**Zpráva o činnosti Plzeňské pobočky ČSM za rok 2024**

**Publikační činnost členů plzeňské pobočky ČSM za rok 2024**

**Publikace Jimp**

* BERÁNEK, V., ŠŤASTNÝ, P., BACIK, B., BOŃKOWSKI, T., NOVÁČEK, V. The effect of protective mat thickness on the upper limb strike force simulation in combat sports and self defense. JOURNAL OF HUMAN KINETICS, 2024, roč. 94, č. OCT 2024, s. 47-63. ISSN: 1640-5544
* BUBLÍK, O., PECKA, A., VIMMR, J., ŠNÁBL, P., PEŠEK, L. Investigation of blade cascade torsional flutter using the discontinuous galerkin approach in correlation with experimental measurements. INTERNATIONAL JOURNAL OF COMPUTATIONAL FLUID DYNAMICS, 2024, roč. 38, č. 1, s. 45-60. ISSN: 1061-8562
* BYRTUS, M., DYK, Š. Self-induced non-synchronous resonance phenomena and stability in reduced aero-elastic system. COMMUNICATIONS IN NONLINEAR SCIENCE AND NUMERICAL SIMULATION, 2024, roč. 137, č. OCT 2024, s. 108141. ISSN: 1007-5704
* DYK, Š., BULÍN, R., RENDL, J., SMOLÍK, L. Identifying internal resonance regimes in free-vibrating systems with multiple autoparametric couplings. JOURNAL OF SOUND AND VIBRATION, 2024, roč. 590, č. 10 November 2024, s. 118551. ISSN: 0022-460X
* DYK, Š., RENDL, J., SMOLÍK, L., BULÍN, R. Energy-based analysis of quadratically coupled double pendulum with internal resonances. JOURNAL OF SOUND AND VIBRATION, 2024, roč. 577, č. 12 May, s. 1-18. ISSN: 0022-460X
* HOSSEINKHANI, A., ROHAN, E. Multi-functional periodically heterogeneous structures for energy harvesting and vibration attenuation-effects of piezoelectricity and shunting circuits. SMART MATERIALS AND STRUCTURES, 2024, roč. 33, č. 11, s. 115009. ISSN: 0964-1726
* Hynčík, L., 2024. Application of Smoothed Particle Hydrodynamics to a Ballistic Gelatine Sample High-Speed Impact. In: Wittek, A., Kobielarz, M., Babu, A.R., Nash, M.P., Nielsen, P.M.F., Miller, K. (eds) Computational Biomechanics for Medicine. MICCAI 2023. Lecture Notes in Bioengineering. Springer, Cham. <https://doi.org/10.1007/978-3-031-64632-4_7>
* LEVÝ, T., MAY, G. Conservative solution transfer between anisotropic meshes for time-accurate hybridized discontinuous Galerkin methods. INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN FLUIDS, 2024, roč. 96, č. 6, s. 1011-1030. ISSN: 0271-2091
* Mokhtar A. A., Hyncik L., 2024 A comprehensive review of human body model in different crash scenarios: active and passive models. International Journal of Crashworthiness, 1-13 <https://doi.org/10.1080/13588265.2024.2352242>
* Moura R., Oliveira D. A., Parente M. P.L., Kimmich N., Hynčík L., Hympánová L. H., Jorge R. M. N., 2024. Patient-specific surrogate model to predict pelvic floor dynamics during vaginal delivery. Journal of the Mechanical Behavior of Biomedical Materials 160 <https://doi.org/10.1016/j.jmbbm.2024.106736>
* ROHAN, E., LUKEŠ, V. Homogenization of the acoustic transmission on periodically perforated plates interacting with potential mean flow. JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS, 2024, roč. 438, č. 1 March 2024, s. 115509. ISSN: 0377-0427
* ROHAN, E., LUKEŠ, V. Homogenized model of peristaltic deformation driven flows in piezoelectric porous media. COMPUTERS & STRUCTURES, 2024, roč. 302, č. 1 October 2024, s. 107470. ISSN: 0045-7949
* ROHAN, E., NGUYEN, V., NAILI, S. Homogenization of fluid saturated double porosity media with a new type of the contrast in the Biot mesoscopic model. APPLIED MATHEMATICAL MODELLING, 2024, roč. 125, č. JAN 2024, s. 750-777. ISSN: 0307-904X
* ŠULDA, J., ADÁMEK, V., KROFT, R. Transient response of non-prismatic heterogeneous viscoelastic rods and identification of their material properties. EUROPEAN JOURNAL OF MECHANICS A-SOLIDS, 2024, roč. 105, č. MAY-JUN 2024, s. 105241. ISSN: 0997-7538
* TAJSHAM, A., YOUNESIAN, D., GOODINI, J., HOSSEINKHANI, A. A new polyhedral sonic crystal for broadband sound barriers: Optimization and experimental study. APPLIED ACOUSTICS, 2024, roč. 218, č. MAR 15 2024, s. 109881. ISSN: 0003-682X

**Publikace D**

* JONÁŠOVÁ, A., PLÁNIČKA, S., VIMMR, J. A preliminary in silico study of flow-mediated thrombosis in medical devices. In Advances in Mechanism Design IV - Proceedings of TMM 2024. Cham: Springer, 2024. s. 66-75. ISBN: 978-3-031-70250-1, ISSN: 2211-0984
* ROHAN, E., CAMPROVÁ TURJANICOVÁ, J. Homogenization of the perfusion and contrast fluid transport in the liver lobules. In Computer Methods in Biomechanics and Biomedical Engineering II - Lecture Notes in Computational Vision and Biomechanics. Paris, France, 2024. s. 224-232. ISBN: 978-3-031-55314-1, ISSN: 2212-9391
* ROHAN, E., MORAVCOVÁ, F. Acoustic streaming in porous media – homogenization based two-scale modelling. In Journal of Physics: Conference Series. Published under licence by IOP Publishing Ltd, 2024. s. 232009. ISSN: 1742-6588
* SMOLÍK, L., RENDL, J., BULÍN, R. Evaluation of forces in dynamically loaded journal bearings using feedforward neural networks. In Awrejcewicz, J. Perspectives in Dynamical Systems II — Numerical and Analytical Approaches. Cham: Springer, 2024. s. 617-632. ISBN: 978-3-031-56495-6, ISSN: 2194-1009

**Vydané publikace**

* Sborník - Proceedings of Computational Mechanics 2024, ZČU v Plzni, 2024, ISBN 978-80-261-1249-5
* Časopis - Applied and Computational Mechanics, ISSN: 1802-680X, e-ISSN: 2336-1182, Vol. 18, No. 1 a 2, ZČU v Plzni, 2024, indexován v databázích: EBSCO, DOAJ a SCOPUS

**Projekty základního výzkumu řešené v roce 2024 členy plzeňské pobočky ČSM**

* GA22-29874S „Termohydrodynamické účinky mezného skluzu a texturování povrchu kluzných kontaktů“, řešitel: prof. Hartl (VUT v Brně), spoluřešitel: doc. Polach, 2022 – 2024
* GA22-00863K „Řiditelné metamateriály a chytré struktury: Nelineární problémy, modelování a experimenty“, česko-německý LA projekt, řešitel: Ing. Kolman, Ph.D. (ÚT AV ČR), spoluřešitel: prof. Rohan, 2022 – 2024
* GA23-07280S „Identifikace a kompenzace nepřesností ve vazbách mechatronických systémů“, řešitel: doc. Hajžman, spoluřešitel: prof. Šika (ČVUT v Praze), 2023 – 2025
* GA23-06220S „Flexoelektrické periodické struktury pro transport tekutin a sběr energie“, řešitel: prof. Rohan, spoluřešitel: Ing. Cimrman, Ph.D. (ÚT AV ČR), 2023 – 2025
* GA24-12291S **„**Multiscale modelling of acoustics driven fluid suspensions flows in adaptive porous structures“, řešitel: prof. Rohan, 2024-2026
* GA23-06220S"Flexoelectric periodic structures for fluid transport and energy harvesting", řešitel: prof. Rohan, 2023-2025.

**Projekty aplikovaného výzkumu řešené v roce 2024 členy plzeňské pobočky ČSM**

* TK04020057 „Zvýšení spolehlivosti provozu turbosoustrojí z pohledu životnosti segmentových ložisek“, program THÉTA, TAČR, 2022 – 2024

**Konference a semináře organizované v roce 2024 členy plzeňské pobočky ČSM**

* *Computational Mechanics 2024*, 39. ročník konference s mezinárodní účastí, 4. - 6. 11. 2024, Hotel Srní
* *Výpočty konstrukcí metodou konečných prvků 2024*, 28. ročník semináře, 28. 11. 2024, ZČU v Plzni

**Další akce organizované v roce 2024 členy plzeňské pobočky ČSM**

* *MechCamp 2024,* 7. ročník letní školy mechaniky pro studenty středních škol, 28. 8. – 30. 8. 2024, organizační garant: Ing. Bulín, Ph.D.

**Členství členů plzeňské pobočky ČSM v mezinárodních společnostech**

* *CEACM:* doc. Hajžman, doc. Polach, doc. Hynčík
* *EUROMECH:* doc. Hajžman, doc. Polach, prof. Vimmr, prof. Zeman
* *ESB:* Ing. Jonášová, Ph.D., prof. Rohan
* *FISITA:* doc. Hynčík
* *GAMM:* prof. Dupal, prof. Rohan, prof. Rosenberg, prof. Zeman
* *IFToMM:* doc. Byrtus, prof. Dupal, doc. Polach, prof. Vimmr (místopředseda českého národního komitétu), prof. Zeman, doc. Hynčík

**Členství členů plzeňské pobočky ČSM v edičních radách mezinárodních časopisů**

* Highlights of vehicles: doc. Hynčík
* International Journal of Automotive Innovation: doc. Hynčík
* International Journal of Vehicle Safety: doc. Hynčík – hostující editor

**Visiting Professor**

Visiting Professor na Tianjin University of Science and Technology ([http://www.tust.edu.cn](http://www.tust.edu.cn/))

Adjunct Associate Professor na The University of Western Australia ([https://www.uwa.edu.au](https://www.uwa.edu.au/))

**Přednášky zahraničních autorů**

**Foundations for the mechanics of materials and extremely deformable structures in biology**

Prof. Ing. Dr. Christian Hellmich, TU Wienna, Austria

**21. 10. 2024 – Lecture 1**: In the biological realm, particularly interesting examples for materials and extremely deformable structures are found. This is true for biological tissues found at the millimeter down to the micrometer scale, as well as at even smaller scales, in the case of bio-macromolecules. Both types of biological systems exhibit mechanical propertis which are well suited for its functioning. This can be impressively shown by the combination and adaptation of fundamental concepts of theoretical and applied mechanics, including continuum micromechanics, solving the Eshelby’s matrix inclusion problem, thermodynamics-informed hypoelasticity, the Principle of Virtual Power, and molecular dynamics. Illustrative examples refer to tendinous tissue and DNA strands are given.

**Experimental, theoretical, and computational mechanics of hard bioengineering materials: bone and dental cement paste (BioDentine)**

Prof. Ing. Dr. Christian Hellmich, TU Wienna, Austria

**22. 10. 2024 – Lecture 2:** Complex engineering materials are also key to biomedical applications, and the deciphering of their fascinating properties often require multiscale combined experimental-computational approaches: In this context, we here report on a grid nanoindentation campaign with ultra-ﬂat surfaces on BioDentine, a cementitious material used in dentistry. The corresponding normalized histogram of indentation moduli can be represented by the superposition of three log-normal probability density functions. The overall stiffess can be equally well upscaled from only two, piecewise uniform, hydrate phases exhibiting median microstiffess values. Finally, the materials exhibits a high level of optimization, evidenced through a fairly uniformly distributed utilization level throughout the hydrates phases observed close to material failure. Bone failure can be satisfactorily predicted from the materials’ microstructure, at the extraﬁbrillar, extracellular, and macroscopic scales. This opens new avenues radiology-based bone fracture risk assessment.

**PDE constrained optimization under uncertainty**

Prof. Dr. Michael Stingl, Friedrich-Alexander-University Erlangen-Nürnberg, Department of Mathematics, SRN

**30. 10. 2024 – Part 1**: **Introduction to the problem formulations and a first solution approach**

A class of discretized PDE constraint problems is discussed, which are constrained by functions that depend on uncertain data. Three different models to treat these uncertainties are discussed: the robust formulation as well as two versions of stochastic optimization problems modeling uncertainties via expectations or chance constraints. The three different approaches are compared by a structural optimization example. While the case of uncertainty sets with finitely many scenarios can be expressed as standard nonlinear programming problem in all this three problem classes, the case of infinite uncertainty sets is way more challenging. In the first part of this talk it will be further demonstrated in more detail, how a robust protection against infinitely many realizations of uncertainties can be achieved. As the resulting semi-infinte problem is non-convex, well-known reformulations based on duality cannot be applied. Rather than this, the problem is formulated as minimax problem and an adaptive bundle method is suggested for its solution. According to the character of the robust PDE constrained problem, this bundle method has to be able to work with a rather poor outer approximation of the subdifferential. The application of this new bundle approach is first demonstrated by means of a gas network problem and then discussed in the context of structural optimization.

**31. 10. 2024 – Part 2: Dealing with randomness and chance constraints in topology and material optimization.** In the second part of the talk topology and material optimization problems with objective functions or constraints depending on random or distributed parameters. Important examples are problems, in which expected properties are minimized or problems subject to chance constraints. Here, standard deterministic optimization approaches rely on a discretization of the appearing integrals. However, the underlying quadrature rule can introduce artificial local minima, resulting in an overall poor performance of the optimizer. As a remedy, stochastic gradient type methods have gained popularity over the years, most recently also for the solution of topology optimization problems. However, standard schemes from literature are typically limited to expected loss functions and still require many iterations. This implies that a lot of expensive state problems have to be solved. Thus, we present the continuous stochastic gradient method (CSG), which provides an efficient hybrid approach, without these limitations. In CSG, samples calculated in previous iterations are collected in an optimal linear combination to obtain an approximation to the full gradient and objective function value. It can be shown that the approximation error for both quantities vanishes during the optimization process. Moreover, the approximation idea in CSG is not limited to simple gradient schemes but can be combined with more elaborated sequential programming techniques. For the case of treating chance constraints, the combination with the MMA-scheme well known from topology optimization is shown. Its efficiency is demonstrated for applications from reliability based topology optimization of elastic structures.

**TRANSFERS IN POROUS MEDIA IN BIOMECHANICS AND SOILS MECHANICS**

Prof. Dr. Ing. Thibault Lemaire, Laboratoire MSME UMR 8208 CNRS, UGE, Université Paris Est Créteil, France

**11. 12. 2024**: The study of mass and energy transfers in porous media is critical in both biomechanics and soil mechanics, as it influences various natural and engineered systems. In biomechanics, the transport of interstitial fluids within biological tissues plays a vital role in nutrient delivery, waste removal, and overall tissue health. The mechanical properties of these tissues, influenced by their porous structure, directly affect fluid flow rates, which can impact cellular functions and tissue regeneration processes. Similarly, in soil mechanics, the movement of water through soil pores is essential for understanding soil behavior, stability, and drainage. The interaction between soil particles and pore fluid dynamics governs phenomena such as consolidation, shear strength, and permeability. Recent advancements in imaging and computational modeling techniques have enhanced our ability to visualize and simulate these complex interactions, providing deeper insights into both biological and geotechnical applications. This presentation highlights the significance of understanding fluid transfer in porous media, emphasizing the need for interdisciplinary approaches that bridge phenomena at different scales to address challenges in health, engineering, and environmental sustainability.

**Vyzvané přednášky**

**Peristaltic driven flows in piezoelectric porous metamaterials - multiscale computational approaches** (9. 2. 2024, prof. Rohan). Séminaire transverse de Laboratoire Modélisation et Simulation Multi Echelle, Université Paris-Est Créteil Val de Marne (UPEC)

**Homogenization based model of flows in piezoelectric porous metamaterials driven by peristaltic deformation** (25. 3. 2024, prof. Rohan). Nečasův seminář, MFF, UK Praha

**Další akce pro veřejnost – Popularizace a veřejná prezentace výzkumu**

Český rozhlas Plzeň, Náš host – 28. 6. 2024

<https://plzen.rozhlas.cz/ortopdum-do-lecby-nemluvime-jen-zkoumame-a-testujeme-fixace-zlomenin-9265109>

Noc vědců – 27. 9. 2024

<https://www.nocvedcu.cz/udalost/10930-biomechanika-lidskych-kosti>

YouTube – Západočeská univerzita v Plzni

<https://www.youtube.com/watch?v=o2_ooUme8eA>

ČT Události – 27. 9. 2024 (Noc vědců)

[https://www.ceskatelevize.cz/porady/1097181328-udalosti/224411000100927/cast/10$](https://www.ceskatelevize.cz/porady/1097181328-udalosti/224411000100927/cast/10%24)

ČT Události v regionech – 27. 9. 2024 (Noc vědců)

[https://www.ceskatelevize.cz/porady/15334114383-udalosti-v-regionech-jih-a- HYPERLINK "https://www.ceskatelevize.cz/porady/15334114383-udalosti-v-regionech-jih-a-%20zapad/224411000180927/"zapad HYPERLINK "https://www.ceskatelevize.cz/porady/15334114383-udalosti-v-regionech-jih-a-%20zapad/224411000180927/"/224411000180927/](https://www.ceskatelevize.cz/porady/15334114383-udalosti-v-regionech-jih-a-%20zapad/224411000180927/)

ČT Události v regionech - 22. 10. 2024 (Biomedicinské inženýrství)

<https://www.ceskatelevize.cz/porady/10118379000-udalosti-v-regionech-praha/224411000141022/>

Inovujeme Plzeň – 7. - 8. 6. 2024

<https://www.inovujemeplzen.cz/>

Noc vědců – 27 .9. 2024

[https://www.nocvedcu.cz](https://www.nocvedcu.cz/)

Týden s Akademií věd - 4. - 10. 11. 2024

<https://www.tydenavcr.cz/>

Let's NTIS – 11. 11. 2024
<https://info.zcu.cz/Let%E2%80%99s-NTIS-nabidla-fixaci-zlomene-panve--neurovedu--darcovstvi-kostni-drene-a-dalsi-temata/clanek.jsp?id=7391>

**2. 12. 2024** - Přednáška pro studenty gymnázia ve Žďáru nad Sázavou na téma Computational biomechanics jako součást klasické fyziky – 2. 12. 2024

V Plzni dne 17. ledna 2025

 prof. Ing. Jiří Křen, CSc.

 předseda pobočky