# Doctoral Dissertation Thesis Topics for academic year 2025/2026

## 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: Assoc. Prof. Petr Voltr, Ph.D.**
**Supervisor specialist: Ing. Stanislava Liberová, Ph.D.**
**Form 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: Assoc. Prof. Petr Voltr, Ph.D.**
**Form 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.

**Diagnostics of rail vehicles running gear**
**Supervisor: Assoc. Prof. Petr Voltr, Ph.D.**
**Supervisor specialist: Ing. Jakub Vágner, Ph.D.**
**Form of study: full-time/part-time**

**Annotation**
Industry 4.0 brings new on-board diagnostic systems based on vibrodiagnostics applied in the running gears and driving systems of rail vehicles. The development of new sensor types also enabled new applications in the field of way-side diagnostics, where information on vehicles are obtained from trackside measurements. The PhD thesis will include review of existing on-board and way-side solutions and their comparison in terms of measurement principles as well as parameters. Based on this, the aim of the thesis is to develop novel procedures for data evaluation using up-to-date computational methods. Proposed algorithms will be tested on an available extensive dataset from real operation.

**Diagnosis of track state by a running railway vehicle**
**Supervisor: Assoc. Prof. Tomáš Michálek, Ph.D.**
**Supervisor specialist: Ing. Martin Kohout, Ph.D**
**Form of study: full-time/part-time**

**Annotation**
The idea of diagnostics of track conditions using a running vehicle is not new in principle and is commonly used to monitor standard geometric parameters of the track. However, the development of measurement technology is creating the prerequisites to be able to directly assess the dynamic interaction of the running vehicle and the track. The aim of this work is to assess the possibilities diagnostics of turnouts/track using running vehicles deployed in normal operation and to propose a methodology for the evaluation of measured data, aimed at supporting predictive maintenance of turnouts/track.

**Research of selected dynamic and transient phenomena in the electromechanical system of rail vehicle drives**
**Supervisor: Assoc. Prof. Michael Lata, PhD.**
**Form of study: full-time/part-time**

**Annotation**
The theme is focused on dynamic events in the system of wheelset drive that arise during the transitions between the equilibrium states of the system and are buoyed by non-linearity on the part of the electric drive, the adhesive mechanism, the parameters of excitation between wheels and rails and the very parameters of the propulsion system such as rigidity, damping, transmission parameters, etc. The issue can be addressed in a time plane or frequency area and by simulation methods or experiments on a test bench, possibly by comparing them.

**Analysis of the context of torsional dynamics of driving rail vehicles and rail surface defects (corrugation)**
**Supervisor: Assoc. Prof. Michael Lata, PhD.**
**Form of study: full-time/part-time**

**Annotation**
The theme aims to demonstrate the link between the emergence of the undulations of rails and the dynamics of the torsional system of wheel drive. In the electromechanical system of wheelset drive, transition events are created that are characterized by the formation of torsional oscillations that ultimately cause the oscillating component of the tangential force on the wheel circumference, which may be one of the causes of typical regular defects in the rail surface.

## Department of Electrical and Electronic Engineering and Signalling in Transport

**Finding, specification and visualization of a complex railway signalling system characteristics**
**Supervisor: Ing. Jan Ouředníček, Ph.D.**
**Form of study: full-time/part-time**

**Annotation**
The subject of the study is identification of operational and technical hazards and operational needs of railway system as well as the determination of a suitable method for specification and visualization of a complex railway signalling system characteristics. The goal of the work is the specification of the required characteristic of the complex railway signalling system.