

INSTITUTE OF GEONICS AS CR, OSTRAVA

VŠB - TECHNICAL UNIVERSITY OF OSTRAVA

IMACS: INTERNATIONAL ASSOCIATION FOR  
MATHEMATICS AND COMPUTERS  
IN SIMULATION

# Modelling 2009

**Scientific program**

**Abstracts**

**List of participants**

JUNE 22 – 26, 2009

ROŽNOV POD RADHOŠTĚM, CZECH REPUBLIC

**June 22 – Monday**

**Hotel Relax**

10:00 - 13:30 Registration

12:00 - 13:30 Lunch

**June 22 – Monday**

**Janík's Barn, Wallachian Museum**

13:00 - 14:00 Registration

14:00 - 14:30 Opening the conference

Plenary talks

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14:30 - 15:15 O. Axelsson: Macro-Elementwise Preconditioning Methods

15:15 - 16:00 Y. Saad: From Data-Mining to Nanotechnology and Back: the New Problems of Numerical Linear Algebra

Plenary talks

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16:30 - 17:00 T. Kozubek, Z. Dostál, T. Brzobohatý, A. Markopoulos, R. Kučera, V. Vondrák: A Scalable TFETI Based Algorithm for Contact Problems and Its Powerful Ingredients

17:00 - 17:30 I. Vondrák: Presentation of the project IT for Innovations

17:30 Visiting the Wallachian open air museum

18:30 Welcome party at the traditional pub *Na posledním groši*

Plenary talk

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09:00 - 09:50 O. Kolditz, N. Böttcher, W. Wang, C.-H. Park, U.-J. Görke: Numerical Simulation of Two-Phase Flow in Deformable Porous Media: Application to Carbon Dioxide Storage in the Subsurface

Parallel session A: **Mechanics 1**

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Chairman: J. Haslinger

10:20 - 10:40 J. Valdman: Numerical Methods and a Posteriori Error Estimates for Elastoplastic Problems

10:40 - 11:00 J. Zeman, A. Mielke, T. Roubíček: Numerical Approximation of Rate-Independent Non-Local Damage Problems

11:00 - 11:20 L. Tchoualag: Boundary Integral Formulation for Contact Problems with Wear

11:20 - 11:40 P. Bělík, M. Shvartsman, B. Jennings, C. Thomas: Heat-Shrinkable Thin Films, Their Applications, and Modeling of Their Behavior

Parallel session B: **Numerical Linear Algebra 1**

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Chairman: I. Marek

10:20 - 10:40 Z. Strakoš: Moments, Krylov Subspace Methods and Model Reduction

10:40 - 11:00 I. Hnětynková, M. Plešinger, Z. Strakoš: The Total Least Squares Problem and Reduction of Data

11:00 - 11:20 Z. Strakoš, P. Tichý: On Efficient Numerical Approximation of the Scattering Amplitude

11:20 - 11:40 I. Pultarová: Cyclic Matrices and Iterative Aggregation - Disaggregation Methods

Parallel session C: **Fluid Mechanics 1**

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Chairman: M. Brandner

10:20 - 10:40 W. Shen, B. Tian, S. Wang: A Global ALE Method for Compressible Multi-Material Flows

10:40 - 11:00 C. Bourdarias, M. Ersoy, S. Gerbi: Air Entrapment in Transient Flows in Closed Water Pipes: a Bilayer Approach

11:00 - 11:20 J. Vimmer, H. Klášterka, M. Hajžman: Analytical Solution of Gaseous Slip Flow in Microchannels Using Oseen Flow Model

11:20 - 11:40 M. Pultar: Numerical Simulation of External Steel Frame during Fire Experiment

Lunch

**June 23 – Tuesday**

**Hotel Relax**

Parallel session A: **Multiscale Computing 1**

Chairman: E. Rohan

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- 14:00 - 14:20 J. Sýkora, J. Šejnoha, M. Šejnoha: Multi-Scale Modeling of Coupled Heat and Moisture Transfer in Masonry Structures with Interfaces: Mesostructural Study
- 14:20 - 14:40 J. Vala: Multi-Scale Modelling of Mechanical Behaviour of Concrete at Early Ages
- 14:40 - 15:00 J. Malík: Some Homogenization and Corrector Results for Quasilinear Elliptic Equations
- 15:00 - 15:20 R. Cimrman, E. Rohan: Homogenization-Based Recovery of State in Bone Poroelastic Microstructure

Parallel session B: **Finite Element Method 1**

Chairman: T. Vejchodský

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- 14:00 - 14:20 J. Dalík: A General Second-Order Gradient Recovery Scheme
- 14:20 - 14:40 P. Jiránek, Z. Strakoš, M. Vohralík: A Posteriori Error Estimates and Stopping Criteria for Iterative Solvers
- 14:40 - 15:00 M. Brandner, J. Egermaier, H. Kopincová: High Order Semidiscrete Schemes for Balance Laws
- 15:00 - 15:20 T. Z. Boulmezaoud: Inverted Finite Elements Method for Problems in Unbounded Regions of Space: Principles and Results

Parallel session C: **Uncertainty et al.**

Chairman: L. Lukšan

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- 14:00 - 14:20 J. Chleboun: An Approach to Deal with Neumann Boundary Value Problems Defined on Uncertain Domains
- 14:20 - 14:40 P. Harasim: On the Worst Scenario Method: Application to an Uncertain Differential Equation and Numerical Examples
- 14:40 - 15:00 D. Janovská, G. Opfer: Simple Quaternionic Polynomials

**June 23 – Tuesday**

**Hotel Relax**

Parallel session A: **Domain Decomposition 1**

Chairman: V. Vondrák

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- 15:50 - 16:10 J. Kruis: Description of Material Interfaces Based on Domain Decomposition Methods
- 16:10 - 16:30 M. Beneš, K. Matouš: Multi-Domain Asynchronous Variational Integrators for Nonlinear Solid Materials
- 16:30 - 16:50 P. Burda, M. Čertíková, J. Novotný, J. Šístek: On Coarse Space for the BDDC Method

Parallel session B: **Bio Applications**

Chairman: Z. Strakoš

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- 15:50 - 16:10 I. Marek: On Some Models of Cell Biology: Computational Aspects
- 16:10 - 16:30 A. Janka, F. Yerly: Mechanical Model of Plant Growth
- 16:30 - 16:50 M. Biák, D. Janovská: Filippov Systems Application
- 16:50 - 17:10 L. Buřič, V. Janovský: A Road Traffic Model with Overtaking: Nonidentical Cars on the Road
- 17:10 - 17:30 T. Hanus, D. Janovská: Qualitative Methods in Discontinuous Dynamical Systems

Parallel session C: **Fluid Mechanics 2**

Chairman: J. Maryška

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- 15:50 - 16:10 J. Rosenberg, L. Hynčík: Dynamical Properties of the Periodically Stimulated Growing 1D Continuum Using Multiple-Scale Method
- 16:10 - 16:30 A. Jonášová, J. Vimmr, O. Bublík: Finite Volume Modelling of Unsteady Blood Flow Using a Fractional-Step Method
- 16:30 - 16:50 D.-G. Calugaru, C. I. Bozdog Calugaru: Numerical Modelling of Oxygen Transport in Arteries in the Context of Atherosclerosis
- 16:50 - 17:10 V. M. Zhuravlev, A. V. Zhuravlev: The Algorithm of Non-Linear Models Creation Based on the Method of Generalized Discrete Cole-Hopf Substitutions

Dinner at the hotel

Poster party

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- 19:30
1. M. Al Wohaishi: The Role of Mathematics and Modelling in Modern Communication Systems
  2. H. Baarová, Jan Šembera: Modelling Large-Scale Reactive Transport - a Case Study of Stráž pod Ralskem
  3. P. Beremlijski, J. Haslinger, M. Kočvara, R. Kučera, J. V. Outrata: Shape Optimization in 3D Contact Problems with Coulomb Friction
  4. C. I. Bozdog Calugaru, D.-G. Calugaru: Modelling and Simulation of Flow and Transport Phenomena with SoFTP Software
  5. J. Brož, J. Kruis: Heuristic Algorithm for Searching Corner Nodes in FETI-DP Method
  6. T. Brzobohatý, A. Markopoulos: MatSol - Matlab Solvers
  7. O. Bublík, M. Butnikošarovski: Using Positive Scheme for Modelling of Flow through Reticle at Car Radiator
  8. D. Černá, V. Finěk: Adaptive Wavelet Scheme for Fourth-Order Elliptic Problems
  9. D. Černá, V. Finěk: Adaptive Wavelet Method for 3D Singular Electrostatic Problem
  10. P. Gruber, J. Zeman, J. Kruis: FETI-Based Algorithm for Homogenization of Composites with Debonding Phases: Numerical Study
  11. M. Holík, J. Bradley, V. Bellido-González, D. Monaghan: Modelling of Magnetron Sputter Plasma - Monte Carlo Model of Particles' Trajectories and Adaptive Mesh Refinement Approach to Solution of Plasma Potential Distribution
  12. J. Hron, M. Mádlík: Monolithic Solver for Fluid-Structure Interaction Problems

Poster party

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- 19:30
13. R. Blaheta, O. Jakl, R. Kohut, A. Kolcun, J. Starý:  $\mu$ -FEM Analysis in Rock Mechanics
  14. M. Jarošová: Transformation of Basis for Contact Problems
  15. Z. Dostál, P. Kabelíková, P. Kovář, T. Kozubek: Generalised Inverse Matrix Evaluation Using Graph Theory
  16. D. Lukáš: A Shape Optimization Method for Nonlinear Axisymmetric Magnetostatics Using a Coupling of Finite and Boundary Elements
  17. D. Lukáš: Multi-Frequency Acoustic Analysis of a Railway Wheel Using a Fast BEM
  18. A. Markopoulos, T. Brzobohatý: Semicoercive Contact Problems - Applications
  19. T. Olas, R. Wyrzykowski: Parallel Geometric Multigrid for Three-Dimensional FEM
  20. V. Štumbauer, Š. Papáček, D. Štys, C. Matonoha: Modelling and Simulation of Photosynthetic Microorganism Growth: Finite Difference Method vs. Random Walk
  21. J. Havlíček, M. Hokr, P. Rálek: Numerical Solution of the Flow in Discrete Fracture Network with Mechanical Loading - Practical Implementation
  22. J. Rymarczyk, E. Czerwosz, A. Richter: FEM Modelling of Nanoindentation Experiment for Nanostructural N - Carbon Film (N - Pd, Ni)
  23. M. Sadowská, Z. Dostál, T. Kozubek: Scalable TBETI Based Solver for 3D Contact Problems
  24. S. Sysala: Applications of Modified Semismooth Newton Method to Some Elasto-Plastic Problems

**June 24 – Wednesday**

**Hotel Relax**

Plenary talk

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09:00 - 09:50 P. Wriggers, İ. Temizer, C. Wellmann: On Multi-Scale Methods in Contact Mechanics

Plenary talks

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10:20 - 11:10 P. Arbenz:  $\mu$ -Finite Element Analysis of Human Bone Structures

11:10 - 12:00 O. Steinbach: Applications of Fast Boundary Element Methods

Lunch

Excursions

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14:00      a. Tourist trip to *Pustevny*  
              b. Trip to *Kopřivnice* and *Štramberk*  
              c. Visiting the Wallachian open air museum

18:00 - 21:00    Dinner at the hotel



**June 25 – Thursday**

**Hotel Relax**

Plenary talk

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09:00 - 09:50 R.H.W. Hoppe: Modeling, Simulation and Optimization of Surface Acoustic Wave Driven Microfluidic Biochips

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Parallel session A: **Contact Problems** Chairman: Z. Dostál

10:20 - 10:40 J. Haslinger: Approximation and Numerical Realization of 3D Contact Problems with Coulomb Friction and a Solution Dependent Coefficient of Friction

10:40 - 11:00 V. Janovský: Solving a Discrete Contact Problem via a Path-Following Technique

11:00 - 11:20 I. Bock: An Elastic Plate with Dynamic Contact

11:20 - 11:40 Z. Dostál, J. Haslinger, R. Kučera: Algorithms for Contact Problems with Anisotropic Friction in 3D

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Parallel session B: **Finite Element Method 2** Chairman: J. Malík

10:20 - 10:40 P. Šolín, I. Doležel, O. Čertík, J. Červený, L. Dubcová: Adaptive Multi-mesh *hp*-FEM and the Open-Source Project HERMES

10:40 - 11:00 P. Kus, T. Vejchodský: Static Condensation for 3D Elliptic Problems Solved by *hp*-FEM

11:00 - 11:20 M. Ainsworth, T. Vejchodský: Guaranteed and Robust a Posteriori Error Estimator for Singularly Perturbed Problems

11:20 - 11:40 Q. Zhao, G. Yuan: On Vertex Reconstructions for Cell-Centered Finite Volume Scheme of 2D Diffusion Problems on Distorted Meshes

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Parallel session C: **Nano, Particles et al.** Chairman: M. Hokr

10:20 - 10:40 D. Pelikánová, J. Šembera: Mathematical Model of Aggregation of Nanoscale Particles with Surface Charge

10:40 - 11:00 M. Shvartsman, P. Bělík: Modeling Delay in Spiking Neurons

11:00 - 11:20 A. Shymanska: Mathematical and Computer Simulations of Stochastic Processes of Electron Multiplication

11:20 - 11:40 J. Bylina, B. Bylina, T. Skaraczyński, A. Zoła: SBR in a Call Center with Varying Arrival

Lunch

**Parallel session A: Domain Decomposition 2**

Chairman: P. Šolín

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- 14:00 - 14:20 V. Vondrák, T. Kozubek, A. Markopoulos, Z. Dostál: Contact Shape Optimization Problems with MatSol Library
- 14:20 - 14:40 D. Horák, Z. Dostál: Convergence Improving of Scalable FETI-DP Algorithm for Contact Problems
- 14:40 - 15:00 J. Haslinger, O. Vlach, R. Kučera: T-FETI Domain Decomposition Method for Quasistatic Contact Problems with Coulomb Friction

**Parallel session B: Porous Media**

Chairman: J. Kruis

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- 14:00 - 14:20 D. Frydrych, M. Hokr: Fully Coupled Algorithm for Heat and Water Transport – Estimation of Non-linear Parameters Based on the Experimental Data
- 14:20 - 14:40 M. S. Mahmood: A Conservative Galerkin Characteristics Method for Contaminant Transport Problems in Porous Media
- 14:40 - 15:00 L. Zedek, J. Šembera: Application of Principal Component Analysis in Modelling of Underground Solute Transport
- 15:00 - 15:20 J. Vala, S. Štátník: Experimental and Computational Identification of Thermal Technical Characteristics of Building Materials

**Parallel session C: Fluid Mechanics 3**

Chairman: V. Janovský

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- 14:00 - 14:20 K. Tůma: What Thermodynamically Compatible Rate Type Fluid Model is capable to Capture Behavior of Asphalt?
- 14:20 - 14:40 J. Pokorný, J. Křen, K. Koudela, K. Koudela jr.: Model of the Knee Alloplastic with Synovial Fluid
- 14:40 - 15:00 M. Lanzendörfer, J. Stebel: On Boundary Conditions for Fluids with Pressure Dependent Viscosity
- 15:00 - 15:20 M. Lanzendörfer: Journal Bearing Lubrication: Steady Flow of Incompressible Fluid with Pressure Dependent Viscosity

**June 25 – Thursday**

**Hotel Relax**

**Parallel session A: Finite Difference Method**

Chairman: L. Jódar

- 15:50 - 16:10 L. Jódar, J.-C. Cortés, L. Villafuerte: Random Mixed Hyperbolic Models: Numerical Analysis and Computing
- 16:10 - 16:30 A. J. Arenas, G. González-Parra, B. M. Chen-Charpentier: On a Non-standard Numerical Scheme for Reaction-Diffusion Equations with Uncertainty
- 16:30 - 16:50 J.-V. Romero, M.-D. Roselló, F. J. Arnau, P. Piqueras: Study of Finite Difference Numerical Method Solution Applied to One-Dimensional Compressible Flow in Ducts with Mass Flow Source Terms
- 16:50 - 17:10 R. Company, L. Jódar, J.-R. Pintos: A Consistent Stable Numerical Scheme for a Nonlinear Option Pricing Model in Illiquid Markets

**Parallel session B: Numerical Linear Algebra 2**

Chairman: O. Axelsson

- 15:50 - 16:10 J. Scott, M. Tũma: Importance of Structure in Algebraic Preconditioners
- 16:10 - 16:30 J. Duintjer Tebbens, M. Tũma: On an Approximate Preconditioner Update for Sequences of Large Nonsymmetric Linear Systems
- 16:30 - 16:50 P. Boyanova, I. Georgiev, S. Margenov, L. Zikatanov: Multilevel Preconditioning of Graph-Laplacians: Polynomial Approximation of the Pivot Blocks Inverses
- 16:50 - 17:10 N. Kosturski, S. Margenov: Scalable PCG Solution Algorithms for  $\mu$ FEM Elasticity Systems

**Parallel session C: Electromagnetic Problems**

Chairman: T. Kozubek

- 15:50 - 16:10 K. Du, W. Sun: Sine and Cosine Transform Based Preconditioners for Electromagnetic Scattering Problems
- 16:10 - 16:30 J. Hrdlička, D. Šnita: Mathematical Modeling of Electrokinetic Micropumps
- 16:30 - 16:50 F. Seifrt, G. Leugering, E. Rohan: Topology Optimization for Propagation of Electromagnetic Waves for Multiple Wavelengths
- 16:50 - 17:10 A. I. Al Mussa: The Effects of Magnetic Configurations on MHD Thrusters: Modelling Review of Analytical and Numerical Investigation

19:30 Farewell party at the Wallachian shed restaurant *Kordulka*

**June 26 – Friday**

**Hotel Relax**

Plenary talk

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09:00 - 09:50 M. Rozložník: Numerical Behavior of Saddle Point Solvers

Parallel session A: **Multiscale Computing 2**

Chairman: M. Šejnoha

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10:20 - 10:40 E. Rohan, V. Lukeš: Multiscale Modelling of Dual Porous Fluid Saturated Layers Using Homogenization

10:40 - 11:00 J. Franců: On a New Approach to Non-Periodic Homogenization

11:00 - 11:20 J. Franců, L. Nechvátal: Homogenization and Uncertain Input Data

Parallel session B: **Optimization**

Chairman: M. Tůma

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10:20 - 10:40 L. Lukšan, C. Matonoha, J. Vlček: Interior-Point Method for Nonlinear Programming with Complementarity Constraints

10:40 - 11:00 J. Vlček, L. Lukšan: Transformations Enabling to Construct Limited-Memory Broyden Class Methods

11:00 - 11:20 L. Lukšan, C. Matonoha, J. Vlček: Interior-Point Method for Nonlinear Nonconvex Optimization

Parallel session C: **Mechanics 2**

Chairman: J. Rosenberg

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10:20 - 10:40 V. Lukeš, E. Rohan: Computation of Acoustic Impedance Coefficients of Perforated Layers

10:40 - 11:00 L. A. Alexeyeva, G. K. Kaishibayeva: The Generalized Functions Method in Boundary Value Problems of Elastodynamics by action of Stationary Running Loads

11:00 - 11:20 S. G. Ghalme: Mathematical Modeling of Fatigue Fracture

Closing the conference

Lunch