Study programme: Applied Mechanics

	Téma disertační práce	Školitel	Katedra
1.	**Experimental and theoretical research of the mechanical properties of composites reinforced with selected types of hybrid textiles and numerical modelling of their response to mechanical loads using FEM based on a suitable material model** **Abstract:** Such composites are used in innovative lightweight structures in aerospace and automotive industries. The subject of the work will be the design and verification of the type hybrid textile reinforcement and a method of composition of the different materials with respect to the required rigidity strength and durability of the composites in accordance with the technical requirements of function, particularly with respect to dynamic load and impact. The research of the response of composites to loading speeds and the research of the failure of the composite.	prof. Ing. Bohdana Marvalová, CSc.	KMP
2.	**Experimental and theoretical research of the mechanical properties of composites with the matrix of acrylic resin reinforced by natural fibres and textiles of natural fibres. Numerical modelling of their response using FEM based on a suitable material model** **Abstract:** Experimental and theoretical research on mechanical properties of composites with the matrix of acrylic resin reinforced by natural fibres and textiles made of natural fibres. Numerical modelling of their response using FEM. Water-based acrylic resins are suitable for composites with natural fibres reinforcement for good wettability. Such composites are 100% green as even during their cure do not release any harmful organic substances. The composites are lightweight and are used in the automotive and aerospace industries.	prof. Ing. Bohdana Marvalová, CSc.	KMP
3.	**Localized deformation processes in NiTi based shape memory alloys** NiTi shape memory alloys (SMAs) in form of wires and ribbons are being used in medical devices and technical applications as they exhibit large reversible deformations (e. g. vascular stents) and can actuate cyclically upon heating and cooling (e. g. switches, actuators, thermal regulators). These functional properties stem from thermally and stress induced changes in microstructure (crystal lattice) called martensitic	Dr. Luděk Heller (Institute of Physics of CAS, heller@fzu.cz) doc. Ing. Iva Petríková, Ph.D.	KMP

	transformations, which can proceed reversibly in SMAs unlike in steels, where they are accompanied with plastic deformation resulting in the hardening effect. The stress-induce martensitic transformation in NiTi is localized; it nucleates and proceeds in shear bands of transformation deformation (http://ofm.fzu.cz/localized-deformation-of-niti-in-tension). The shear band fronts act as stress concentrators and, hence, contribute to the overall low fatigue performance of SMAs being the key obstacle to development of novel NiTi-based applications. The subject of the PhD dissertation is analysis of origins, mechanisms, and morphology of shear banding in NiTi with regard to loading modes, sample shapes, and microstructure parameters. Localized plastic deformation accompanying the martensitic transformation is yet one another aspect of the subject. The ultimate goal of the dissertation is a better understanding of localized deformation processes in NiTi based alloys on the level of continuum mechanics.		
4.	**Mechanics of grain interactions in polycrystalline metals** Metals are mostly used in polycrystalline form where the individual grains sizing from nm to mm interacts with their neighbours due to different orientations and elastic anisotropy of the crystal lattice. Consequently, the interactions lead to inhomogeneous strains and stresses within the grains. Strains and stresses must be then considered as distributions whose mean values over a sufficiently large neighbourhood (representative volume element) correlate with the strains and stresses predicted by continuum mechanics ignoring the grain structure. Besides the elasticity, the grain interactions arise also from other deformation mechanisms on the crystal lattice level such as plasticity by dislocation slip and twinning, and martensitic transformation. Nowadays, experimental methods can probe the structure, and strains and stresses in individual grains of polycrystalline metals subjected to loadings. Furthermore, the geometry of internal grain structure of polycrystals can created using tessellation algorithms. Finally, the geometry can by used in finite element codes to simulate the grain interactions. The subject of the dissertation is analysis of grain interactions within a polycrystalline metal sample the model of which is based of an experimental dataset. The aim of the dissertation is to find correlations between the morphology of grain structure (grain sizes and orientations, grain boundary orientations, grain misorientations) and grain interactions in the regime of elastic deformations and, possibly, plastic and transformation deformation processes.	Dr. Luděk Heller (Institute of Physics of CAS, heller@fzu.cz) doc. Ing. Iva Petríková, Ph.D.	KMP
5.	**Termomechanics of laser annealed NiTi based shape memory alloys** NiTi shape memory alloys (SMAs) in form of wires and ribbons are being used in medical	Dr. Luděk Heller (Institute of Physics of	KMP

	devices and technical applications as they exhibit large reversible deformations (e. g. vascular stents) and can actuate cyclically upon heating and cooling (e. g. switches, actuators, thermal regulators). These functional properties stem from thermally and stress induced changes in microstructure (crystal lattice) called martensitic transformations, which can proceed reversibly in SMAs unlike in steels, where they are accompanied with plastic deformation resulting in the hardening effect. The thermomechanical treatment of semi-finished products from NiTi using laser annealing mechanical constrains enables to set the shape and functional properties in a wide range. The subject of the PhD dissertation is a general analysis of how the laser treatment can be used to modify the martensitic transformation proceeding in NiTi wires and ribbons in terms of transformation stresses and strains, localization, accompanying plasticity and fatigue properties. In more detail the laser surface annealing under stress is to be studied with the aim to introduce compressive stresses in order to improve the fatigue performance. The aim of the PhD dissertation is a better understanding the relation between the thermomechanical behaviour of NiTi wires or ribbons and parameters of laser annealing under mechanical constraints.	CAS, heller@fzu.cz) doc. Ing. Iva Petríková, Ph.D.	
6.	**Experimental research of synthetic jet using 3D PIV** Dissertation thesis will be focused on the experimental research of a synthetic jet from a SJ actuator. Research will be performed using 3D PIV method. The velocity and pressure fields will be investigated. PIV experiments will be supported with other experimental methods like visualization, thermoanemometry, and laser Doppler vibrometry.	doc. Ing. Petra Dančová, Ph.D.	KEZ
7.	**Investigation of the material response on cavitation field impact** The thesis will be focused on the description of the material response on the cavitating flow impact. Experimental and numerical techniques will be used. The experiment will be based on the measurement of bubble impact by PVDF sensors and evaluation of pitting tests. FEM and CFD methods will be used to describe the material deformation under cavitation load.	doc. Ing. Petra Dančová, Ph.D.	KEZ