

## SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

**Action number: CA16227 – Investigation and Mathematical Analysis of Avant-garde Disease Control via Mosquito Nano-Tech-Repellents**

**STSM title: Mathematical Analysis and Modelling – Dynamical Systems and Applications**

**STSM start and end date: 04/09/2018 to 15/09/2018**

**Grantee name: Tatjana Atanasova - Pachemska**

### PURPOSE OF THE STSM/

In the framework of this STSM visit, we dealt with mathematical modelling of financial markets and adaptation of this modelling in dynamical systems in biology. A variety of stochastic models are used in modelling the security of prices. Finding a good balance between a realistic and tradeable model is a part of the art of stochastic modelling and it was a subject of this STSM. We considered both discrete (in time and state) and continuous models.

I must also note that the types of models we are going to develop are not used only in the financial world, because examples of significant random fluctuation can be found in: biology (differential equations representing the interaction of predators and prey); engineering (they analyse problems with random inputs as a truck traveling over the essentially random bumps in the road), and other fields of science. This is motivation to split two research fields and comparing models...

### DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

The common part of the STSM ( prof. Djorgjevic and me) was gathering information about the present situation in the field, summarizing this and defining the exact problems to be solved. Some of the established problems will be solved in a team formed from researchers from different partner countries and modelling will be done jointly...During the researching process appropriate computer software for calculation, simulation and programming are used.

All the gained results will be prepared for publishing in international journals and presented in an international scientific meetings in the next period.

It is anticipated that papers on the above-mentioned topics will be submitted and most of them accepted for publication in well-known mathematical journals by the end of the CA16227. It is also intended that the main results will be presented at important international conferences during and following the CA16227.

The basic researching in the proposed STSM are from the field of mathematical sciences, so it has a fundamental nature. The results of this collaboration are expected to be high applicable, so they will give big contribution in the practice, too, in the applied mathematics, mathematical modelling and optimization. Benefits for the partner countries will be dominantly scientific, although after finishing the CA16227 subsequent applications with direct economical benefits can be expected and, what is the greatest importance, it will strengthen the links between the partner countries.

#### **DESCRIPTION OF THE MAIN RESULTS OBTAINED**

Main results of my STSM stay were simulations of different models (epidemic, in biology and chemistry, even in connection with finance models). Obtained results are concrete algorithms and images of simulations for different groups of models done in mathematical packet Matlab. As an illustration, we have obtained a spread of images which present simulations of the models (ours and from different authors) for different initial values. Also, a discussion about different types of optimal control for medicine, biology and chemistry has led us in new field of simulations which we have incorporated in existing ones, and obtain a new simulation algorithms which we plan to incorporate in our future work.

The main research theme is very relevant in the context of the COST Action CA16227. Indeed we have discussed a stochastic SICA epidemic model for HIV transmission, but when the coefficients of the model are dependent of the time parameter. We have made a draft of the paper, by constructing a model which consists from 4 equations (two stochastic and two ordinary differential one) where one of the equations is describing susceptible individuals, while, the other three are describing the infected individuals with infectiousness is on different stages. An intention is to prove existence and uniqueness of the solution of this

model, some properties and to do an numerical illustrations. The goal is to present the paper on some future conference or maybe even on some of the next CA events.

**FUTURE COLLABORATIONS (if applicable)**

Our aim is to collaborate in the future on several fields. First, to continue scientific research together and with our colleagues to obtain a model for bacteria desists (epidemic, stochastic model...), and write a paper which would obtain, theoretical set up of the model, optimal control tool and at the end, numerical illustrations and simulations.

We would like to obtain a collaboration in the teaching field, because we can supplement our programs, we could deal some courses from the application of mathematics which I hold on my department, particularly from the field of financial modelling and probability theory.

I find that this visit was very successful not only scientifically, but also, for the establishment of possible collaboration at the field of education.

Thank you very much for supporting my STSM stay.