Témata disertačních prací k přijímacímu řízení do doktorského studijního programu na ČVUT v Praze Fakultu dopravní

Zahájení studia - 1. březen 2026

Katedra mechaniky a materiálů (K618)

Studijní program: Dopravní systémy a technika

Školitel
prof. Ing. Ondřej Jiroušek, Ph.D.

Téma:
Využití umělé inteligence pro optimalizaci 3D tištěných bio-inspirovaných struktur pro úlohy impaktní mechaniky

Topic:
AI-Driven Impact Mechanics of 3D-Printed Optimized Bio-Inspired Structures

Jazyk
český

Anotace:
This PhD project focuses on leveraging artificial intelligence (AI) to enhance the understanding and predictive modeling of impact mechanics in 3D-printed bio-inspired structures. By integrating AI-based optimization techniques with finite element simulations and experimental validation, the research aims to develop novel materials and structural designs with superior energy absorption and impact resistance. The study will explore bio-inspired architectures, additive manufacturing techniques, and AI-driven surrogate modeling to accelerate the identification of optimal configurations for high-performance applications. The work involves close collaboration between computational modeling, machine learning, and experimental impact testing, making it ideal for candidates with a background in mechanical engineering, computational mechanics, or materials science.

Literatura:
1. Zeng, C., Liu, L., Bian, W., Leng, J., & Liu, Y. (2021). Compression behavior and energy absorption of 3D printed continuous fiber reinforced composite honeycomb structures with shape memory effects. Additive Manufacturing, 38, 101842. https://doi.org/10.1016/j.addma.2021.101842
2. Peng, B., Wei, Y., Qin, Y., Dai, J., Li, Y., Liu, A., Tian, Y., Han, L., Zheng, Y., & Wen, P. (2023). Machine learning-enabled constrained multi-objective design of architected materials. Nature Communications, 14(1), 6630. https://doi.org/10.1038/s41467-023-42415-y
3. Katiyar, N. K., Goel, G., Hawi, S., & Goel, S. (2021). Nature-inspired materials: Emerging trends and prospects. NPG Asia Materials, 13(1), 56. https://doi.org/10.1038/s41427-021-00322-y

Počet doktorandů: 1

Forma studia: ***prezenční***

Školitel:
doc. Ing. Daniel Kytýř, Ph.D.
(školitel specialista doc. Ing. Tomáš Fíla, Ph.D.)

Téma:
Laboratorní rentgenové zobrazovací techniky s velmi vysokým časovým a prostorovým rozlišením

Topic:
Laboratory based X-ray imaging techniques with very high temporal and spatial resolution

Jazyk:
český

Anotace:
Actual challenges in the state-of-the-art in-situ X-ray imaging can be divided into the following key goals: to increase spatial resolution, to increase temporal resolution, to reduce scanning time, to get high quality visualizations of problematic materials, e.g., low attenuation materials like biological tissues, or materials with very different phases like polymers with metal reinforcements, and to keep costs of the measurement in a reasonable range. While the technical challenges can be overcome in particle accelerators like synchrotrons with very high costs, it is extremely demanding task in versatile laboratory based X-ray systems but with application potential. The topic of the dissertation is a development of a laboratory based X-ray computed tomography system for in-situ material testing with unprecedently high temporal and spatial resolution. To achieve this goal, a state-of-the-art liquid anode X-ray source will be integrated together with a variety of radiation imaging systems, detectors, and in-situ devices, while all the elements will be synchronized in real-time. The system will be combined with advanced data processing and post-processing methods allowing for automated analysis of large datasets, e.g., identification and tracking of damage in the material microstructure. The capabilities of the system will be demonstrated on representative applications studying time-dependent processes in biomechanics and material engineering.
The dissertation will be performed in close co-operation and sharing of research infrastructure between Department of Mechanics and Materials FTS CTU and Department of Biomechanics ITAM CAS

Literatura:
E.A. Zwanenburg et al.: Review of high-speed imaging with lab-based x-ray computed tomography, Measurement Science and Technology, 2022, 33(1), DOI:10.1088/1361-6501/ac354a
B. Nurel, et. al., Split Hopkinson pressure bar tests for investigating dynamic properties of additively manufactured AlSi10Mg alloy by selective laser melting, Additive Manufacturing, Volume 22, 2018, pp 823-833, doi:10.1016/j.addma.2018.06.001.

S.C. Garcea et al.: X-ray computed tomography of polymer composites, Composites Science and Technology, 2018, 156, DOI:10.1016/j.compscitech.2017.10.023
L. Xuekun et al.: Anisotropic Crack Propagation and Deformation in Dentin Observed by Four-Dimensional X-ray Nano-Computed Tomography, Acta Biomaterialia, 2019, 96(3), DOI: 10.1016/j.actbio.2019.06.042

Počet doktorandů : 1

Forma studia: ***prezenční***