:

- In collaboration with Dr Zuzanna Szymanska from ICM (Interdisciplinary Center for Mathematical and Computational Modeling) and Pr Miroslaw Lachowicz from University of Warsaw, we work on the mathematical modeling of the intracellular protein dynamics. The main objective of this work was to explain without non-biological assumption the oscillatory behavior in the intracellular concentration of some proteins. We based our arguments on the elaboration of a new modeling of active transport along microtubules. The fine modeling of intracellular pathway is an efficient tool to understand the initial dysfunction in cancer progression, and to develop more effective therapeutic protocols.

- In collaboration with Pr Miroslaw Lachowicz from University of Warsaw, we develop a new model of the formation and destruction of swarms using a nonlinear Boltzman-like equation. We show that the nonlinear coefficient characterized the attractiveness of repulsiveness of individuals on their fellows, which allowed to represent gregarious and solitariouss behaviors. In the case of solitarioous behavior, we provide a mathematical analysis in the space homogeneous framework and we identify relevant hydrodynamic regimes on the formal way. We introduce some preliminary result in the case of gregarious behavior and we indicate open problems for further research. Finally, we perform numerical simulations to illustrate the ability of the model to represent formation or destruction of swarms.

II - PUBLICATION(S) DURING YOUR FELLOWSHIP

Two publications was realized during the fellowship:

- Lachowicz M., Parisot M. and Szymanska Z.,
  Mathematical modeling of the intracellular protein dynamics : the importance of active transport, submitted an international journal.

- Lachowicz M. and Parisot M.,
  A Kinetic Model for the formation of Swarm with nonlinear interactions, submitted an international journal.

III - ATTENDED SEMINARS, WORKSHOPS, CONFERENCES

Participation to the conference "Mathematics, Mechanics and modeling, a tribute to Zbigniew Peradzynski" joint with the 13th conference of Mathematics in Technical and Natural Sciences in Bedlewo. The first topic of the fellowship (intracellular dynamics) was presented.

IV - RESEARCH EXCHANGE PROGRAMME (REP)
Period: June, 3rd to 7th
Contact: Prof Frank Jason - J.E.Frank@cwi.nl - http://homepages.cwi.nl/ jason/
Institute: CWI - http://www.cwi.nl/
Program: The first two days was dedicated to the presentation of my scientific realisations and the main topic of the team of prof Frank Jason. Then we discussed about an adaptive multi-layers numerical scheme for hydrostatic flows. The objective of this work is to develop a numerical strategy able to adapt locally the number of layers. The applications will be coupling of shallow water models, transport of sediments, fluid-structure interactions.

Visit: November, 18th to 22th
Contact: Prof Talal Rahman - Talal.Rahman@hib.no - http://home.hib.no/ansatte/tra/
Program: During the first half of the week, I exchanged with professor Talal Rahman about multi-scale problem and its application to the shallow-water model with microtopography. The main objective of this project is to adapt the shallow-water model to the be able to represent locally very small variation of topology, i.e. under the scale of the general mesh size. This kind of issue is largely study in context of porous media and numerical multi-scale resolutions are currently proposed. The application concern flood plain flows. During the second part of the week, I exchanged with professor Henrik Kalisch about modeling of free surface flows and more particularly about undular bores. The main objective is the discussion was about the derivation and the advantages of a multi-layers version of the Boussinesq equations.

Signatures
Fellow: Martin PARISOT
Scientific Coordinator: Miroslaw LACHOWICZ