
Analysis, modeling and computational mathematics

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Mathematical and functional analysis, mathematical modeling and computational mathematics belong among the fields represented in the world by seminal contributions of outstanding Czech mathematicians such as Bolzano, Kurzweil, Nečas, Pták, Fiedler and Babuška. These related classical disciplines are at present complemented by the development of scientific computing and non-equilibrium thermodynamics. Recent research topics include analysis of function spaces used in the theory of partial differential equations, regularity of admissible and minimizing deformations in nonlinear elasticity, thermodynamical and mathematical (partial differential equations) analysis of mechanical, thermal, electromagnetic and chemical processes in complex fluids and solids and their interactions, large scale iterative computations, sparse direct algebraic solvers, numerical stability, a posteriori error analysis and adaptivity in numerical solution of partial differential equations. Research activities of the junior researchers are also linked with research of their peers in planetary physics and astrophysics within the University Centre (UNCE) for mathematical modeling, applied analysis and computational mathematics, financed for the period 2018-2023.

Selected outputs

- Beck, Lisa; Bulíček, Miroslav; Málek, Josef; Süli, Endre: [On the existence of integrable solutions to nonlinear elliptic systems and variational problems with linear growth](#). Arch. Ration. Mech. Anal. 225 (2017), no. 2, 717–769..
- Breit, Dominic; Schwarzacher, Sebastian: [Compressible fluids interacting with a linear-elastic shell](#). Arch. Ration. Mech. Anal. 228 (2018), no. 2, 495–562.
- Campbell, Daniel; Hencl, Stanislav; Tengvall, Ville: [Approximation of \$W^{1,p}\$ Sobolev homeomorphism by diffeomorphisms and the signs of the Jacobian](#). Adv. Math. 331 (2018), 748–829.
- Carson, Erin C.; Rozložník, Miroslav; Strakoš, Zdeněk; Tichý, Petr; Tůma, Miroslav: [The numerical stability analysis of pipelined conjugate gradient methods: historical context and methodology](#). SIAM J. Sci. Comput. 40 (2018), no. 5, A3549–A3580.
- Gergelits, Tomáš; Mardal Kent-André; Nielsen, Bjoern Fredrik; Strakoš, Zdeněk: [Laplacian preconditioning of elliptic PDEs: localization of the eigenvalues of the discretized operator](#). SIAM J. Numerical Analysis (to appear).
- Hencl, Stanislav; Pratelli, Aldo: [Diffeomorphic approximation of \$W^{1,1}\$ planar Sobolev homeomorphisms](#). J. Eur. Math. Soc. (JEMS) 20 (2018), no. 3, 597–656.
- Janečka, Adam; Málek, Josef; Průša, Vít; Tierra, Giordano: [Numerical scheme for simulation of transient flows of non-Newtonian fluids characterised by a non-monotone relation between the symmetric part of the velocity gradient and the Cauchy stress tensor](#). Acta Mech. 230 (2019), no. 3, 729–747..
- Liu, Zhuomin; Malý, Jan; Pakzad, Mohammad Reza: [Approximation by mappings with singular Hessian minors](#). Nonlinear Anal. 176 (2018), 209–225.
- Málek, Josef, Průša, Vít, Skřivan, Tomáš, Süli, Endre: [Thermodynamics of viscoelastic rate-type fluids with stress diffusion](#), Physics of Fluids 30 (2018) 023101.
- Papež, Jan; Strakoš, Zdeněk; Vohralík, Martin: [Estimating and localizing the algebraic and total numerical errors using flux reconstructions](#). Numer. Math. 138 (2018), no. 3, 681–721.
- Pavelka, Michal; Klika, Václav; Gmela, Miroslav: [Multiscale Thermo-Dynamics. Introduction to GENERIC](#). Berlin: De Gruyter, 2018.