University
of Pardubice
Faculty of Transport
Engineering

Doctoral Dissertation Thesis Topics for academic year 2019/2020
Study program: Transport Means and Infrastructure

Department of Transport Means and Diagnostics

Performance assessment of lubricants and friction modifiers for the wheel–rail interface

Supervisor: doc. Ing. Petr Voltr, Ph.D.
Mode of study: full time / part time
Annotation:

In railway operation, materials for lubrication or, more generally, modification of friction conditions at the wheel–rail interface are used. Laboratory assessment of performance of these materials (i.e. if and to what extent they display the required effect on friction conditions) employs twin-disc machine testing. Testing methods exist and are even reflected in European standards; in practical use, however, some uncertainties and imperfections show up. The dissertation should aim at improvement and clear definition of methodology for twin-disc testing or possibly propose new procedures. The research should also include finding correlation between results of these tests and full-scale roller rig measurements.

Transient phenomena and combined factors in wheel–rail adhesion

Supervisor: doc. Ing. Petr Voltr, Ph.D.
Mode of study: full time / part time
Annotation:

Conditions determining the adhesion performance of rail vehicles in operation result from a superposition of many factors which, in addition, can change in time. It is desirable to deal particularly with the cases of opposite effects, e.g. contamination and HPF modifier or conditioning by sliding. These phenomena are often studied in a constant slip setup, however real vehicle performance depends on realistic scenarios with variable slip. The aim of the dissertation should be to progress knowledge on combined and non-stationary adhesion phenomena with the use of roller rig experiments and modelling.

Measuring system of longitudinal force effects in wheel-rail contact

Supervisor: prof. Ing. Bohumil Culek, CSc.

Mode of study: full time / part time

Annotation:

The aim of the work is determination of new measurement method of tangential forces FT. The research will be based on:

- the analysis of longitudinal brake/tensile forces (tangential forces FT) in the wheel-rail contact with respect of the research of adhesive properties,
- the possibility of continuous measurement of FT forces based on measurement of wheel deformation (use of semiconductor strain gauges),
- the shape of the output signal measured force FT in the context of the elimination of parasitic influences (influence of transverse force effects, influence of vertical force effects, influence of temperature changes, influence of centrifugal forces),
- the solving of the problem of on-line determination of FT forces under real operating conditions.

The solution will be based on:

- the FEM calculations of the wheel disc deformation from FT forces,
- the available experimental results from measurement of wheel disc deformations,
- the experiments on Full-size Roller Rig, DFJP,
- the experiments on calibration stand of measuring wheels, VÚKV.

Experimental research of spin influence on the forces in wheel-rail contact

Supervisor: prof. Ing. Bohumil Culek, CSc.

Mode of study: full time / part time

Annotation:

The aim of the work is research of the spin influence on the mechanical quantities in the wheel-rail contact by experimental way (force effects, possible influence on the natural frequency of the wheelrail assembly). All experiments will be done on the Full-size Roller Rig (DFJP) – Wheel-rail testing facility.

The research will be based on:

- the theoretical analysis of the spin influence on the forces in wheel-rail contact with respect of given operating conditions of the Roller Rig,
- proposal of experiments on the Roller Rig Testing Equipment to determine/confirm of the spin influence on the forces in the wheel-rail contact,
- Implementation of experiments for states:
- without tangential slip of the contact surfaces,
- with tangential slip,
- with transverse slip caused by the rise angle,
- with slip combination.

All test will be done by variable operating speeds and contact forces.

Design of computational models of dynamic states simulation for car tire loading

Supervisor: doc. Ing. Jan Krmela, Ph.D.

Mode of study: full time / part time

Annotation:

The aim is to design computational models in a selected program based on the finite element method, which will simulate dynamic operating conditions of tire loading and give adequate results. Verification will take tests on a tire dynamic test machine.

Design of a method for evaluating of experimental data from a dynamic tire test machine for tire loading prediction

Supervisor: doc. Ing. Jan Krmela, Ph.D.

Supervisor - specialist: Ing. Petr Jilek, Ph.D.

Mode of study: full time / part time

Annotation:

The aim is to propose a method for the evaluation of experimental data in order to predict dynamic tire loading and stiffness parameters. The output will also be a mathematical relationship that can predict the behavior of the rolling tire based on vehicle speed, inflation pressure, contact surface, casing geometry and other parameters.

Mathematical description of tire loading states in relation to used tire casing materials with experimental verification

Supervisor: doc. Ing. Jan Krmela, Ph.D.

Supervisor - specialist: Ing. Petr Jilek, Ph.D.

Mode of study: full time / part time

Annotation:

The aim is to find a mathematical description of the relationship between load and deformation of the tire casing, which will help to express the various static and dynamic tires states with include the material parameters of the individual tire casing parts, the tire inflation pressure and the geometry of the tire casing. Experimental verification will be done by measuring on static and dynamic test machines.

Computer program formation to obtain stiffness of car tires from the aspect of material, geometry and other tire casing parameters

Supervisor: doc. Ing. Jan Krmela, Ph.D.

Mode of study: full time / part time

Annotation:

The aim is creation of a computer program to obtaining tire stiffness. Input data into the program are material parameters of each individual tire casing parts with include material models of elastomers, operating conditions, experimental data from dynamic tests etc. Verification will be done on based results from tests on dynamic test machine.

Mathematical model of secondary suspension of rail vehicles
Supervisor: doc. Ing. Jaromír Zelenka, CSc.
Supervisor - specialist: Ing. Martin Kohout, Ph.D.
Mode of study: full time
Annotation:
The utilization of computational simulations in design phase or in approval process of rail vehicles is based on knowledge of the characteristics of spring and damping elements. The aim of the thesis is to create a parametric mathematical model of the secondary suspension used in computational simulations of running and guiding behavior of rail vehicles based on theoretical knowledge and results of some experiments. Part of the work should be the design of the suspension testing methodology, the design of the test equipment and the realization of some tests in the laboratory conditions of the Jan Perner Transport Faculty.

Department of Transport Structures

Probabilistic lifetime evaluation of steel bridges
Supervisor: doc. Ing. Bohumil Culek, Ph.D.
Mode of study: full time / part time
Annotation:
The work will deal with the methodology of probability assessment of fatigue life of steel bridges with regard to variability of input data. The subject of the work will be analysis of current state of knowledge, evaluation of probabilistic fatigue lifetime methodology, realization of strain gauges measurements of selected bridge constructions, creation of FEM models, implementation of experimental measurements on dynamic test stand, validation / verification of results.

Empirical determination of fatigue curves
Supervisor: doc. Ing. Bohumil Culek, Ph.D.
Mode of study: full time / part time
Annotation:
The work will focus on the empirical determination of the fatigue curves with respect to the sample geometry and the mode of cyclic loading. The subject of the work will be analysis of the current state of knowledge, with regard to various hypotheses of fatigue lifetime assessments, determination of boundary conditions and their influence on the calculation, determination of evaluation methodology, validation of results on dynamic test stand. The theoretical and experimental procedures will be used

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Department of Mechanics, Materials and Machine Parts

Multiphase Steels for Transport Means Safety Parts
Supervisor: prof. Ing. Eva Schmidová, Ph.D.
Mode of study: full time / part time
Annotation:
The doctoral work will be focused on research in the field of advanced high-strength steels, applied for transport means passive safety parts. The analyses of material processes, under influence of the high strain rate and internal imperfections according the fracture mechanics parameters, will be the main part of the work. Complex material analyses will be used for research of included strengthening and plasticity processes.

Behavior of high-strength steels for transport means exposed to lower temperatures

Supervisor: prof. Ing. Eva Schmidová, Ph.D.

Mode of study: full time / part time

Annotation:

The research will be focused on transition behavior of high-strength steels or their welding joints, leading to safety decrease due to lowered temperature. The intention is to bring new information towards to prediction of the limit state based on fracture energy capacity drop, including the fracture mechanics approach. Comprehensive material analyzes of involved processes, influencing the fracture mechanisms will be the substantial part of experimental study.

Physical energy pretreatment of metallic materials for glue joint at transport vehicle construction

Supervisor: doc. Ing. Pavel Švanda, Ph.D.

Mode of study: full time / part time

Annotation:

Aim of this work is to study of pretreatment of metallic surface by physical energy for glue joints. The surface pretreatment may be usage at transport vehicle manufacturing. Theoretical part of study will be target the selection of suitable pretreatments. In practical part of study will be evaluate the surface state before and after pretreatments. In the work will be study the strength of prepared glue joints ant their stability during service life.

Department of Electrical and Electronic Engineering and Signaling in Transport

Indirect Microwave Holography for Transport Security Imaging Systems

Supervisor: prof. Ing. Vladimír Schejbal, CSc.

Supervisor - specialist: Ing. Dušan Čermák, Ph.D.

Mode of study: full time / part time

Annotation:

The basic theory of indirect microwave holography and how it can be used for the determination of antenna far field patterns and the reconstruction of antenna aperture fields. Analyses how the technique can be used for both planar scanning and cylindrical scanning. Measurement analyses for medium gain antennas of wide spectral extent and imaging of concealed metal and dielectric objects. Utilization for transport security imaging systems.

MIMO Antennas for Transport Telecommunications

Supervisor: prof. Ing. Vladimír Schejbal, CSc.

Supervisor - specialist: Ing. Dušan Čermák, Ph.D.

Mode of study: full time / part time

Annotation:

The basic theory of antenna arrays, especially MIMO antennas. The new technologies such as 5G, UWB, IoT and automotive applications considering various issues such as electromagnetic compatibility, electromagnetic interferences and electromagnetic susceptibilities.