

## Study programme: Machines and Equipment Design

	Ph.D. Thesis Topic	Supervisor	Department
1.	<p><b>Vibroinsulation systems of transported objects</b>  <b>Abstract:</b> Vibroinsulation systems of the transported objects concern the problem of minimizing the vibrations transmitted to the transported objects or persons in the means of transport. The solution is centered on the structure of the support device, which allows to control the stiffness and damping of the connection of the transported object to the vehicle frame. This requirement is necessary for optimal tuning of the system solved with regard to instantaneous kinematic excitation caused by uneven road. The doctoral thesis will design guiding mechanisms of vibroinsulation system, elastic and damping elements. Simulation of their behavior under operating conditions will be performed and dynamic parameters optimized. The dissertation will also solve the design of the selected vibroinsulation system and the production of its functional sample.</p>	prof. Ing. Lubomír Pešík, CSc.	KST
2.	<p><b>Using methods of detection and localization of damage on rolling parts of machinery</b>  <b>Abstract:</b> The Ph.D. thesis will focus on research and study the possibility of using the methods of detection and localization of damage on rolling parts of machinery. These methods are as a tool for more accurate identification of the origin and development of damage on rolling parts leading to the design of appropriate structural modifications. Experimental measurements will be carried out to obtain information describing the emergence and spread of defect and the influence of operating conditions on the identification of wear damage detected in the character of the sensed signal.                      During your work, you can use software and measurement analysers that are available at the Department of Vehicles and Engines.</p>	doc. Dr. Ing. Elias Tomeh	KVM
3.	<p><b>Research and development of an application head</b>  <b>Abstract:</b> Research and development of the application head, which will be placed at the end of a robotic arm (or other positioning mechanism). This head's task rests in the application of concrete (or other) building material in the individual layers to</p>	doc. Ing. Petr Lepšík, Ph.D.	KST

	<p>create an object. The head's functions and parameters will be based on material needs (a need for additives to be supplied directly into the head, mixing the mixture in the head, temperature control, etc.) and the needs of the construction process itself (flow rate control, flow closing, smoothing and forming of the applied layer, etc.). It will result in a tested functional prototype and a patented solution for the application head. New methods of product design or innovation (e.g. TRIZ, additive technology, etc.) will be applied to design development.</p>		
4.	<p><b>Research and development of light constructions made of composite materials</b>  <b>Abstract:</b> The aim of the dissertation is to develop knowledge in the design of light constructions made of composite materials consist long prepregged carbon fibers. The aim will be to develop a comprehensive methodology for designing light constructions of more complex shapes in order to achieve the required mechanical properties. In addition to the methodology, a functional sample of a lightweight construction replacing the selected construction of conventional materials will be made. The research will be based on literary review, design, implementation and evaluation of experiments and numerical modeling.</p>	doc. Ing. Petr Lepšík, Ph.D.	KST
5.	<p><b>Research of thermo-acoustic cooling device</b>                  The aim of the study is theoretical description (on high level) of the thermo-acoustic device which could be possibly used for cooling of microelectronics, design of experimental arrangement with possibility of changing basic parameters, suggestion of experimental approaches and preparation of experiments, implementation and evaluation of experiments and analyses of results with numerical calculations.</p>	prof. Ing. Tomáš Vít, Ph.D.	KEZ
6.	<p><b>Vision systems for wide range of optical electromagnetic spectrum</b>                  There is currently a proved methodology of image acquisition and processing for visible spectrum. However, the situation is different when talking about detection of transparent materials, or environment highly loaded by interfering effects (e.g. parasitic reflections) and noise. There is no complex methodology which would include hardware and software solution of these problems. There is a strong potential for a development of such a methodology by use of wider range of optical spectrum - from ultraviolet to infrared electromagnetic radiation.                  Theoretical part of the study will be oriented to a problem of image acquiring in wider range of an optical radiation, image analysis, technological scene evaluation and</p>	doc Ing. František Novotný, CSc.	KSR

	<p>generating of 3D models. The task will also be the implementation into control system. During the study it will be necessary to manage physical principals of acquiring techniques, methodology and software requirements of image analysis. The experimental part will focus on suitable and non-convention methods of 3D data acquiring. It will be necessary to describe in detail physical principle and relations for 3D model calculation. Based on executed experiments it will be necessary to set appropriate principle parameters, limits and boundary conditions. In the practical part, particular tasks of image acquiring and analysis will be solved for difficult possibilities of imaging and object defining. It will also include the connection with control systems and implementation to robot control. Student's work will be oriented to spread application possibilities of machine and robot vision in industrial praxis. Student's invention is expected by practical solving of particular task, programming and experimental results evaluation.</p>		
7.	<p><b>Collaborative robots for medical rehabilitation application</b>          Providing the possibility of direct contact of robotic effector with human, the interactive robotics is a new trend in mechatronics. This possibility provides a wide range of new activities in medical applications. Using robots for medical rehabilitation is one of the major applications. In this context it is very interesting to use the interactive robot for optimization of rehabilitation device movement's trajectories with respect to patient's biomechanical parameters.          It is assumed, that student gains overview of safe human-robot interaction system with respect to biomechanical parameters (limb mobility). In a theoretical part of the solution a thorough background research with biomechanical parameters analysis with the possibility of 3D trajectories planning will be performed.          In a practical part of the study a possibility application of IIWA robots, available in a laboratory of the interactive robotics, will be monitored. IIWA robots will be applied in a field of the upper limb movement rehabilitation activities. Specific adjustable effector with elastic type of contact for selected arm part grab will be designed. The whole system will be verified in laboratory conditions.          Understanding the physiological issues and systematical studies will be required from a student. Procedures and results will be consulted with professional medical personnel. Creative and innovative approach to test and design engineered device will be mandatory.</p>	doc Ing. František Novotný, CSc.	KSR

8.	<p><b>Flexible Robot Effectors for Gripping of Sensitive and Rheological Objects</b>                  Interactive robotics is a new phenomenon based on a direct contact between robot effector and human. In context with supporting topics of Industry 4.0, initiative HRI robotics is supplemented by appropriate safety parameters in critical system structures. That means, autonomous interactive robots with safe flexible grippers for interactive communication with human are being implemented.                  This opens a wide range of topics in effector robotics field. One of the huge topics is problem of electric servo-drives for effectors with force, position and combined control of gripper – object interaction. Another strong topic are new design principles and materials with controlled toughness for gripper application. Individual problem here is a gripper (effector) flexibility, based on ability of gripping element space configuration.                  Understanding the mechatronic aspects of drives, used sensors, effector designing principles and control system communications and systematical studies will be required from a student. During gained theoretical knowledge verification for experimental robotized workplace with flexible effectors for aimed application student's invention is expected.</p>	doc. Ing. František Novotný, CSc.	KSR
9.	<p><b>Research of cooling of microelectronics systems</b>                  Increase of cooling intensity of microelectronics becomes one of the most important topics in the field of design of portable consumer electronics devices                  Usage of conventional cooling systems as standard fans in microelectronics is extremely disadvantageous.                  It is therefore necessary to find new physical principles to design miniaturized air mover systems. Most promising are cooling systems based on Ion Wind Synthetic Jets technologies.                  The aim of this work is to summarize current knowledge and modern techniques in the field of cooling of microelectronic systems, develop appropriate physical models, and design an algorithm for the numerical simulation of cooling processes in microelectronics.</p>	doc. Ing. Petra Dančová, Ph.D.	KEZ