THE JAN PERNER TRANSPORT FACULTY

CATALOGUE

OF

R&D, CONSULTATION,
EXPERT AND SERVICE ACTIVITIES

Content

Department of Transport Technology and Control

Head of department: doc. Ing. Pavel Drdla, Ph.D.
Telephone: +420 466 036 204
E-mail: pavel.drdla@upce.cz

Research and Development

- Optimization of technological and logistical processes in all the transport modes;
- Transport simulation and modelling;
- Application of operational research methods and modelling in transport processes;
- Modelling of logistical processes and location of service centres;
- Intermodal transport systems;
- Crisis management in transport systems;
- Accessibility of public transport systems for the disabled;
- Creating of transport systems plans (public transport services in a particular area);
- Integration of transport modes in the Integrated public transport system;
- Periodic character of traffic on transportation networks;
- Urban planning and transport engineering.

Software equipment

- OmniTRANS – software for modelling of transport (for transport planning) which uses a four-step model (multi-modal multi-temporal system particularly suited to model the interactions of transport modes in an urban context with aggregate and disaggregate demand modelling methods);
- OpenTrack – support software for railway transport research (it is based on a mathematical simulation model) in the following branches:
  - infrastructure (its scope, topology);
  - transport means (a vehicle ride simulation);
  - traffic (research of a timetable stability and resilience);
- Viriato – software for operational timetable planning in railway transport, for creating of traffic concepts with regard to parameters of track and rail vehicles;
- Skeleton – support for creating of railway and public (city) transport timetables;
- Virtual Crash – simulation and analysis of traffic accidents;
- ESRI ArcLogistic – software for routing and scheduling of fleet and organization of deliveries, optimization of transport problems;

- ESRI ArcGIS – geographic information system;
- Solid Edge – support for creation of technical documentation;
- DOP3sim – simulation of rail traffic management in a line (track);
- Simlog – Simulation of a Station Dispatcher office.

Consultation activities

- Urban planning – cooperation in creation of urban development plans (for transport) and plans for sustainable mobility in urban areas, proposals of changes, creating of map basis;
- Transport Engineering – organization of individual car transport on a transport network, crossroads analysis, organization of bicycle traffic in urban areas and its surroundings, road and traffic facilities pasportization, transport surveys, transport prognosis and prognosis of the traffic flows intensity, transport demand and offer analysis in the branch of transport flows intensity;
- Barrier-free transport – accessibility of transport systems for the disabled (wheelchair users, blind, deaf or otherwise handicapped people);
- Public transport – integration of personal public transport subsystems, quality of public transport services, creation of transport service plans, optimization of line routing and optimization of timetable, public transport system organization, assessing the formation of new public transport systems (or subsystems), preference of public transport systems;
- Simulation of railway traffic – simulation of technological processes in railway transport, transport demand simulation and its relation to traffic on the railway lines, capacity of railway tracks;
- Modelling in transport – transport-decision problems modelling, models related to vehicle load capacity usage, etc.;
- Logistic and freight transport – optimization of store and loading operations, modelling of logistical processes, draft of distribution systems (hub-and-spoke systems, regionalization, circle riding), locations of service centres and creation of their attraction range, support of activities related to logistic centres networks for combined transport;
- Transport in Crisis situations – assessment of a relation between infrastructure and traffic during crisis situations, solving with use an operational research methods, transport plan for logistics support during evacuations.

Department of Informatics in Transport

Head of department: doc. Ing. Vladimír Jehlička, CSc.
Telephone: +420 466 036 519
E-mail: vladimir.jehlicka@upce.cz

Section of Software Systems in Transport

Research and Development

- Information and control systems in transport;
- Optimization methods and location problems on transportation networks;
- Web and desktop applications programming.

Section of Applied Mathematics

Research and Development

- Applications of operation research methods related to the fields of Transport and Logistics systems;
- Applications of statistics in transportation and decision making in transportation systems;
- Applications of fuzzy logic in transportation processes;
- Applications of genetic algorithms in optimization.

Consultation activities of the department

- Computer networks;
- Development tools and application development;
- Multimedia and web applications;
- Image analysis;
- Optimization methods on transportation networks.

Department of Transport Management, Marketing and Logistics

Head of department: doc. Ing. Libor Švadlenka, Ph.D.
Telephone: +420 466 036 375
E-mail: libor.svadlenka@upce.cz

Research & Development

- Financial and economic aspects of transport operation;
- Transport policy, sustainable transport, effectiveness of transport system;
- Subject behaviour in transport system;
- Creation of traffic participant value and transport services value research;
- Theory of management and its application in transportation;
- Safety and crisis management in transport;
- Issues related to logistical securing of collection operations;
- Issues of transport services in a broader context;
- Issues of operation and economics in the sector of electronic communications and postal services.

Software equipment

1. StatSoft – Statistica;
2. StatSoft – Statistica (neural networks);
3. SPSS PAWS Statistics;
4. LOGI;
5. COLLI;
6. Specialized collection of software products including:
    - Economical and financial analyses;
    - Cost calculation;
    - Logistics;
    - Forwarding;
    - Support means of management, marketing, decision making theory and managerial activities.

Consultation activities

- Economic aspects of transport;
- Transport systems – theory and technology in relation to economics and management;

- Subject behaviour in the transport system;
- Value of transport services for its users;
- Methods and techniques of management applied in transport and logistics;
- Logistics;
- Logistic systems;
- Decision making in transport from the point of logistic costs;
- Issues of investment evaluation in the transport sector;
- Financial analysis of transport services and subjects influencing transport market;
- Principles of electronic communications and postal services regulation sector;
- General services provision in the sector of electronic communications and postal services;
- Legislation in the sector of electronic communications and postal services.

Department of Electrical and Electronic Engineering and Signalling in Transport

Head of department: Assoc. Prof. Radovan Doleček, Ph.D.
Telephone: +420 466 036 427
E-mail: radovan.dolecek@upce.cz

Research & Development

- Development of electrical machines and their parameters optimization and measurements (development of asynchronous dynamometers and eddy-current brakes for control of transport means);
- Development of control systems for power supplies of electric railways;
- Development of multilateration systems for air traffic control;
- Development of FMCW anticollision radar systems;
- Development of control systems for permanent magnet synchronous motors used for traction.

Equipment Gadgets

1. Test stand with permanent magnet synchronous motor;
2. Test dynamometer for revolving machines up to 5kW;
3. Frequency converters for power supply of three-phase motors;
4. AC power supply of 3x 0-600V/10kW (booster);
5. Cylindrical dynamometer with eddy-current brake for measurement of static and dynamic power of single track vehicles up to 100kW;
6. Test stand for road vehicle alternators;
7. Service analyzer for emission measurements of spark-ignition engines;
8. Bosch KTS 550 and VAG-COM serial diagnostics;
9. 8 channel oscilloscope Autoscope 2 with accessories;
10. Standard laboratory equipment:
    - Digital oscilloscopes with voltage and current probes;
    - Function generators;
    - Laboratory DC and AC power supplies;
    - Analogue and digital measuring equipment.

Consultation activities

Automotive techniques and autotronics

- Power measurement of single track vehicles up to 100kW using cylindrical dynamometer;
- Service emission measurement of spark-ignition engines;
- Serial and parallel diagnostics of road vehicles;
- Computer model design of combustion engines and hybrid drives.

Electric drives

- Measurement and analyses for electric machines;
- Measurement and analyses for electric power engineering;
- Analyses of traction power supply and power engineering;
- Design and application of regulator systems for traction drives.

Department of Mechanics, Materials and Machine Parts

Head of department: Ing. Petr Tomek, Ph.D.
Telephone: +420 466 036 698
E-mail: petr.tomek@upce.cz

Research & Development

- Strength and loss of stability of thin-walled shell structures;
- The strength and fatigue of parts of railway vehicles;
- The strength, loss of stability and fatigue of machines and equipment in the process industry and energy industry (in general engineering applications);
- Bonded connections in technical practice, pretreatment technologies of metal surfaces prior to bonding;
- Micro and macro structure of steels related to materials properties;
- Physical metallurgy and limited states of materials:
  - Degradation mechanisms due to contact – fatigue loading;
  - Structural stability of heterogeneous welding joints.

Equipment Gadgets

- Universal testing machine for measuring the strength of materials in compression and in tension with the record of data in the PC;
- Optical system ARAMIS 4M;
- Stereo-microscope NIKON SMZ 800, light microscope Neophot 32, image analysis AnalySiS DOCU Olympus;
- Universal Hardness tester ZWICK ZHU 2.5/Z2.5, Micro-hardness tester ZWICK / ROELL ZHV 10;
- Contact roughness tester Mitutoyo SURFTEST SJ-210;
- Scanning electron microscope TESCAN VEGA 5130SB;
- Energy Dispersive Spectroscop EDX Bruker Quantanax 200;
- Electron Backscatter Diffraction Analysis - detector Quantax CrystAlign 400i;
- Instrumented impact tester RKP 450.

Consultation activities

- Expert witness in the field “general engineering, pressure and non-pressure vessels and equipment, boilers, piping and steel structure, calculations of strength and fatigue, the causes of failures and accidents”;

- The strength, loss of stability and fatigue of nuclear facilities (primary, secondary circuit, auxiliary operations);
- The area of process industry and power industry;
- General engineering applications;
- Phase and structural evaluation of steels related to materials properties;
- Analysis of operational degradation mechanisms;
- Quality evaluation of materials and technologies in influence on operational resistance;
- Analyses of mechanical, structural parameters and fracture behavior of metal materials.

Department of Transport Means and Diagnostics

Head of department: assoc. prof. Michael Lata, Ph.D.
Telephone: +420 466 036 493
E-mail: Michael.Lata@upce.cz

Section of Road Vehicles

Research & Development

- Issues of driving characteristics of road vehicles

  The research is conducted at two levels - experimental and simulation:

  During the experiments the section's own measuring system is used for measuring vehicle driving characteristics, which consists mainly of two optical non-contact multifunctional sensors Correvit S-CE with integrated gyroscope.

  Simulation calculations are performed in the MSA system. The sections own models of road vehicles are developed. These models can then be used advantageously e.g. for detecting vehicle driving characteristics on a stability threshold.

- Issues of road safety

  Research in this area has so far been mainly focused on influence of behavior of road users by the media.

- Ecological problems of operation and disposal of road vehicles

Equipment Gadgets

- Sensor of the velocity vector of the vehicle Correvit S-CE with integrated gyroscope (2x);
- Dual-axis accelerometer ADXL 311;
- Optical gate BOS 36K;
- Ultrasonic sensors U – GAGE (4x);
- Decentralized measuring system based on data logger imc Cronos PL2/UNI8 (1x) and imc Cansas SCI 8 (2x);
- Data logger system DATAQ DI-718B with the two voltage and one potentiometric module;
- Strain gauge force sensors;
- Static and dynamic adhesor for tire experiments.

Consultation activities

- Alternative vehicle drives;
- Road safety;
- Ecological car disposal;
- Computational modelling of parts of vehicles and their construction.

Section of Railway Vehicles

Research & Development

Research activities of the staff of the Subsidiary Česká Třebová are focused on interaction of vehicles and tracks in close connection with the design of running gears of rail vehicles. As part of this research the staff are involved in the following topics:

Contact geometry wheelset-track

Study of interaction of wheel profiles with rail head profiles in order to reduce wear of the wheel profiles and improve their running behaviour. The research results are mainly proposals of wheel profiles of rail vehicles for specific operation conditions. For theoretical calculations the input data are obtained from the measurements of real wheelset and track parameters in operation.

Vehicle-track interaction in curves of small radii

Investigating the causes and subsequent solutions to problems arising as a result of the vehicles running through curves of small radii. These include increased wear of wheels and railheads as well as creation of slip waves on inner rail.

Vehicle-track interaction on a straight track

Analysis of the running behaviour of vehicles on a straight track at higher speeds and the ability to influence the unstable running of rail vehicle through the shape of wheel profiles.

Dynamic response of vehicle running through a turnout

Experimental determination of dynamic effects of the rolling stock in lateral and vertical directions when passing a turnout on a straight track at higher speed for a purpose of increasing the speed at main railway corridors. These issues include research of unstable vehicle running at higher speed to ensure comfort and safety of vehicles.

Computational simulations of vehicle running on a real track

Modelling of dynamic systems of rail vehicles running on a real track (track geometry, wheel and rail profiles) in order to optimize the structural design of the running gears with regard to safety and ride quality of vehicles.

Measurement of running and guiding behaviour of rail vehicles

Based on measurement of the vehicle parts acceleration and deformation of the elastic and damping elements in the running gears of rail vehicles.

Research of traction systems characteristics from the point of torsional dynamic

Development of simulation models focused on the transient phenomena of a system in case of exceeding the limits of adhesion, which enabling e.g. prediction of loading of individual couplings or detection limits for setting up an anti-slip regulation of traction vehicles.

Experimental research on test stands of a railway and tram wheel

Test stands of the railway and tram wheels in the laboratories of the Jan Perner Transport Faculty (located in the Educational and Research Centre in Transport) are used for research in the areas of adhesion, force interaction in the wheel-rail contact, for measuring wheel set development or research and development of new types of electric drives and their regulation.

Software equipment

AdamsRail, Simpack, Ansys, LabWiev, AutoCAD, SolidEdge, Delphi, the section`s own software products focused mainly on rail vehicle ride simulation.

Section of Diagnostics and Environment

The activity of the department is focused on reducing negative effects of transport on the environment, in particular:

- evaluating the effectiveness of used noise and anti-vibration measures based on detailed measurement and data analysis in the time and frequency domain;
- optimization of existing measures and verifying the possibility of application of other methods of reducing noise and vibration generated by the interaction of the vehicle with the transport route;
- verification of the real applicability of noise simulations in the areas of vehicle design - the issue of noise vehicle optimization at the stage of design, testing and approval of vehicles for operation;
- proposing immediate intervention or preventive maintenance;
- tribotechnical diagnostics (oil analysis, optimizing engine oil change intervals, evaluation wear regime of lubricated system based on the analysis of abrasion of particles);
- the application of environmental management systems and methods of risk assessment methodologies in an environment of real firms.

Software equipment

- Multianalyser B&K Pulse 3560 C – 6 channels;
- Measuring microphones B&K 4188 + preamplifier B&K 2671;
- Sound level meter;
- Measuring system Kistler for vibration measuring, 16 channels;
- Voltcraft tachometers (laser + mechanical rev counting);
- Contactless thermometer Voltcraft IR-1001 A;
- Software – LabVIEW 7, DEWESOFT, PULSE;
- 2 FTIR spectrometers iS10 (Nicolet) with ATR unit, Vector 22 (Bruker) with ATR unit and with unit for solid samples measuring MIRacle Diamond (Pike Technologies);
- Potentiometric titrator HI 902 C2-02;
- Coulometer WTD with drying oven;
- Stabinger viscometer SVM-3000, viscotester VT-6R, viscometer Höppler, refractometer AR3 and manual refractometers, viscosity bath TV 2000 with accessories;
- Device for oil dilution by fuel determination FUEL Dilution meter FDM Q;

- Ferrograph REO-1, analytical ferrograph T_2FM, densimeter REO 31, ferrometer REO 22;
- Laser analyser LNF Q200 (Spectro Inc.);
- Trinocular microscopes with digital camera, software image processing Stream Essential;
- Tester for evaluation of oil and process fluids lubricity Reichert M2 (Petrotest);
- Testers for brake fluids boiling temperature determination Alba Diagnostic Velvana with accessories.

Consultation activities

- Analysis of noise emissions emerging from transport means and route interaction;
- Noise and vibrations – measuring and data analysis in time and frequency area;
- Vibrations – analysis and prediction of the measured object technical state;
- Tribotechnical diagnostics and operating material testing:
  - Oil analysis (motor oil, hydraulic, etc.);
  - Determination of dynamic and kinematic viscosity, density, viscosity index, determination of ignition point in an open cup;
  - determination of oxidation, nitration and sulfation product, water content, glycol content, soot percentage, monitoring decline of additives etc. (using FTIR spectrometry);
  - determination of TAN and TBN oils by potentiometric titration;
  - Determination of water content in oils by coulometric titration;
  - particle analysis (including determination of cleanliness code);
  - Analysis of brake and coolant fluids (boiling and hardening point etc.) using refractometry and FTIR spectrometry;
  - analysis of fuels, plastic lubricants and other operating material (only FTIR spectrometry);
  - application of chemometric methods in tribotechnical diagnostics;
- Application of environmental control systems and risk evaluation methods in the environment of real firms;
- Consultancy regarding application of legal regulation requirements in the field of environment protection.

Department of Transport Structures

Head of department: assoc. prof. Vladimír Doležel, CSc.
Telephone: +420 466 036 195
E-mail: vladimir.dolezel@upce.cz

Research & Development

Organization and thematic structure of R&D at the Department of Transport Structures is shaped especially by specialization in particular expert areas of the department. Those are:

- Bridge structures (concrete and steel);
- Roads;
- Railways;
- Geotechnical structures (slope stability, foundation structures, underground structures).

Contemporary trends of research and development, given by thematic research priority areas in the European Research Area (ERA) and National Policy of Research and Development in the Czech Republic, tend to deal with research projects and grant opportunities in collaboration of more departments. External collaboration is performed with other universities, institutes of Czech Academy of Sciences, departmental institutes and foreign institutions.

The common feature of fundamental trends of R&D pursued at the Department of Transport Structures is the specialization in diagnosis of main transport structures, area of development of new materials, structures and technologies with respect to their durability and reliability, dynamic stresses during their lifetime, etc.

Research activity is realized within scope of research projects supported by grants of the Czech Grant Agency, Czech Academy of Sciences and Czech Technological Agency, national authorities, particular ministries, European Union or construction companies. Thanks to 7th Framework Programme of the European Union, COST, Erasmus+ and other projects, there is a direct international collaboration at the department.

Expert witness activities which are focused on defects of transport structures in the Czech Republic are also emphasized.

Laboratory Equipment

- Geotechnical field;
- Geotechnical modelling stand;
- Multichannel ground-penetrating radar;
- Concrete press 300 tons;
- ED 20 Universal testing machine;
- Total station and GPS Leica;

- Levelling instruments and theodolites;
- Triaxial load frame;
- Oedometer;
- Proctor test apparatus - can perform these activities:
    - Static tests, and to some extent dynamic tests, of steel and concrete elements of bridge structures or their scaled models, especially with regard to material fatigue;
    - Stress tests of concrete (press 300 tons);
    - Ordinary tests to determine data of physical properties of materials (press ED 20);
    - Geotechnical tests (moisture, absorption, sieving and densimeter test, density of solids, shear strength of soils, triaxial tests, oedometric compressibility of soils, fine-grained soil stress tests, modified Proctor Standard test);
    - In situ measurements;
    - Loading tests of bridges;
    - Experimental measurements in subsoil of transport structures.

The workplace is equipped with geodetic instruments (levelling instruments, laser instruments, theodolites, total stations) and computers with specialized calculation programmes.

Consultation activities

- Underground structures

  Expert consultations in problems of underground structures influence on their surroundings and in assessment of bearing parts of underground structures at extraordinary states;

- Geotechnical structures

  Expert consultations in assessment of geotechnical structures in serious disrepair;

- Bridge structures

  Expert consultations in diagnosis of concrete and steel bridge structures and assessment of their limit states;

- Road and railway structures

  Expert consultations in problems of road layers, especially their defects occurring in the design and building phase.

Educational and Research Centre in Transport

Educational and research activities of the ERCT are divided by research topics into sections and directly linked to the departments of the Jan Perner Transport Faculty.

The activities of particular sections are interconnected. Complexity and mutual cooperation is emphasized.

Dynamic test stand

Specialization:

- experimental research on static and dynamic properties of stress constructions;
- determination of fatique characteristics of construction /material;
- tests of material properties at given speed up to 15 m/s;
- experimental measurements of construction stress- states.

Transport structures

Specialization:

- determination of concrete strength in various climatic conditions, ultrasound diagnostics;
- construction material degradation (ageing, extreme temperatures);
- research on longitudinal road unevenness;
- research on geotechnical properties (in full extent);
- non- destructive diagnostics of transport structures (georadar).

Transport means – rail vehicles

Specialization:

- research in the area of rail vehicles adhesion;
- research on wheel-rail contact measurement systems;
- research on adhesive and abrasive wear.

Transport means – road vehicles

Specialization:

- research on driving dynamics and stability of vehicles;
- research on oils and lubricants;
- research on adhesive and deformation characteristics of tyres.

Transport means – measurements and diagnostics

Specialization:

- measurements (force, acceleration, track, length, angle, stress);
- research on suspension properties of vehicles;
- research on noise characteristic of vehicles.

Transport means – electrical engineering, electronics and control systems

Specialization:

- research on driving systems (engines);
- research on combustion process and energy transfer on vehicles;
- research on vehicle driving structures;
- research on power engineeering and energy transfer onto a running vehicle.

Materials and Mechanics

Specialization :

- research on adhesive and abrasive wear of materials;
- research on mechanical properties of materials (including tensile shock and instrumented testing);
- structure and phase analysis;
- research on makro and micro fractographic analysis.

Accredited Testing Laboratory of the JPTF

This laboratory carries out accredited and unaccredited tests related to the Jan Perner Transport Faculty educational activities.

It has a certificate of accreditation No. 014/2006 for tests in the area of bridge loading, acceleration measuring for railway vehicle running behaviour determination, tenzometric measuring of steel constructions and measuring of contact geometry determination.

The laboratory is divided into five specialized branches:

Specialized Branch SP1: „**Bridge loading test**“ (AL MZ 1-1, ČSN 736209)	Unaccredited test
Specialized Branch SP3: „**Measurement of environmental noise**“ (AL MZ 3-1, ČSN ISO 1996-1:1992, ČSN ISO 1996-2:1992, ČSN ISO 1996-3:1993, HEM 300-11.12.01-34065	Unaccredited test
Specialized Branch SP4: „**Acceleration measurement to determine running behaviour of railway vehicles**“ (AL MZ 4-1, UIC 518, EN 14363)	Unaccredited test
Specialized Branch SP5: „**Tensometric measurement of steel structures**“ (AL MZ 5-1)	Unaccredited test
Specialized Branch SP6: „**Measurement of wheel and rail profiles for the determination of the wheelset-track contact geometry**“ (AL MZ 6-1, UIC 519)	Accredited test