

In-House Seminar on Advances in Applied Analysis and Computational Science

Room 209, Building C4, Faculty of Mathematics and Physics Institute of Science and Engineering,
Kanazawa University, Kakuma Campus

July 10, 2023, Monday, 13:00 - 14:30

13:00 - 13:05	Opening
13:05 - 13:20	Lenka Horvátová , Faculty of Nuclear Sciences and Physical Engineering, CTU in Prague
Title. Mathematical modeling of contrast agent transport and transfer in myocardial perfusion problems Abstract. This work deals with mathematical modeling of problems arising during myocardial perfusion using the contrast agent. The transfer of the contrast agent from the vascular system to the extravascular system is modeled using convolution with the Dirac delta function. We consider an incompressible Newtonian fluid that is not subject to any external forces. The extravascular environment is considered to be porous and rigid. The main goal of this project is to solve the problem of transport and transfer of contrast agent in the vascular system using the finite volume method, and in the extravascular medium using the finite difference method.	
13:20 - 13:35	Tomáš Hrdina , Faculty of Nuclear Sciences and Physical Engineering, CTU in Prague
Title. Spectrum of the discrete bilaplace operator with a complex potential Abstract. We study the spectrum of the discrete bilaplace operator on $l^2(\mathbb{Z})$ perturbed by a complex potential generated by a sequence $v \in l^1(\mathbb{Z})$. We will find so called spectral enclosures using the Birman-Schwinger principle and we will show that they are optimal. Moreover, we will discuss the possibility of proving the absence of eigenvalues of the perturbed operator in the interval $(0, 16)$, which is a subset of the essential spectrum of the unperturbed bilaplace operator.	
13:35 - 13:50	Bořivoj Kronowetter , Faculty of Nuclear Sciences and Physical Engineering, CTU in Prague
Title. Optimization methods based on lattice Boltzmann method Abstract. The aim of this work is to derive a method for the reconstruction of blood flow according to data obtained from magnetic resonance imaging. As a first step, a simplified problem is solved, in which the blood flow is simulated using the lattice Boltzmann method and the data from this simulation are saved. We then try to reconstruct the control parameters from the stored data using the adjoint method. Several optimization problems are going to be introduced. The acceleration caused by the external force field and the inlet velocity profile were chosen as the control parameters in these problems. Both the discrete adjoint approach and the continuous adjoint approach are going to be presented. In the last part, numerical results of these approaches are compared.	
13:50 - 14:05	Dominik Horák , Faculty of Nuclear Sciences and Physical Engineering, CTU in Prague
Title. Numerical model of non-isothermal flow around obstacles based on the lattice Boltzmann method Abstract. The work deals with the mathematical modeling of non-isothermal flow of incompressible Newtonian fluids. The aim of the work is to implement and describe heat transfer in a 3D numerical model. In the theoretical part, the mathematical model of non-isothermal flow of Newtonian fluids is presented together with a basic description of the cooling circuit of a student formula car. In the second part, the reader is introduced to the lattice Boltzmann method (LBM), and the last part discusses the results of the application of LBM with implemented heat transfer to the mathematical model. The implementation of heat transfer was successful, and the method produces satisfactory results.	
14:05 - 14:20	Dominik Žurek , Faculty of Nuclear Sciences and Physical Engineering, CTU in Prague
Title. Dynamics of signal propagation in excitable media Abstract. Mathematical models in electrocardiology are a tool that could reduce the large number of victims of cardiovascular diseases in the future. These models are represented by a system of reaction-diffusion equations to which this work is devoted. At the beginning, the basics of physiology are summarized and models describing signal propagation in the environment of the heart muscle are described. This is followed by the formulation of the nonlinear problem in 1D and on the curve. The final part is devoted to the numerical solution of the FitzHugh-Nagumo model using the explicit finite difference method and the method of lines.	
14:25 - 14:30	Closing