Topics of dissertations for the admission procedure
to the doctoral program
at the CTU in Prague Faculty of Transportation Sciences

Commencement of Study: 1. March 2023

Department: **K618**

Study programme*: *Transportation Systems and Technology

Supervisor: **prof. Ing. Ondřej Jiroušek, Ph.D.**	
Topic: **Deep Learning Methods in the Design of Optimal Structures for Impact Energy Dissipation**	
Research topic is agreed with supervisor	***Language*:** **English**
***Abstract*:** **The goal of the PhD topic is research in the use of deep learning methods for the design, modeling and fabrication of structures (e.g. auxetic structures) so that an optimal combination of stiffness, strength and energy dissipation is uniquely achieved in the design while maintaining low mass. The design will take advantage of all possible auxetic microstructures with hybrid topologies, including re-entrant and chiral structures. The resulting optimal auxetic structures will be additively manufactured and tested under quasi-static and low-velocity impact for experimental validation and numerical verification. The goal of the research is to use physics-informed learning to bring new opportunities for the development of targeted materials/structures with desired behaviors through systematic inverse design, especially for aerospace and transportation applications.** **The work will be solved using modern laboratory equipment of the Department of Mechanics and Materials and utilizing wide international cooperation of the Department in this field.**	
Literatura / *References*: **Fayolle, X. & Hild, F. Exp Mech (2014) 54: 305. https://doi.org/10.1007/s11340-013-9790-x** **J.M. Franco et al., Engineering Structures 153 (2017) 97–105** **H.Z. Xing et al., International Journal of Impact Engineering 113 (2018) 61–72** **H. L. Yue et al., Applied Mechanics and Materials, Vols. 405-408, pp. 2515-2519, 2013**	
Number of doctoral students: 1	
Form of study: full-time	

Školitel / Supervisor:
prof. Ing. Ondřej Jiroušek, Ph.D.

Téma:
Využití zábleskového RTG pro studium chování materiálů při nárazovém zatížení

Topic:
The use of Flash X-ray to study the behaviour of materials under impact loading

Doktorské téma je *dohodnuté*	**Jazyk/*Language*:**
Research topic is ***agreed with supervisor***	**English**

Anotace / *Abstract*:

The topic of the dissertation is rather broad - using Flash X-ray in studying materials in impact. The aim is to experimentally investigate the dynamic response of metamaterials in moderate and high-velocity impacts. Experimental investigation utilizing gas-gun impact experiments and Open Hopkinson Pressure Bar (OHBP) technique will be used to study new composite materials and 3D printed structures at high velocity impacts. To study the deformation response of the metamaterials under impactors our Flash X-ray (FXR) radiography will be used. The candidate is expected to conduct and evaluate impact/penetration experiments of given metamaterials at various impact velocities and capture the plastic deformation and failure of the samples at different time intervals while penetrating the target with a projectile. A part of the work should be oriented at numerical simulations of the impact event using commercial FE code LS-DYNA and comparison of the results of numerical simulations with the experimental FXR images.

The work will be solved using modern laboratory equipment of the Department of Mechanics and Materials and utilizing wide international cooperation of the Department in this field.

***References*:**

Number of doctoral students: 1

Forma studia: ***prezenční***
Form of study: full-time

Supervisor:
doc. Ing. Daniel Kytýř, Ph.D. (supervisor specialist Ing. Tomáš Fíla, Ph.D.)

Topic:
High speed X-ray radiography in low to medium velocity impact dynamics

Research topic is ***agreed with supervisor***	**Jazyk/*Language*:**
	English

Anotace / *Abstract*:

The topic of the dissertation is an application of high speed X-ray radiography in impact dynamics with low and medium impact velocities. The goal is to conduct the instrumented impact experiments with strain rate in range from 0.1 to 1000 1/s (approximately corresponding to the impact velocities of 0.1 - 20 m/s) together with high speed X-ray imaging of the specimen during the impact. For the experiments, the direct impact stage equipped with linear motors or a variety of split Hopkinson bars will be used. The high speed X-ray imaging will be performed using a

stationary high power X-ray source in combination with a scintillation panel and high-speed camera or state-of-the-art direct deposition X-ray imaging detector. The subject of the dissertation will be to investigate capabilities of high speed X-ray imaging during the impact experiments for detection of deformation mechanisms in porous solids or for identification and tracking of defects in the specimen, including analysis of crack development and propagation. During the dissertation, it is expected that the candidate will research also the techniques for volumetric analysis, i.e. methods of computed tomography, digital image/volume correlation based on X-ray projections, or methods combining X-ray data with the information from the surface of the specimen. The outcome of the dissertation will be an application of novel experimental approach for characterization of complex materials under dynamic loading.

The work will be solved using modern laboratory equipment of the Department of Mechanics and Materials and utilizing wide international cooperation of the Department in this field.

***References*:**

Number of doctoral students: 1

Form of study: full-time

Topics of dissertations for the admission procedure to the doctoral program at the CTU in Prague Faculty of Transportation Sciences

Commencement of Study: 1. March 2023

Department: **K620**

Study programme*: *Smart Cities

***Supervisor*:** **Prof. Dr. Ing. Miroslav Svítek, dr. h.c.**	
Topic: **Smart parking as a part of a smart city**	
Research topic is **agreed with supervisor**	***Language*:** **english**
***Abstract*:** **Smart parking is an integral part of a smart city. As part of autonomous mobility, charging solutions for electric cars or refueling for hydrogen vehicles will be studied. The entire chain of autonomous mobility will be modeled using "resource-demand" agent systems, as supply will certainly exceed demand. Special algorithms for smart parking management will be tested at selected locations in Prague.**	
***References*:** **Svítek M., Skobelev P., Kozhevnikov S.: Smart City 5.0 as an Urban Ecosystem of Smart Services, chapter in SOHOMA 2019. Studies in Computational Intelligence, vol 853. Springer, Cham, 2020, ISBN 978-3-030-27476-4, pp. 426 - 438** **Kozhevnikov S., Svitek M., Skobelev P.: Multi-agent Approach for Smart Resilient City, chapter in SOHOMA 2020. Studies in Computational Intelligence, vol 952. Springer, Cham https://doi.org/10.1007/978-3-030-69373-2_15**	
Number of doctoral students: 1	
Form of study: **full-time**	