Departments of Software Engineering and Mathematics
FNSPE CTU in Prague, Czech Republic

Workshop on scientific computing 2025

May 29 - May 31, 2025. Děčín.

Conference Information

The international scientific colloquium is organized by the Faculty of Nuclear Sciences and Physical Engineering of the Czech Technical University in Prague on annual basis. It is devoted to the meeting of students and young applied mathematicians dealing with numerical solution of partial differential equations, mathematical modelling, numerical simulation of problems in technology, environment, biology and computer science.

Organizers

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Conference office

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Organizing committee

K. Horaisová, M. Beneš, R. Fučík, P. Eichler

Additional information

URL: `http://geraldine.fjfi.cvut.cz/wsc-2025`
Venue: Faculty of Nuclear Sciences and Physical Engineering,
Pohraniční 1288/1, 405 02 Děčín
and MS Teams online

Acknowledgement

This workshop was supported by the Grant Agency of the Czech Technical University in Prague, grant No. SVK 44/25/F4.

List of Participants

The list of all participants in alphabetical order.

Name	University / Institute	
Filip Bartoš	FNSPE, CTU in Prague	Student
Michal Beneš	FNSPE, CTU in Prague	
Štěpán Bezděk	FNSPE, CTU in Prague	Student, Poster
Kryštof Blažek	FNSPE, CTU in Prague	Student
Pavel Eichler	FNSPE, CTU in Prague	
Radek Fučík	FNSPE, CTU in Prague	
Jooyoung Hahn	FNSPE, CTU in Prague	
Tomáš Halada	FME, CTU in Prague	
Kateřina Horaisová	FNSPE, CTU in Prague	
Pavel Hron	Siemens Industry Software	
Vladimír Jarý	FNSPE, CTU in Prague	
Martin Jex	FNSPE, CTU in Prague	Student
Pavel Ježek	FNSPE, CTU in Prague	Student
Jakub Klinkovský	FNSPE, CTU in Prague	
Miroslav Kolář	FNSPE, CTU in Prague	
Patrik Kříž	FNSPE, CTU in Prague	Student
Dana Majerová	FNSPE, CTU in Prague	
Ondřej Marek	FNSPE, CTU in Prague	Student
Matěj Michálek	FNSPE, CTU in Prague	Student
Jakub Michna	FNSPE, CTU in Prague	Student
Michal Moc	FNSPE, CTU in Prague	Student
Maneesh Narayanan	FNSPE, CTU in Prague	Student
Jan Oršl	FNSPE, CTU in Prague	Student, Poster
Petr Pauš	FIT, CTU in Prague	
Roman Pirogov	FNSPE, CTU in Prague	Student
Neda Bagheri Renani	Comenius University	Student
Daniel Sevcovic	Comenius University	
Daria Soboleva	FNSPE, CTU in Prague	Student
Frantisek Stloukal	FCE, CTU in Prague	
Pavel Strachota	FNSPE, CTU in Prague	
Robert Straka	AGH - USF	
Filip Šebek	FNSPE, CTU in Prague	Student

Josef Štemberk	FNSPE, CTU in Prague	Student
Dalibor Trampota	FIT, CTU in Prague	Student
Quang Van Tran	FNSPE, CTU in Prague	
Martin Tůma	FNSPE, CTU in Prague	Student

Scientific Programme

Conference venue:

The conference venue: **the main building of CTU at Pohraniční street, 1288/1**
or
Online: MS Teams

Registration for local participants:

Registration for local participants takes place at the conference venue:
Thursday: from 13:00 to 14:00
+ during coffee breaks between the sessions

Regular talks

Oral presentation duration is 20 min = 15 min talk + 5 min for discussion.

Poster pitch talks

Each poster will be briefly introduced in a short 1-3 min presentation (suitable for 1-2 slides). Discussion will happen during the following coffee break.

Thursday, May 29

13:00 – 14:00 *Registration of participants*

14:00 – 14:10 *Opening ceremony by Radek Fučík*

Chairman: Radek Fučík

14:10 – 14:30 **Tomáš Halada**: TNL-SPH: Solving free surface flows with open boundaries using conservative SPH scheme

14:30 – 14:50 **Martin Jex**: Methods of nonconvex optimization for determination of phase equilibria of multicomponent mixtures

14:50 – 15:30 *Cofffee break*

Chairman: Jakub Klinkovský

15:30 – 15:50 **Neda Bagheri Renani**: The Comparison of the Improved Interior-Newton-Smart Test (INS) Method and the Interior-Point Method (IPM) on Large-Scale Models

15:50 – 16:10 **Vladimír Jarý**: Current status of the Development of the Triggerless Data Acquisition System for the AMBER experiment at CERN

16:10 – 16:30 **Daria Soboleva**: Web-based application for control of the Data Acquisition System of the AMBER experiment at CERN
16:30 – 16:50 **Matěj Michálek**: The development of advanced tools for accessing the registers of the FPGA devices on COMPASS / AMBER experiment
16:50 – 17:10 **Filip Bartoš**: Solving PDE-constraint optimization problem using physics-informed neural networks
18:00 – 21:00 *Social events in Děčín*

Friday, May 30

08:00 – 09:00 *Breakfast*

Chairman: Petr Pauš
09:00 – 09:20 **Miroslav Kolář**: Spatially dependent models of infectious diseases by reaction-diffusion equations
09:20 – 09:40 **Michal Beneš**: Dynamics of Space Curves by Normal and Binormal Curvature
09:40 – 10:00 **Daniel Sevcovic**: Mean Curvature Flow of Closed Curves Evolving in Two Dimensional Manifolds
10:00 – 10:20 **Roman Pirogov**: Mathematical Analysis of Behavior of Excitable Media

10:20 – 10:50 *Coffee break*

Chairman: Pavel Eichler
10:50 – 11:10 **Ondřej Marek**: The Multi-speed Entropic Lattice Boltzmann Method
11:10 – 11:30 **Martin Tůma**: Virtual reality in time visualization of LBM fluid flow simulations
11:30 – 11:50 **Patrik Kříž**: The use of Machine Learning for video analysis of the Děčín Via Ferrata
11:50 – 14:00 *Lunch*

Chairman: Miroslav Kolář
14:00 – 14:20 **Jakub Michna**: Solution of the phase problem in crystallography by machine learning methods
14:20 – 14:40 **Pavel Strachota**: Three-dimensional phase-field simulations of water freezing and thawing at pore-scale
14:40 – 15:00 **Maneesh Narayanan**: Applications of Constrained Curvature Flow in Plane

15:00 – 15:30 *Coffee break*

Chairman: Pavel Strachota
15:30 – 15:50 **Jooyoung Hahn**: Topological Data Analysis of Mass Spectrometry
15:50 – 16:10 **Pavel Hron**: Fluid Structure Interaction Simulations in Applications
16:10 – 16:30 **Josef Štemberk**: Mathematical Modeling of Structural Dynamics of Elasto-Plastic Materials

16:30 – 16:50 **Filip Šebek**: Mathematical modeling of propagation of biochemical agents in heterogeneous media

18:00 – 21:00 *Conference dinner at the conference venue*

Saturday, May 31

08:00 – 09:00 *Breakfast at the conference venue*

Chairman: Kateřina Horaisová

09:00 – 09:20 **Dalibor Trampota**: Building a CPU Ray Tracer from scratch

09:20 – 09:40 **Kryštof Blažek**: Mathematical Modelling of Infectious Diseases by SIR model

09:40 – 10:00 **Michal Moc**: Leveraging AI for Health Status Assessment

10:00 *Poster pitch talks (Each poster will be briefly introduced in a short 1-3 minute presentation.)*

10:00 – 10:03 **Jan Oršl**: Enhancing the logbook through checklist integration

10:03 – 10:06 **Štěpán Bezděk**: Procedural map generation for strategy games

10:06 – 10:30 *Poster session and coffee break*

Chairman: Dana Majerová

10:30 – 10:50 **Petr Pauš**: Texturing 3D models using Stable Diffusion

10:50 – 11:10 **Quang Van Tran**: Model Real Business Cycle with Banking Sector

11:10 – 11:30 **Pavel Ježek**: Using GAN neural networks to predict asset movements in the financial market

11:30 – 11:40 *Closing ceremony*

List of Abstracts

The list of abstracts of all talks and posters in alphabetical order.

Solving PDE-constraint optimization problem using physics-informed neural networks

Filip Bartoš Thursday, May 29, 16:50 – 17:10
FNSPE, CTU in Prague

This thesis focuses on solving PDE-constraint optimization problems using neural networks, specifically using physics-informed neural networks. We will present the results of applying this method to a particular physical problem that can be described by heat equation in 2D.

Dynamics of Space Curves by Normal and Binormal Curvature

Michal Beneš, Miroslav Kolář and Daniel Ševčovič Friday, May 30, 09:20 – 09:40
FNSPE, CTU in Prague, FNSPE CTU Prague and Comenius University, Bratislava

We discuss the motion of closed non-intersecting space curves by curvature in binormal and normal directions with application in vortex dynamics. We formulate the general motion law in space by binormal and normal curvature and mention its analytical properties. The finite-volume scheme allows to solve the motion numerically. We demonstrate behavior of the solution on several computational studies combining normal and binormal velocity and mutual interactions.

Procedural map generation for strategy games

Štěpán Bezděk Saturday, May 31, 10:03 – 10:06
FNSPE, CTU in Prague

This poster deals with procedural map generation for strategy games. It presents a comparison of several approaches to the algorithmic generation of game worlds and focuses in detail on the implementation of the height map method. It demonstrates the use of random generation, coarse grid interpolation and gradient noise (Perlin noise) to generate game terrain and presents visual results of generated maps with different terrain types.

Mathematical Modelling of Infectious Diseases by SIR model

Kryštof Blažek, Ing. Miroslav Kolář, Ph.D. Saturday, May 31, 09:20 – 09:40
FNSPE, CTU in Prague, FNSPE, CTU in Prague

This bachelor project numerically investigates the propagation speed and convergence properties of SIR models. We use finite?difference discretization in space and a fourth?order Runge–Kutta scheme in time to simulate traveling?wave solutions in one? and two?dimensional domains. We perform an experimental order?of?convergence study under varying interpolation schemes (linear,

natural spline, and not?a?knot spline) and verify the theoretical minimal wave speed derived via a supersolution argument. Additionally, we implement and test a moving?boundary SIR model with Stefan?type front dynamics.

Topological Data Analysis of Mass Spectrometry

Jooyoung Hahn
FNSPE, CTU in Prague

Friday, May 30, 15:30 – 15:50

This study introduces a novel approach combining two-dimensional gas chromatography (GC x GC), high-resolution time-of-flight mass spectrometry (HR-TOF-MS), and topological data analysis (TDA) to identify unique chemical signatures in botrytized wines from Austria, Hungary, Slovakia, and France. Employing the ball mapper algorithm, we manage the high-dimensional data generated by HR-TOF-MS, simplifying the complex dataset into a representative set of chemical compounds for each wine. This method allows us to visualize and analyze chemical diversity and relationships in a more accessible two-dimensional form, facilitating the identification of distinct chemical profiles unique to wines from different regions. The application of this technique not only enhances our understanding of the compositional variations in European wines but also demonstrates the potential of TDA in analytical chemistry for complex mixture analysis such as food authentication and environmental studies. Our findings provide a new perspective on the standard analytical approaches, offering advancements in the field of computational geometric design applied to chemometrics.

TNL-SPH: Solving free surface flows with open boundaries using conservative SPH scheme

Tomáš Halada
FME, CTU in Prague

Thursday, May 29, 14:10 – 14:30

In Smoothed Particle Hydrodynamics (SPH) method, dealing with free surface flows using weakly compressible model of fluid, artificial viscosity is frequently used to stabilize the computations. Artificial viscosity is associated with excessive dissipation. However, using only the physical viscosity, issues with stability arise. In fact, artificial viscosity hides some of the problems of a widely used SPH schemes. In order to resolve stability issues, we employed conservative modification of boundary integrals formulation of boundary conditions together with midpoint scheme to solve free surface flows in three-dimensional complex geometries including open boundaries. Next to the numerical properties of SPH schemes, open source SPH solver TNL-SPH developed as a submodule of Template Numerical Library is presented.

Fluid Structure Interaction Simulations in Applications

Pavel Hron
Siemens Industry Software

Friday, May 30, 15:50 – 16:10

We explore the mathematical foundations and computational implementations of Fluid-Structure Interaction (FSI) simulations across diverse engineering domains. FSI represents a challenging surface-coupled problem where the state of the fluid domain depends on the structural interface displacement, while the structural domain state depends on fluid traction at the interface. We examine the mathematical formulation of these coupled systems and demonstrate how modern numerical methods—including Finite Volume for fluids and Finite Element for structures—can be effectively implemented to solve complex FSI problems ranging from aeroelasticity in aerospace applications to hemodynamics in biomedical engineering. The presentation will highlight both one-way and two-way coupling methodologies, showcasing how these computational approaches enable engineers to design lightweight, flexible structures through reduced conservatism and improved predictive capabilities.

Current status of the Development of the Triggerless Data Acquisition System for the AMBER experiment at CERN

Vladimír Jarý, Jozef Hrdý, Jan Chrastina, Matěj Michálek, Josef Nový, Jan Oršl, Daria Soboleva, Samuel Zahorec
FNSPE, CTU in Prague, FNSPE, CTU in Prague

Thursday, May 29, 15:50 – 16:10

Modern particle physics experiments strongly depend on the efective implementation of the data acquisition (DAQ) systems. In this paper, we will focus on development of the DAQ of the AMBER experiment at CERN. We will start with brief overview of the scientific program of the experiment. Next we will explain the standard architecture of the traditional DAQ systems that heavily rely on fast trigger subsystems that select potential event candidates in distributed, high rate environment. We will discuss disadvantages of such triggered DAQ system and the we will introduce innovative triggerless DAQ system that has been development for the AMBER experiment. In this system, filtering logic is moved to higher levels which allows to use more advanced algorithms for event candidates selection. We will describe current status of development that involves work of student of Bachelor's and Master's degree courses at our faculty.

Methods of nonconvex optimization for determination of phase equilibria of multicomponent mixtures

Martin Jex
FNSPE, CTU in Prague

Thursday, May 29, 14:30 – 14:50

This study focuses on multiphase compositional equilibrium calculations in Volume-temperature-moles in each component (VTN) and Pressure-temperature-moles in each component (PTN) formulations, which are fundamental to a variety of applications in chemical engineering and thermodynamics, such as separation processes, reservoir simulations or CO_2 sequestration. We introduce novel enhancements to widely used algorithms and demonstrate their improved efficiency and robustness on several mixtures.

Using GAN neural networks to predict asset movements in the financial market

Pavel Ježek
FNSPE, CTU in Prague

Saturday, May 31, 11:10 – 11:30

The thesis explores the application of Generative Adversarial Networks (GANs) for predicting the prices of selected financial assets, specifically Apple stock, ČEZ stock, commodity gold, and the cryptocurrency Bitcoin. GANs, as an advanced deep learning framework, offer the ability to generate realistic time series predictions, which is particularly valuable for financial forecasting. The work covers the theoretical foundations of deep learning and GANs, a detailed description of the data, model implementation, and analysis of the results. Additionally, model-based trading strategies were applied to evaluate the practical viability of the predictions, including calculations of potential profits.

Spatially dependent models of infectious diseases by reaction-diffusion equations

Miroslav Kolář
FNSPE, CTU in Prague

Friday, May 30, 09:00 – 09:20

We present an overview of spatially dependent description of spread of an infectious disease. We focus on the class of so called SIR models where an individual in the target population belongs either in the Susceptible, Infected or Recovered class. Such models can be described by a system of reaction-diffusion equations for the population densities and further enhanced by additional effects, like e.g. a demography. We also briefly discuss Hopf bifurcation and Turing bifurcation for classical SIR systems and also for nonlinear SIR systems.

The use of Machine Learning for video analysis of the Děčín Via Ferrata

Patrik Kříž
FNSPE, CTU in Prague

Friday, May 30, 11:30 – 11:50

This presentation showcases my thesis, which focuses on a practical use of Machine Learning models, namely Mask R-CNN and YOLO, and the creation of a dataset suitable for this problem. The aim of the thesis is to create a suitable model capable of counting the amount of people currently climbing and tracking which trails are the most used. This information is then going to be used in stopping

overcrowding on the wall and helping the administrator know which trails are the most prone to erosion.

The Multi-speed Entropic Lattice Boltzmann Method

Ondřej Marek
FNSPE, CTU in Prague

Friday, May 30, 10:50 – 11:10

This contribution studies the multi-speed entropic lattice Boltzmann method (ELBM). A generalization of a single-speed LBM wall boundary condition to multi-speed models is proposed and compared. A numerical study of drag and lift coefficients for a cylinder and NACA profile is perfomed using a single-speed LBM model, single-speed ELBM model, multi-speed ELBM model and the finite volume method.

The development of advanced tools for accessing the registers of the FPGA devices on COMPASS / AMBER experiment

Matěj Michálek
FNSPE, CTU in Prague

Thursday, May 29, 16:30 – 16:50

This work presents the development of an advanced C++ software tool with a graphical user interface (GUI) designed to facilitate efficient communication with FPGA devices used in the COMPASS/AMBER experiments at CERN. The primary function of the tool is to provide intuitive and flexible access to the internal registers of FPGA-based hardware, simplifying tasks such as configuration, monitoring, and debugging. By abstracting low-level operations and presenting them through an accessible interface, the application enhances user interaction with the hardware and supports more effective system control in high-energy physics experiments.

Solution of the phase problem in crystallography by machine learning methods

Jakub Michna, Ing. Pavel Strachota Ph.D.
FNSPE, CTU in Prague

Friday, May 30, 14:00 – 14:20

TBA

Leveraging AI for Health Status Assessment

Michal Moc
FNSPE, CTU in Prague

Saturday, May 31, 09:40 – 10:00

TBA

Applications of Constrained Curvature Flow in Plane

Maneesh Narayanan, Michal Beneš
FNSPE, CTU in Prague, Czech technical University in Prague

Friday, May 30, 14:40 – 15:00

We investigate the area-preserving flow of a closed embedded curve under constrained motion with force terms. Specifically, we analyze the deformation of a circle under two force scenarios: a droplet under external force and a circular-shaped eukaryotic cell. Reformulating the motion law as a system of degenerate parabolic PDEs, we solve it numerically using the finite volume method. Our findings offer insights into constrained geometric flows with applications in physical and biological systems.

Enhancing the logbook through checklist integration

Jan Oršl
FNSPE, CTU in Prague

Saturday, May 31, 10:00 – 10:03

This thesis focuses on the integration of a checklist, developed as part of a bachelor's thesis, into the existing logbook system to enhance efficiency and accuracy in task tracking. It compares different methods of checklist integration and their benefits, including error reduction and improved clarity of recorded information. Emphasis will be placed on the technical aspects of implementation as well as the user-friendliness of the solution. The thesis also includes the design of innovative logbook modifications that will expand their functional capabilities.

Texturing 3D models using Stable Diffusion

Petr Pauš, Ondřej Sakala, Radek Richtr
FIT, CTU in Prague, CTU FIT, CTU FIT

Saturday, May 31, 10:30 – 10:50

This talk presents the project called Most: A city that did not disappear, an initiative focused on the 3D reconstruction and immersive presentation of a historical city through web and virtual reality platforms. The project encompasses several key stages, including the creation of detailed 3D models and the development of robust application frameworks. A significant challenge encountered was the generation and application of realistic textures, particularly given the need for an automatic process derived from real-world data. To address this, our methodology incorporated the innovative use of AI image generation, specifically leveraging Stable Diffusion, to create high-quality textures. Furthermore, we developed a novel approach for generating textures from multiple photographic views and accurately mapping them onto 3D objects. This entire process has been encapsulated within a custom Blender module, streamlining the workflow and enabling efficient content creation for this ambitious digital preservation effort.

Mathematical Analysis of Behavior of Excitable Media

Roman Pirogov
FNSPE, CTU in Prague

Friday, May 30, 10:00 – 10:20

In my work, I focus on deriving the weak formulation of the FitzHugh–Nagumo system of reaction-diffusion equations in a
two-dimensional domain. The aim is to find a weak solution in Sobolev spaces and to approximate it numerically using the finite difference method. The model simulates the propagation of electric signals in cardiac tissue. The results show how the system's dynamics depend on model parameters and the domain type.

The Comparison of the Improved Interior-Newton-Smart Test (INS) Method and the Interior-Point Method (IPM) on Large-Scale Models

Neda Bagheri Renani
Comenius University
Thursday, May 29, 15:30 – 15:50

This work provides a detailed comparison between two commonly applied algorithms for solving nonlinear optimization problems: the enhanced Interior-Point approach (IPM) and the enhanced Inexact-Newton-Smart test (INS) approach. The enhanced INS method incorporates regularization of the Hessian matrix, iterative line search strategies, and improved termination rules to boost both numerical stability and the precision of the solution. While the IPM delivers more accuracy in optimal value approximation, the modified INS technique achieves increased convergence rates, computing efficiency, and numerical stability. The results show that the enhanced IPM method offers better computational performance and faster convergence while also achieving greater accuracy in meeting optimality criteria. By clarifying the computational properties of various methods, this work advances large-scale optimization by assisting in the selection of suitable techniques according to the needs of individual problems.

Mean Curvature Flow of Closed Curves Evolving in Two Dimensional Manifolds

Daniel Sevcovic, Miroslav Kolar
Comenius University, FJFI CVUT Praha
Friday, May 30, 09:40 – 10:00

We investigate the motion of a family of closed curves evolving on an embedded or immersed manifold in three dimensional Euclidean space according to the geometric evolution law. We derive a system of nonlinear parabolic equations describing the motion of curves belonging to a given two-dimensional manifold. We consider both embedded and immersed manifolds. Using the abstract theory of analytic semiflows, we prove the local existence, uniqueness of Hölder smooth solutions to the governing system of nonlinear parabolic equations for the position vector parametrization of evolving curves. We apply the method of flowing finite volumes in combination with the methods of lines for numerical approximation of the governing equations. Numerical experiments support the analytical conclusions and demonstrate the efficiency of the method.

Three-dimensional phase-field simulations of water freezing and thawing at pore-scale

Pavel Strachota Friday, May 30, 14:20 – 14:40
FNSPE, CTU in Prague

This work deals with numerical simulation of water freezing and thawing in a complex three-dimensional geometry of a porous medium. The porous structure is represented by a virtual container filled with glass beads. Phase transition modeling is approached at both macro-scale and micro-scale, combining heat transfer in a heterogeneous medium and a phase-field approximation of the Gibbs-Thomson relation by means of the Allen-Cahn equation. The formulation of the model contains novel components tailored for the given purpose. In addition to this general model, two limit scenarios are considered: At the macro-scale, surface tension effects are negligible and phase transition focusing based on temperature can replace the Allen-Cahn equation. In contrast to that, simulations of equilibrium states at the micro-scale allow to eliminate the heat equation by assuming constant supercooling. For numerical solution, an efficient hybrid parallel algorithm based on the finite volume method and the Runge-Kutta-Merson solver with adaptive time stepping are employed. The results of different model variants at different scales are discussed. In a parametric study, the full phase-field model is demonstrated to deliver consistent results across a wide range of surface tension values, exhibiting curvature-induced premelting if surface tension is artificially exaggerated. As surface tension tends to the realistic values, the results of the phase-field approach those of the simplified temperature-driven phase transition model. In addition, micro-scale simulations of water freezing at different supercooling values aim to predict the unfrozen water content and compare the results with data from literature. Numerical stability, accuracy, and computational costs are also discussed.

Mathematical modeling of propagation of biochemical agents in heterogeneous media

Filip Šebek Friday, May 30, 16:30 – 16:50
FNSPE, CTU in Prague

This talk presents my thesis, which focuses on the mathematical modeling of the propagation of biochemical agents in heterogeneous media. The model is based on the 3D convection-diffusion equation, which is numerically solved using the finite difference method implemented in a custom code. The aim of the thesis is to simulate biomedical scenarios such as corrosion processes of biodegradable implants or drug delivery to tumor tissues.

Mathematical Modeling of Structural Dynamics of Elasto-Plastic Materials

Josef Štemberk
FNSPE, CTU in Prague

Friday, May 30, 16:10 – 16:30

The theoretical part of the work connects concepts from elasticity theory with tools from functional analysis and continuum mechanics. It explores selected problems related to the behavior of elastic end elasto-plastic materials. The practical part focuses on the design of a solver for approximating the solution of a 1D static equilibrium problem for thermo-elastic material, based on the Finite Element Method.

Building a CPU Ray Tracer from scratch

Dalibor Trampota
FIT, CTU in Prague

Saturday, May 31, 09:00 – 09:20

In this talk, I'll walk you through a development of a CPU-based ray tracer I wrote as part of my academic work. I'll cover the core rendering pipeline including intersection algorithms like Möller-Trumbore and acceleration structures such as octee.

Model Real Business Cycle with Banking Sector

Quang Van Tran
FNSPE, CTU in Prague

Saturday, May 31, 10:50 – 11:10

The banking sector is rarely included in a macroeconomic model as it is difficult to capture its behavior. This research studies the behavior of the banking sector, which takes deposits from households and provides loans to other entities. First, the model is derived and calibrated. Then, an impulse response analysis is performed to get the reactions of economic variables to various types of external shocks. The results of this analysis can be used to tailor appropriate economic policies for dealing with actual fluctuations in a real economy.

Virtual reality in time visualization of LBM fluid flow simulations

Martin Tůma
FNSPE, CTU in Prague

Friday, May 30, 11:10 – 11:30

This contribution explores the use of virtual reality (VR) for visualizing fluid flow simulations, focusing on the implementation of the Lattice Boltzmann Method (LBM) in Unity. LBM is a numerical method that enables efficient simulation of fluid dynamics by solving a discretized version of the Boltzmann transport equation on a lattice grid, making it well-suited for modeling complex flow behavior. In the context of this work, different categories of virtual environments are briefly introduced, including

Virtual Reality (VR) and Extended Reality (XR), with an emphasis on their potential for scientific visualization. The practical component demonstrates how Unity's XR toolkit can be used to create an environment for viewing and interacting with 2D LBM simulation results. The goal is to provide an accessible and engaging platform for exploring fluid behavior, which can serve as a foundation for further development in scientific visualization using VR.