

DEPARTMENT OF POWER ELECTRICAL SYSTEMS

General Information

Department of Power Electrical Systems was founded in the academic year 1955/56 as the Department of Electric Traction and Energetics at the Railway University in Prague. Since 1992 the department has been a part of the Faculty of Electrical Engineering.

The department had originally an accreditation in a field of "Electric Traction and Energetics". Graduates of the department were formerly trained mainly for 24 and 12 FMD, for industrial plants producing electric traction equipment (Škoda Pilsen, ČKD Trakce Prague, ŽOS Nymburk, ZOS Vrútky), for both urban and industrial transport and for the scientific and research laboratories in the electro-technical industry.

The highly important period for the department was during years 1991 – 1994. In those years, a TEMPUS project JEP-1939/91-94 was accepted and realized. The project titled "Improvement of Educational Activities in Power Electronics and its Applications" considerably affected the next heading of the department. The aims of the project were: a creation of a new curriculum for Power Electronics, Electric Drives and Electrical Machines, setting up new laboratories, purchase of computing and measuring hardware, mobility of students and staff. The universities in Catania, Roma, London and Helsinki co-operated and guaranteed this project. The results of the project set the department forward in its effort to become a modern department with a high-level educational programme. In 1996 the department finished a TEMPUS project JEN-01939SQ-94 representing a continuity of the project mentioned above.

In 2005, the Faculty of Electrical Engineering underwent a vast reconstruction. A section of Power Electronics was secluded from the Department of Power Electrical Systems together with a part of Department of Electronics and Electrotechnology and formed a new Department of Mechatronics and Electronics.

Change of the labour market enforced the department, besides its own traditional educational and research activities, to look for other possibilities of employability of its graduates. Nowadays the department is divided into the section of Electric Power Systems and section of Electric Drives and Electric Traction. Educational and research activities of these sections guarantee a wide professional orientation which covers almost whole power electrical engineering branch.

In the academic year 2005/2006, a three-degree study has been put to an effect at all universities in Slovakia. Department of Power Electrical Systems has been granted an accreditation for a bachelor degree in a programme of studies of Electrical Engineering; for master degree in programme of Electric Power Systems, Electric Drives and Electric Traction. For PhD degree, third study degree, the department was accredited in a study programme of Power Electrical Engineering.

Within the complex accreditation in 2009, University of Žilina confirmed its position as university. Department of Power Electrical Systems gained right to bestow the Bachelor degree in study program of Electrical Engineering, academic master degree in study programs of Electric Power Systems, Electric Drives and Electric Traction.

Within the latest complex accreditation in 2015, all the study programs have been accredited except of Electric Traction, which became a part of the Electric Drives program.

Since 1997 the department has had an accreditation for PhD degree study in a field of "Power Electrical Engineering", with the following branches: Electric Drives, Electric Machines and Apparatus, Power Electronics and Electric Traction.

Department is equipped with high quality computer and measuring technology in the area of technical infrastructure. The substantial improvement of department was achieved mainly by the help of EU Structural Funds, which enabled reconstruction of rooms of department as well as the departments' instrumentation.

This was possible mainly by the project: Centre of excellence of power electronics systems and materials for their components I., II.

NXP Semiconductor (former Freescale Semiconductor) from the Czech Republic provided a big support for the department by generalizing latest technologies in the area of digital signal controllers. Department was able to apply for grant research projects on this basis. Department solved several VEGA, KEGA and SRDA projects recently, which have identified students, graduates and staff of the department.

Department intensively cooperates with significant companies from Slovakia. These are mainly Slovenské elektrárne, Slovenská elektrizačná prenosová sústava, Stredoslovenská energetika, EVPÚ Nová Dubnica, NXP Semiconductor, SIEMENS, ŽSR, SEZ Krompachy and others.

Staff of the Department

Head of the Department:	Juraj Altus
Vice-head of the Department:	Alena Otčenášová
Secretary:	Darina Rufusová

Sections of the Department

Section of Electric Power Systems

Head of the Section:	Alena Otčenášová
Professors:	Juraj Altus
Associate Professors:	Peter Bracíník, Alena Otčenášová, Marek Roch
Senior Lecturers (with PhD):	Josef Beran, Miloslav Bůžek, Marek Höger, Ivan Litvaj, Michal Reguľa, Martina Kajanová (Látková)

Section of Electric Drives and Electric Traction

Head of the Section:	Pavol Makyš
Professors:	Valéria Hrabovcová, Ján Vittek, Pavol Rafajdus
Associate Professors:	Pavol Makyš, Milan Pospíšil
Research Fellows:	Pavel Lehocký, Vladimír Vavruš, Juraj Makarovič, Lukáš Gorel
Senior Lecturers (with PhD):	Matěj Pácha, Marek Štulrajter

Postgraduate Students

Internal (full-time):	Andrej Bolf, Pavol Belány, Pavel Sovička, Filip Suško, Ľuboš Struharňanský, Michal Repák (until August 2018), Adrián Peniak (until August 2018), Dávid Motyka, Marek Novák, Martin Sumega, Patrik Varecha, Šimon Zošťák, Marek Širanec (from September 2018), Marián Tomašov (from September 2018), Štefan Kočan (from September 2018)
External (part-time):	Dávid Kaprál, Marek Baňas (until August 2018), Milan Diko (until August 2018)

Education

Courses in Bachelor, Master and Doctoral Degree Programmes

Bachelor Degree Programmes

Code	Title	Sem.	Hours/Week
			L-S-LE*
Courses at the Faculty of Electrical Engineering			
3B0104	Basics of Electrical Engineering	1	1 – 2 – 0
3B0111	Project Learning 1: Solar Team Slovakia	1	1 – 3 – 0
3B5100	Professional Practice (60 hours)	1	0 – 0 – 0
3B0207	Enterprise Management and Economics	2	2 – 1 – 0
3B0214	Project Learning 2: Solar Team Slovakia	2	1 – 3 – 0
3B5200	Professional Practice (60 hours)	2	0 – 0 – 0
3B0203	Programming Languages	3	1 – 0 – 2
3B0311	Normalization, Metrology, Testing	3	1 – 1 – 0
3B0318	Project Learning 3: Solar Team Slovakia	3	1 – 3 – 0
3B5301	Professional Practice (60 hours)	3	0 – 0 – 0
3B0405	Electric Machines	4	4 – 1 – 2
3B0413	Work Safety in Electrical Engineering	4	2 – 0 – 1
3B0415	Electricity Distribution	4	2 – 1 – 1
3B5404	Electric Machines in English 1	4	1 – 1 – 0
3B5402	Introduction to Electric Drives	4	2 – 0 – 1
3B5401	Materials and Technologies in Electrical Engineering	4	2 – 1 – 1
3B0416	Project Learning 4: Solar Team Slovakia	4	1 – 3 – 0
3B5405	Professional Practice (60 hours)	4	0 – 0 – 0
3B5504	Electric Traction 1	5	2 – 0 – 2
3B0505	Electric Drives 1	5	3 – 2 – 0
3B0506	Electrical Apparatus	5	3 – 0 – 2
3B0508	Electricity Generation	5	2 – 0 – 2
3B0511	Methods of Quality Management	5	3 – 1 – 1
3B0513	Project Learning 5: Solar Team Slovakia	5	1 – 1 – 0
3B5500	Electricity Transmission	5	2 – 0 – 1
3B5501	Mechanics of Power Lines	5	2 – 2 – 0
3B5502	Selected Sections of Electric Machines	5	0 – 0 – 2
3B5506	Electric Machines in English 2	6	0 – 2 – 0
3B5507	Application of Digital Signal Processors 1	6	0 – 0 – 6
3B5508	Professional Practice (60 hours)	6	6 – 0 – 4
3B5600	Bachelor Thesis	6	6 – 2 – 2
3B5606	Elaboration and Defence of the Bachelor Thesis	6	6 – 2 – 2
3B0606	Electric Drives 2	6	4 – 2 – 0
3B0607	Quality Management	6	0 – 0 – 4
3B5601	Bachelor Project of the Electric Power System	6	0 – 0 – 6
3B5602	Bachelor Project of Electric Drives	6	0 – 0 – 6

3B5603	Bachelor Project Electric Traction	6	0 – 0 – 2
3B5604	Electric Traction 2	6	3 – 0 – 2
3B5609	Basics of Project Documentation Creating	6	0 – 0 – 2
3B0614	Project Learning 6: Solar Team Slovakia	6	1 – 3 – 0
3B5607	Application of Digital Signal Processors 1	6	0 – 0 – 2
3B5608	Professional Practice (60 hours)	6	0 – 0 – 0
Courses at the Faculty of Mechanical Engineering			
211062	Electroenergetics	5	2 – 2 – 0

*(L) lessons - (S) seminars - (LE) laboratory exercises

Master Degree Programmes

Code	Title	Sem.	Hours/Week
			L-S-LE*
Courses at the Faculty of Electrical Engineering			
3I4101	Transients in Power Systems		2 – 1 – 1
3I4102	Power Plants	1	2 – 2 – 0
3I4103	Electric Substations	1	3 – 1 – 1
3I3104	Professional Practice (60 hours)	2	0 – 0 – 0
3I4106	Professional Practice (60 hours)	1	0 – 0 – 0
3I3100	Analysis of Electric Machines	1	2 – 0 – 2
3I3101	Control of Electric Drives 1	1	3 – 2 – 0
3I3102	Dynamics and Energetics of Electric Traction	1	2 – 2 – 0
3I3103	Electric Traction Vehicles	1	3 – 0 – 1
3I0117	Project Learning 1: Solar Team Slovakia	1	1 – 3 – 0
3I4200	Control of Electric Power Systems	2	2 – 1 – 1
3I4201	Renewable Energy Sources	2	2 – 1 – 1
3I4202	Protective Relaying	2	2 – 1 – 1
3I4203	Electric Drives in Electric Power System	2	2 – 1 – 1
3I4204	Power Supply of Electric Railways	2	2 – 2 – 0
3I4205	Electric Power System in English	2	0 – 2 – 0
3I3200	Control of Electric Drives 2	2	3 – 2 – 0
3I3201	Sensors, Actuators and Interfaces	2	2 – 0 – 2
3I3203	Electric Traction	2	2 – 1 – 2
3I3204	Professional Practice (60 hours)	2	0 – 0 – 0
3I3206	Professional Practice (60 hours)	2	0 – 0 – 0
3I0211	Special Electric Machines	2	2 – 0 – 2
3I0213	Simulation Languages in Electric Power System	2	2 – 0 – 2
3I0220	Project Learning 2: Solar Team Slovakia	2	1 – 3 – 0
3I4300	Negative Influences on Power System	3	2 – 2 – 1
3I4301	Feasibility Calculations for Power Networks Development	3	2 – 2 – 0
3I4302	Information Systems for Power System Control and Monitoring	3	2 – 0 – 2
3I4303	Diploma Project of Electric Power Systems	3	0 – 2 – 2
3I4304	Reliability of Electric Power Systems	3	2 – 2 – 0

3I4305	Application of Numerical Calculations in Electric Power Systems Operation	3	0 – 0 – 4
3I3303	Professional Practice (60 hours)	3	0 – 0 – 0
3I4307	Professional Practice (60 hours)	3	0 – 0 – 0
3I0306	Programmable Logic Controllers	3	2 – 0 – 2
3I0316	Methods for Systematic Design	3	3 – 1 – 0
3I0319	Electric Energy Utilization	3	2 – 2 – 0
3I0320	Project Learning 3: Solar Team Slovakia	3	1 – 3 – 0
3I3300	Sensorless Control of Electric Drives	3	3 – 1 – 1
3I3301	Discreet Control of Electric Drives	3	3 – 0 – 3
3I3302	Diploma Project of Electric Drives 1	3	0 – 2 – 0
3I9301	Control of Electric Drives 1	3	3 – 1 – 1
3I4400	High Voltage Engineering	4	2 – 0 – 2
3I4401	Diploma Project of Electric Power Systems 2	4	0 – 2 – 1
3I4402	Elaboration and Defence of the MSc Thesis	4	0 – 10 – 0
3I4403	Course of State Examination	4	0 – 2 – 0
3I4404	Economy of Electric Power Systems Operation	4	2 – 2 – 0
3I3403	Professional Practice (60 hours)	4	0 – 0 – 0
3I4405	Professional Practice (60 hours)	4	0 – 0 – 0
3I0403	Corporate Quality Management	4	2 – 2 – 0
3I0408	CAD/CAE Systems	4	0 – 0 – 2
3I0412	Project Learning 4: Solar Team Slovakia	4	1 – 3 – 0
3I3400	Diploma Project of Electric Drives 2	4	0 – 2 – 0
3I3401	Elaboration and Defence of the MSc Thesis	4	0 – 10 – 0
3I3402	Course of State Examination in the Specialization	4	0 – 2 – 0
Courses at the Faculty of Mechanical Engineering			
221197	Electrical Traction Equipment	2	2 – 2 – 0

*(L) lessons - (S) seminars - (LE) laboratory exercises

Doctoral Degree Programmes

Code	Title	Sem.	Hours/Week
			L-S-LE*
Courses at the Faculty of Electrical Engineering			
3D1100	Foreign Language	1	2 - 0 - 0
3D1112	Essay to Dissertation Examination and Defence of Written Project for Dissertation Examination	3	0 - 0 - 0
3D1113	The Thesis and Dissertation Defence	3	0 - 0 - 0
3D1101	Economic Aspects of Electric Power Systems Operation	3	2 - 0 - 0
3D1102	Electromagnetism in Power Systems	4	2 - 0 - 0
3D1103	Smart Grids	3	2 - 0 - 0
3D1104	Power Quality	5	2 - 0 - 0
3D1105	Power Systems Modelling		2 - 0 - 0
3D1106	New Trends in Power Transmission		2 - 0 - 0

3D1107	New Trends in Power Generation		2 - 0 - 0
3D1108	Transients in Power Systems		2 - 0 - 0
3D1109	Power Systems Control		2 - 0 - 0
3D1110	Theory of Electromagnetic Field		2 - 0 - 0
3D1111	Selected Chapters from Mathematics		2 - 0 - 0
3D4101	Electric Drives and Electric Traction		2 - 0 - 0
3D4102	Electrical Machines and Equipment's		2 - 0 - 0

*(L) lessons - (S) seminars - (LE) laboratory exercises

Research & Development

Research and development activities of the **Electric Power System** section are focused on issues concerning electricity generation, transmission and distribution. The research activities oriented on electricity generation are mainly focused on a modelling of the operation of renewable energy sources. Acquired knowledge and results are used to design simulation models, which are thereafter applied in power system analyses as well as in an optimization of renewable energy sources' deployment within virtual power plants.

Scientific and research activities in the field of electricity transmission and distribution are focused on a modelling of electric power system operation, especially on an application of the concept of intelligent networks (Smart Grids) to the control of both power transmission and distribution networks. A use of different artificial intelligence approaches (expert systems, multi-agent systems) and an application of intelligent electronic devices are the key topics of the research in this field.

An integral part of the research activities of the department is solving the issue of power quality in the distribution or transmission system. The issue is solved comprehensively. Attention is given to the causes of poor quality of supply, EMC, statistics in different locations of the system and of course, possibilities for improvement through the application of the proposed device or other feasible measures.

The section of Electric Drives and Electric Traction mainly focuses on control of all electrical drives types such as DC motors, AC motors and special drives with different type of rotors (SRM, BLDC and Stepper Motor). Research focus can be divided into the following areas:

Sensorless control of electric machines – this problematic allows increasing the overall drive reliability, reduce the drive size and therefore it is still very popular. It includes research of estimation algorithms and control techniques for DC and AC drives (IM, PMSM and BLDC). Traditional methods are usually applied for the higher speed range drive. For the low, even zero speed there are methods and algorithms which require high frequency signal injection. Currently, the sensorless techniques form the basis of some control systems, characterized as fault tolerance system, which means ensuring at least partial operation under any circumstances. The research results have been presented on significant international conferences.

Design of progressive control methods – in this area the research has been focused on methods which used forced dynamic control or sliding mode control. New method which has been designed is called Hyper sliding mode control. This scheme does not need any PI controllers what means easier implementation to industrial application.

Design and application of control algorithms for linear motors drives – linear motors are very progressive especially for high dynamic applications. Research activities cover designing of new control methods which have capability to avoid all complaints of linear motors such as non-linear friction, cogging torque and other problems related with high precise positioning algorithms.

Design of energy flow control in hybrid railway vehicles – hybrid vehicles are considered as a very progressive type of railway vehicles. The most needed issues involve a primary source operation optimization (catenary or a diesel engine) or braking energy storage. Conventional vehicles use friction brake and the braking energy is lost as a heat, while in hybrid vehicles the energy can be stored e.g. in supercapacitors or modern electro-chemical cells (Lithium based systems). Research results have been published at several scientific conferences and implemented in an international commercial project

Within the department, the research is oriented also to electrical machines, mainly modern design and optimization method of any types of electrical machines with capability of identifying the parameters and characteristics of these machines and their possible uses in industry, advanced propulsion or in electric traction.

Project „Solar Team Slovakia“ - the project is aimed at cooperation between students, companies, University and Academy of Fine Arts in the development of solar car for competition the Bridgestone World Solar Challenge in Australia. This cooperation shall develop scientific and technological potential of Slovakia (clever young students, the automotive industry, knowledge and experiences of educational institution). The project

aim is to build the first Slovak solar car using new technologies and innovation. The project has, however, mainly to improve education, strengthen active cooperation with practice, popularizing the study of science and technology and create a development environment aimed at the automotive industry. The project now involves more than 50 students from various disciplines.

Laboratory of high voltage

The Laboratory is equipped with measuring and testing equipment for testing electrical strength as well as other parameters of insulation materials and elements used in high voltage engineering up to 300 kV. The laboratory is operated in the cooperation with SSE, a.s. in the analyses of materials' characteristics, reasons of the faults of high voltage devices and the testing of protective means. It is also used for teaching activities.

Laboratory of power electrical systems

The Laboratory of power electrical systems is used for the research oriented on the application of Smart Grid concept in medium voltage networks. The research is mainly focused on the application of artificial intelligence (expert systems, multi agent systems) and intelligent electronic devices for a fault location and network reconfiguration with the goal to minimize the number of customers without electricity supply, as well as on the control of virtual power plants consisting of renewable energy sources, which are connected to the medium voltage network.

The laboratory is equipped with a 3-phase model of a medium voltage power line. The model is monitored and controlled by the computer and it consists of modules representing cable as well as overhead power line sections, remote controlled devices, protection relays and adjustable loads.

Laboratory of power quality

The Laboratory of power quality is equipped with measuring devices obtained due to the international project SK-CZ "Cooperation between the University of Zilina and the VŠB-TU Ostrava on the improvement of the quality of education and preparation of researchers in the field of electrical power engineering", which was funded by EU funds. Purchased measuring system is both used in the laboratory as well as in the field measurements. It consists of power quality analysers designed according to the standard STN EN 50160, measuring accessories, an appropriate software and a SCADA system, which enables online data acquisition of all variables and parameters measured by power quality analysers, their analysis and graphical presentation through personal computers.

Experiments are made on models of 110 kV and 22 kV power lines. The measuring system enables to study different sources of disturbance, the influence of their mutual operation as well as disturbance propagation along modelled power lines for different operation conditions.

Both models are equipped with remote controlled 4Q electronic meters enabling remote data acquisition and evaluation.

Laboratory of electric drive control

The Laboratory of electric drive control has been created in cooperation with NXP Semiconductor, Inc. in order to familiarize students with practical applications of electric drives and all the problems of real applications. The electric drives laboratory stands consist of NXP 56F8346 DSC Controller Board or NXP MPC 5567 Controller Board, a low voltage power stage Freescale 16 V / 120 W and a selectable electric machine – asynchronous machine (Siemens, voltage 21/12 V power 90W) or permanent magnet synchronous machine (TG-Drives,

voltage 21/12 V, 90W). Each electric drive stand is supplied by a low-voltage source and equipped with the debugging tools Freescale USB-TAP.

Students can use other NXP development tools as TOWER system, SLK (Student learning kits), etc. The Laboratory also serves as a base for competitions like Students' Freescale Technology Day and Freescale Cup – smart car race. The laboratory is Freescale certified and registered in the Freescale University Program.

Lab is also equipped with three research stands. The first one consists of two permanent magnet synchronous machines connected with a flexible coupling designed for parameters' investigation and control algorithms for such drives.

The second stand covers a linear engine with permanent magnet synchronous machine of 4 kW. Its track is 2640 mm long and the machine is able to develop a torque of 200 Nm at speeds of 4.2 m/s. The drive load is simulated by an induction machine. Linear motor is supplied from three-phase inverter by VONSCH and controlled by a digital signal controller NXP MC56F8346.

Third stand consists of 3-axis milling machine with linear motors in X and Y axes. Vertical displacement is handled by a step-machine. Horizontal motors have a special construction of the windings with non-ferrous core on the moving part, thus with no cogging torque. This structure brings ability for a high accuracy positioning, practically limited by the accuracy of the position sensor only. These machines have been developed in collaboration with the company EVPÚ, a.s., Nová Dubnica and supported by the Slovak Research and Development Agency (APVV-99-031205). The control of power converters is handled by two NXP MC56F8367 units. Positioning and the cutter commands use CNC Mach3 interface and software.

Laboratory – Centre of excellence of power electrical systems and materials for their components

In the Laboratory there are implemented project activities of centres of excellence (CEEX I and II CEEX), which were implemented within the Operational Programme of Research and Development, Measure 2.1 - creation and promotion of excellence in research.

Created laboratory is used for research and verification of new control structures for drive applications (rotational and linear motion). The proposed algorithms have to consider the adverse effects of the power converter (voltage ripple in the DC link, dead time, saturation power components, etc.). For achieving the highest quality of proposed drive, control is necessary to precisely know motor parameters, which can be done by off-line and on-line motor parameter identification methods. Research team also works with new motor control topologies for non-standard types of electrical machines

Laboratory of electric traction

The Laboratory is equipped with a combined system of two DC traction motors (50 kW, 600 V) for a standard set of measurements on traction machines. The system is supplied by a remote controlled DC power sources (voltage source 0-750 V, current source 0-250 A). The measurements are supported by analogue and digital equipment, high-end oscilloscope Lecroy WaveRunner 44Xi-A, high voltage probe (up to 6 kV), magnetic probe, vector power analyser Zimmer LMG-500 and two electronic power sources (0-600 VDC, 0-25 A and 0-60 VDC, 0-45 A).

The laboratory is being equipped with another combined system of two AC induction traction motors (50 kW) driven by two converters. This stand is supported by EVPÚ, a.s., Nová Dubnica and Operational Programme Research and Development, measure 2.1 Support of networks of excellence in research and development as the pillars of regional development and support to international cooperation. Such combined system allows all the tasks of modern electric traction drive.

The most attractive part of the laboratory is a locomotive simulator with its main part – the drivers cab. This project is supported by Freescale Semiconductor, Inc., Pars NOVA, a.s. Šumperk (Czech Republic) and ČD, a.s.,

DKV Brno (Czech Republic). The software part is supported by OpenRails Train Simulator development team. The main aim is to shed light on the real world problems in electric traction.

Laboratory of electrical machines

This Laboratory is designed for measurement and identification of the parameters of almost all of electrical machines and their operating characteristics in motoring and generating mode. The laboratory is equipped with modern measuring instruments and dynamometers. The laboratory use students from all three levels of education, and of course it is also used for other research activities at the department.

Projects of International Programmes

Projects of National Programmes

Research Projects Funded by the Scientific Grant Agency of the Slovak Republic (VEGA)

VEGA 1/0957/16 Research and Development of Novel Construction of Switched Reluctance Machines for Automotive Traction Applications	
Summary:	This project deals with scientific research of modern electrical drive with switched reluctance motor (SRM) and with investigation of its performances and parameters for traction application in electrical vehicles. In the frame of this project, the detail analysis of a new SRM construction design and optimized construction of SRM will be carried out to obtain the best performances from point of view efficiency, distance range and reliability of electrical car. The modern methods of design as finite element method will be used for these SRM. The research of new control algorithms for this drive will be analysed with cooperation with power converter to obtain best efficiency for all working range. On the base of scientific research of these motors, some recommendations will be given for their manufacturing.
Realization:	01/2016 – 12/2018
Coordinator:	Pavol Rafajdus
Co-operators:	Valéria Hrabovcová, Pavol Makyš, Vladimír Vavrúš, Pavel Lehocký, Juraj Makarovič, Adrián Peniak, Milan Diko

VEGA 1/0774/18 Scientific research of high speed and high efficiency electric drive	
Summary:	The main aim of the present project is a research and design of compact high-speed electric drive. The electric drive represents a set of equipment (electric motor, power converter and control system with an appropriate control structure) that provide energy conversion with some efficiency. Therefore, the project addresses the individual parts of the electric drive focusing on the overall efficiency of the high-speed drive. The project is divided into three key parts. The first part deals with the high-speed electric motor. It is about designing the electro-mechanical motor structure, minimizing the losses in the machine, size proposition, design and verification of mechanical strength and stiffness of the rotor. The second part of the project is focused on the power converter design which is intended to supply the electric motor. The third part of the project discusses the design and implementation of appropriate control algorithms for high speed drive.
Realization:	1/2018 – 12/2020
Coordinator:	Pavol Makyš
Co-operators:	Pavol Rafajdus, Vladimír Vavrúš, Marek Štulrajter, Ján Vittek, Valéria Hrabovcová, Pavel Lehocký, Juraj Makarovič, Slavomír Kaščák, Jozef Šedo, Ľuboš Struharňanský, Milan Diko, Pavel Sovička

Projects Funded by the Cultural & Education Grant Agency (KEGA)

KEGA 031ŽU-4/2016 Implementation of Geometric product specifications (GPS) into the teaching process of engineering study programs and putting them into the technical practice.	
Summary:	The goal of the project is modernisation, improving and supplementing of teaching contents and form within the education of study programs at universities of technical orientation and support for students to achieve such level of knowledge's and skills, which increase their competitiveness at the

	labour market. The project deals with the implementation of the latest findings introduced in the latest international technical standards in the field of Geometrical product specifications (GPS) into the contents of teaching materials of subjects as Engineering Drawing, Design, Methodology of Design, Engineering metrology and Metrology. The project is multidisciplinary. It is aimed at problems of designing and tolerances prescription for dimension, for geometry and form prescription within the product designing. It is also aimed at the field of geometrical quantities measuring and evaluation as well as at using of latest measuring equipment's. The goal of the project is creating of educating program and publishing of textbook for university students. The book will be supplemented with digital annexes available at the information system with exercises assignments and results. Within the annexes there will be teaching tools and tests for students. One part of exercises will be in English. Another result of the solution of the project will be completion of laboratory for 3D measure. That will be a benefit for students preparing themselves for future occupation in international firms – mainly in the field of automobile and bearings industry.
Realization:	01/2016 – 12/2018
Coordinator:	Jozef Bronček – Faculty of Mechanical Engineering, University of Zilina
Co-operators:	Ivan Litvaj

Research Projects Funded by the Slovak Research and Development Agency (APVV)

APVV-15-0464 Efficiency Improvement of Electrical Power Transmission in Slovakia	
Summary:	The project deals with research and development of power losses caused by asymmetrical impedance of selected electric components (transformers, catenary, compensation chokes) of electrical power grid in Slovakia. The aim is to develop a series of steps and technology needed to determine impedance and admittance matrixes and to minimize the power losses due to the asymmetry of the components. Power losses optimization is still the most effective way of improving the energy resources utilization. Importance of such subject is supported by European Commission statement from 10/23-24/2014 aiming to the climate and energy policies frame, which expresses minimum 27% improvement of energy efficiency by 2030.
Realization:	1/2016 – 12/2020
Coordinator:	Juraj Altus
Co-operators:	Marek Roch, Marek Höger, Alena Otčenášová, Jozef Lago, Ľuboš Pavlov

APVV-16-0505: The short-term prediction of photovoltaic energy production for needs of power supply of Intelligent Buildings - PREDICON	
Summary:	The project focuses on the development of a very short-term power forecasting method for photovoltaic power plant (PVP) by using analysis of recorded image data of clouds movement collected at the place of installation of PVP. For the best accuracy of PVP power forecasting, local factors affecting the intensity of sunlight and photovoltaic power plant operation are identified. Which are subsequently used to define the correction factors for the predicted solar energy intensity adaptation algorithm to current local conditions at the PVP installation site.
Realization:	07/2017 – 06/2020
Coordinator:	Róbert Hudec

Co-operators:	Peter Bracíník, Marek Novák
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Outputs from Solved Research Tasks

Books and textbooks

[1]	LITVAJ, Ivan: Manažérstvo kvality, EDIS – vydavateľstvo Žilinskej univerzity, 2018., ISBN 978-80-554-1496-6., 133 s. (Slovak language)
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Current Content Journals

[1]	RAFAJDUS, Pavol – HRABOVCOVÁ, Valéria – LEHOCKÝ, Pavel - MAKYŠ, Pavol – HOLUB, Filip: Effect of saturation on field oriented control of the new designed reluctance synchronous motor, In: Energies : an open access journal of related scientific research, technology development, engineering, and the studies in policy and management., Vol. 11, No. 11, 2018, ISSN 1996-1073 (online), p. [1-10] [online].
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Co-operation

Co-operation Partners in Slovakia

- Power System Management, s.r.o. Košice
- VŠVU Bratislava, (P. Choma, Š. Klein)
- Volkswagen Bratislava
- TU Zvolen
- KIA Žilina
- STU Bratislava: Department of Electrical Machines and Instruments, Department of Electrical Power Engineering
- TU Košice: Department of Electrical Power Engineering, Department of Electric Drives
- ABB Elektro s.r.o. Žilina
- CE Qualite Slovakia Nová Dubnica
- ELTECO Žilina
- ELZA Žilina
- EVPÚ Nová Dubnica
- Bel Power Solutions, s.r.o., Dubnica nad Váhom
- GI-BON Quality systems Žilina
- MARKAB spol. s r.o. Žilina
- NES Nová Dubnica
- SÚTN Bratislava
- PPA Controls
- PV SŽKV Zvolen
- Regional Advisory and Information Center Považská Bystrica
- SIEMENS
- Slovak Productivity Center Žilina, University of Žilina
- SSE, a.s. Žilina
- SEPS, a.s. Bratislav
- SEZ Krompachy
- Schneider Electric Slovakia spol. s r.o.

- Sungwoo hitech, s.r.o. Žilina
- Technical Testing Institute Piešťany
- Vinuta Rajec, s.r.o.
- VUKI, a.s. Bratislava,
- VUVT Engineering, a.s. Žilina
- VVÚŽ Vrútky
- ZSSK Division ŽKV Bratislava
- ŽOS Vrútky
- ŽOS Zvolen
- ŽSR Bratislava,
- CARGO Slovakia Bratislava
- IPESOFT spol. s r. o., Žilina
- Sauter Building Control Slovakia s.r.o., Bratislava

International Co-operation Partners

- ABB Brno, s.r.o. PTPM Brno, Czech Republic
- ABD Praha, s.r.o. závod Technika Czech Republic
- AD Developments Milton Keynes, United Kingdom
- Appraisals Services – Expert institute Prague, Czech Republic
- AŽD Praha, Czech Republic
- Cinvestav Guadalajara, Mexico
- Control Technique Dynamics, Andover, United Kingdom
- CZ Loko, a.s., Česká Třebová, Czech Republic
- České dráhy O12 Praha, Czech Republic
- ELCOM Praha, Czech Republic
- NXP Semiconductors Rožnov pod Radhoštěm, Czech Republic
- ŠKODA Transportation Plzeň, Czech Republic
- ŠKODA Electric Plzeň, Czech Republic
- Telmining, s.r.o. / T-Machinery, s.r.o., Ratíškovice, Czech Republic
- Železniční zkušební okruh VÚŽ Cerhenice, Czech Republic

Non-contractual Cooperation with Academic Institutions

- Aalto University Helsinki, School of Science and Technology, Department of Electrical Engineering, Finland
- Aalto University, School of Electrical Engineering, Finland
- CTU Prague, Department of Electrical Power Engineering, Czech Republic
- Lappeenranta University of Technology Finland, Faculty of Electric Engineering, Finland
- Politechnika Gdańska, Poland
- Politechnika Warszawa, Instytut Maszyn Elektrycznych, Poland
- Academy of Science Russia, Institute of Control Sciences M. Trapeznikova, Russian Federation
- Hochschule für Technik und Wirtschaft, Dresden, Fachbereiches Elektrotechnik, Germany
- Technical University of Bochum, Germany
- Technische Universität Darmstadt, Institut für Elektrische Energiewandlung, Germany

- Technische Universität Dresden, Lehrstuhl Elektrische Antriebe und Grundlagen der Elektroenergie-technik, Germany
- Technische Universität Dresden, Institut für Energieversorgung und Hochspannungs-Technik, Germany
- Technische Universität Graz, Fakultät für Elektrotechnik, Austria
- Institut für Elektrische Machines und Antriebe, Germany
- Institut der El. Leistungssysteme, Germany
- Technical University Cluj-Napoca, Romania
- TU Budapest, Hungary
- University of Bradford, Leeds, United Kingdom
- Università degli Studi di Catania, Dipartimento Elettrico Elettronico e Sistemistico, Italy
- University of East London, Department of Electrical and Electronic Engineering, United Kingdom
- University of Nottingham, United Kingdom
- Universidade do Porto, Portugal
- University of Maribor, Institute of Electrical Power Engineering, Slovenia
- University of Picardie – Jules Verne, Amien, France
- VŠB-TU Ostrava, Faculty of mechanical engineering, Czech Republic
- VŠB-TU Ostrava, Power Electronic Department, Czech Republic
- VŠB-TU Ostrava, Department of Cybernetics and Biomedical Engineering, Czech Republic
- Brno University of Technology, Institute of power electronic, Czech Republic
- University of west Bohemia, Czech Republic
- Institut National des Telecommunications Paris/Evry, France
- Montanuniversität Leoben Austria, Insitut fur Elektrotechnik, Austria
- Berner Fachhochschule, Hochschule für Technik und Architektur Burgdorf, Switzerland

Visits to Foreign Institutions

Name	Institution	Length of stay
Peter Bracíník	RAMBOLL UK, Ltd. Glasgow, UK – research internship	31 days

Other Activities

Membership in International Institutions/Committees

Individual membership of employees of international organizations		Function
Alena Otčenášová	IEEE	Member
Peter Bracíník	Program committee HORIZONT 2020 in area of „Bezpečná, čistá a efektívne využívaná energia“, European commission, Belgium	National delegate
Peter Bracíník	IEEE	Senior Member
Juraj Altus	IEEE	Senior member
Juraj Altus	CIREN, Czech Republic	University of Žilina representative
Juraj Altus	IAE, Paris, France International energetic agency	Slovak republic representative
Matěj Pácha	R&D department CZ LOKO, a.s., Česká Třebová, Czech Republic	Senior member

Matěj Pácha	IEEE - IAS/IES Joint Chapter, Czechoslovakia section	Committee member
Matěj Pácha	IEEE – Region 8	Membership Development Subcommittee
Matěj Pácha	IEEE – Czechoslovakia section	Section chair
Pavol Rafajdus	IEEE	Senior member
Valéria Hrabovcová	IEEE	Senior member
Pavol Makyš	IEEE	Member
Vladimír Vavrůš	IEEE	Member
Marek Roch	IEEE	Member
Marek Höger	IEEE	Member
Ján Vittek	IEEE	Member
Juraj Makarovič	IEEE	Member
Martina Látková	IEEE	Member
Michal Reguľa	IEEE	Member

Individual membership of employees in scientific committees of international conferences		Function
Alena Otčenášová	Conference EPE 2018, Brno, Czech Republic	Member of international science committee
Peter Bracíník	Conference EPE 2018, Brno, Czech Republic	Member of programme committee
Juraj Altus	12th International Conference ELEKTRO 2018, Mikulov, Czech Republic	Member of scientific committee
Peter Bracíník	12th International Conference ELEKTRO 2018, Mikulov, Czech Republic	Member of scientific committee
Valéria Hrabovcová	12th International Conference ELEKTRO 2018, Mikulov, Czech Republic	Member of scientific committee
Alena Otčenášová	12th International Conference ELEKTRO 2018, Mikulov, Czech Republic	Member of scientific committee
Pavol Rafajdus	12th International Conference ELEKTRO 2018, Mikulov, Czech Republic	Member of scientific committee
Pavol Rafajdus	SPEEDAM, ITALY, International Symposium on Power Electronics, Electrical Drives, Automation and Motion, Amalfi, Italy	Member of scientific committee

Individual membership of employees in scientific boards and trade commissions abroad	Function
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Milan Pospíšil	Departmental committee for PhD thesis defence in a field of Power Electrical Engineering at Faculty of Electrical Engineering, Ostrava and TU Ostrava, Czech Republic	Vice-chairman
Milan Pospíšil	Departmental committee for Habilitation thesis defence in a field of Power Electrical Engineering at Faculty of Electrical Engineering, Ostrava and TU Ostrava, Czech Republic	Member
Pavol Rafajdus	CTU, Faculty of Electrical Engineering, Czech Republic	Member of scientific committee

Membership in National Institutions/Committees

Individual membership of employees in organizations of the SR		Function
Alena Otčenášová	Chairman of the Commission for the first attestation in the category teacher and subcategory secondary school teacher for training electrical subjects – MŠVVaŠ SR	chairman
Alena Otčenášová	Chairman of the attestation commission for the second attestation in the category teacher and subcategory secondary school teacher for training electrical subjects – MŠVVaŠ SR	chairman

Individual membership of employees in editorial boards of national journals		Function
Pavol Rafajdus	Communications, ISSN 1335-4205	The member of editorial board

Awards

Valéria Hrabovcová	Rector of the University of Žilina Award: Citations 2018
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