DEPARTMENT OF DEPARTMENT OF POWER SYSTEMS AND ELECTRIC DRIVES

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, 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.

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.

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. Main focus of the Electric power systems section is power quality and control and operation of power transmission systems. In the field of Electric drives, the main focus is on high dynamic control of AC drives, permanent magnet motors and various traction applications.

Department intensively cooperates with significant companies from Slovakia. These are mainly Slovenské elektrárne, Slovenská elektrizačná prenosová sustava, 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 Otcenasova
Administrative Support:	Darina Rufusova

Sections of the Department

Section of Electric Power Systems

Head of the Section:	Alena Otcenasova

Professors:	Juraj Altus
Associate Professors:	Peter Bracinik, Alena Otcenasova, Marek Roch
Senior Lecturers (with PhD):	Josef Beran, Miloslav Buzek, Marek Hoger, Ivan Litvaj, Michal Regula, Martina Kajanova (Latkova)

Section of Electric Drives and Electric Traction

Head of the Section:	Pavol Makys
Professors:	Pavol Rafajdus, Valeria Hrabovcova
Associate Professors:	Pavol Makys, Milan Pospisil
Research Fellows:	Pavel Lehocky, Vladimir Vavrus, Juraj Makarovic, Lukas Gorel
Senior Lecturers (with PhD):	Matej Pacha, Marek Stulrajter

Postgraduate Students

Internal (full-time):	Andrej Bolf (until August 2019), Pavol Belány (until August 2019), Pavel Sovička (until August 2019), Ľuboš Struharňanský (until August 2019) Dávid Motyka, Marek Novák, Martin Sumega, Patrik Varecha, Šimon Zoššák, Marek Širanec, Marián Tomašov, Štefan Kočan, Michal Kováčik (from September 2019), František Perniš (from September 2019)
External (part-time):	Dávid Kaprál

Education

Courses in Bachelor, Master and Doctoral Degree Programmes

Bachelor Degree Programmes

Course ID	Name	Sem.	Hours/Week
			L-E-Ls*
Courses at the Faculty of Electrical Engineering and Information Technology			
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
3B0313	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	3 – 2 – 0
3B0505	Electric Drives 1	5	3 – 1 – 1
3B0506	Electrical Apparatus	5	2 – 0 – 2
3B0508	Electricity Generation	5	3 – 0 – 2
3B0511	Methods of Quality Management	5	1 – 1 – 0
3B0513	Project Learning 5: Solar Team Slovakia	5	1 – 3 – 0
3B5500	Electricity Transmission	5	2 – 2 – 1
3B5501	Mechanics of Power Lines	5	2 – 2 – 0
3B5502	Selected Sections of Electric Machines	5	2 – 0 – 2
3B5506	Electric Machines in English 2	6	1 – 1 – 0
3B5507	Application of Digital Signal Processors 1	6	0 – 0 – 2
3B5508	Professional Practice (60 hours)	6	0 – 0 – 0
3B5600	Bachelor Thesis	6	0 – 2 – 0
3B5606	Elaboration and Defence of the Bachelor Thesis	6	0 – 10 – 0
3B0606	Electric Drives 2	6	3 – 1 – 0
3B0607	Quality Management	6	2 – 1 – 0
3B5601	Bachelor Project of the Electric Power System	6	0 – 3 – 0
3B5602	Bachelor Project of Electric Drives	6	0 – 3 – 0

3B5603	Bachelor Project Electric Traction	6	0 – 3 – 0
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) lectures - (E) exercises - (Ls) labs

Master Degree Programmes

Course ID	Name	Sem.	Hours/Week
			L-E-Ls*
Courses at the Faculty of Electrical Engineering and Information Technology			
3I4101	Transients in Power Systems	1	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) lectures - (E) exercises - (Ls) labs

Doctoral Degree Programmes

Course ID	Name	Sem.	Hours/Week
			L-E-Ls*
Courses at the Faculty of Electrical Engineering and Information Technology			
3D1100	Foreign Language		2 - 0 - 0
3D1112	Essay to Dissertation Examination and Defence of Written Project for Dissertation Examination		0 - 0 - 0
3D1113	The Thesis and Dissertation Defence		0 - 0 - 0
3D1101	Economic Aspects of Electric Power Systems Operation		2 - 0 - 0
3D1102	Electromagnetism in Power Systems		2 - 0 - 0
3D1103	Smart Grids		2 - 0 - 0
3D1104	Power Quality		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
Courses at the Faculty of Mechanical Engineering			

*(L) lectures - (E) exercises - (Ls) labs

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 invertor 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 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 to test 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 NXP Semiconductors, 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 National Programmes

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

1/0774/18: 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 Makys
Sub-Coordinator from FEEIT:	
Co-operators:	Pavol Rafajdus, Vladimir Vavrus, Lukas Gorel, Marek, Stulrajter, Jan Vittek, Valeria Hrabovcova, Pavel Lehocky, Juraj Makarovic, Slavomir Kascak, Jozef Sedo, Lubos Struharnansky, Milan Diko, Pavel Sovicka

1/0615/19**: Scientific research of high-speed drive with minimal torque ripple**	
Summary:	The presented project deals with the scientific research of high-speed drive from point of view of reducing torque ripple and minimizing vibrations. The entire electric drive consists of three important components: a high-speed motor, a power inverter and a control system with a suitable control structure. Base on this, the project is divided into the design and optimization of a high speed motor and a power inverter with a suitable control algorithm for sensor and sensorless control of the electric drive. The project will deal with the electromechanical motor design in terms of minimizing the torque ripple, designing and checking the mechanical strength and stiffness of the rotor. Another part of the project solves the power supply of an electric motor via a power inverter. The last part of the project focuses on the design and implementation of high speed drive control.
Realization:	01/2019 – 12/2021
Coordinator:	Pavol Rafajdus
Co-operators:	Pavol Makys, Valeria Hrabovcova, Vladimir Vavrus, Lukas Gorel, Pavel Lehocky, Marek Stulrajter, Juraj Makarovic, Martin Sumega, Patrik Varecha, Simon Zossak

1/0371/19: Societal vulnerability assesment due to the failure of important systems and services in electricity sector	
Summary:	Reducing the level of social vulnerability is one of the main principles of the functioning of society. Social vulnerability is part of the disaster risk assessment and key information needed to assess relevant threats and measures to mitigate their adverse effects. Identifying key dimensions of vulnerability forms the basis for reducing risk and improving the society's preparedness for various risk and crisis

	situations. Part of the vulnerability assessment is the identification of the resources necessary to deal with an adverse event. The project focuses on research into the possibilities of quantifying the vulnerability of a society due to the failure of important systems and services in the electricity sub-sector. The main output of the project will be a hierarchical model and methodology of assessing social vulnerability, with practical application for a particular selected area, considering the failure of a part of the electricity system.
Realization:	01/2019 – 12/2021
Coordinator:	Mária Lusková (FBI, UNIZA)
Co-operators:	Peter Braciník

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

026ŽU-4/2019: Implementation of integrated GPS system for specification and products verification 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 teaching form within the study programs of the three-level university studies at the technical universities. The project deals with the implementation of the knowledge's introduced in the latest International Technical Standards from the field of Geometric Product Specification (GPS) into the teaching plans of such subjects as Technical/Engineering Drawing, Design, Methodology of Design, Engineering Metrology, Quality Management in Engineering and Measuring Methods and Instruments. The project is multidisciplinary. It is focused on designing and specification prescribing of dimension, geometry and form of the product, as well as on verification of measurement results and on the evaluation of geometric quantities by using of the latest measurement equipment's. The outcome of the project will be the creation of the educational program that will include the publication of two university textbooks. The textbooks will be supported by digital annexes accessible on the faculty's intranet. The annexes will include entering and solving tasks in the form of examples. Part of the tasks will be handled in English. It should help students to learn the professional language. The project is also focused on internationalization in education, increasing of skills, flexibility in vocational training as well as on increasing of university student's linguistic skills. Another project aim will be the equipping of the 3D measurement laboratory with latest technologies for implementation of the measurement strategy. The aim of the project is to help students to achieve such level of knowledge's and professional skills that will increase their competitive advantage for prospective employers, especially in the field of the bearing and automotive industries.
Realization:	2019-2021
Coordinator:	doc. Ing. Jozef Bronček, PhD. (Faculty of Mechanical Engineering, University of Zilina)
Co-operators:	Ivan Litvaj, ...

045ŽU-4/2019: Innovation of the educational process by modernization of Electrical Machines Laboratory	
Summary:	The aim of the project is a complex modernization of the Electrical Machines Laboratory, where the measurements of electrical machines are done by the Department of Power Electrical Systems at the Faculty of Electrical Engineering of the University of Žilina in bachelor and master studies. The result of the modernization of the laboratory is to reach the national and international standards

	and industrial standards in terms of further application of graduates. Innovative studding texts on measuring points will be introduced and automated measurements on electric machines will be created. It can be said that study of the field of electric machines is not easy. This subject is an integral part of the study fields for which this issue is a complete foundation without which the understanding of other contexts is very problematic. Its quite clear, that the most proper way how to be success, is to work in practice and various measurements, to simulate different operating states at test benches. For this purpose, three modern measuring instruments will be constructed as a result of the project, where each station includes electrical machine able to work as a motor or generator, variable power sources with appropriate power levels, variable electronic loads, measuring instruments, recording and computing equipment, mechanical equipment for appropriate fixation and mechanical attachment of the measured electrical machine. This technical part of the project will be complemented by lecture scripts - guides for each measurements, which will be processed according to relevant applicable standards and international standards. The measurement test benches thus allow to individual students to realistically measure the relevant electrical machines, and apply the theoretical knowledge in practice where is a huge request for so skilled and erudite experts in the field of electric machines and drives.
Realization:	01/2019 – 12/2021
Coordinator:	Pavol Rafajdus
Co-operators:	Pavel Lehocky, Juraj Makarovic, Rudolf Madaj, Martin Sumega, Pavel Sovicka

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

APVV-15-0464: Efficiency increase of electricity transmission in TS SR	
Summary:	The project deals with research of losses caused by impedance imbalance of selected electrical elements (transformers, overhead lines and compensating inductors) of the transmission system of the Slovak Republic (PS SR) as a general asymmetric system by research of suitable procedure for determination of impedance and admittance matrices and asymmetries of these elements. Minimizing losses is still considered an appropriate way to make more efficient use of energy resources, which can contribute to increasing energy efficiency. The importance of this objective is also confirmed by the document of the European Council of 23-24 October 2014, focusing on the framework of climate and energy policies, which sets an indicative target for improving energy efficiency by at least 27% by 2030 compared to the expected future. consumption.
Realization:	1/2016 – 12/2020
Coordinator:	Juraj Altus
Co-operators:	Marek Roch, Marek Hoger, Alena Otcenasova, Jozef Lago, Lubos Pavlov

APVV-16-0505: The short-term PREDICtion of photovoltaic energy production for needs of pOwer supply of Intelligent BuildiNgs - PREDICON	
Summary:	The proposed project is aimed at the developing of method for a very short-term prediction of photovoltaic (PV) power plant output with timescale ranging from 5 to 30 minutes. To forecast the intensity of solar irradiance, as the main factor affecting the performance of PV power plant, the algorithm using analysis of recorded image data representing cloudiness motion above the installation site of PV power plant will be proposed. To achieve the best accuracy of output prediction of PV power plant, local factors affecting solar irradiance and PV power plant operation will be

	identified. The analysis will be done in order to define correction factors for the adaptation of predicted values of solar irradiance determined by the proposed algorithm to current local conditions at the installation site of PV power plant. The functionality and accuracy of proposed method will be verified by the help of created PV power plant mathematical model as well as by measurements performed on real PV power plant.
Realization:	07/2017 – 06/2020
Coordinator:	Robert Hudec (KMIKT, FEIT, UNIZA)
Co-operators:	Peter Bracinik, Marek Novak

Projects of European Structural Funds

ITMS2014+: 313012N944: Research and development of new plasma milling system PLASMABIT BHA for effective and environmental well plug & abandonment and implementation of new product to the production process	
Summary:	The main goal of the project is the research and development of plasma milling system PLASMABIT BHA, to perform functional tests of prototype and afterwards to implement new product into production process. Our new product is intended for plasma milling of pipeline (steel tube) as more effective, economic, safer and moreover, environmental way of tight plugging and abandonment of depleted oil & gas wells. PLASMABIT BHA will be able to remove part of a pipeline in contactless way and tightly close the borehole, thus preventing the leakage of residual fractions of oil or gas.
Realization:	06/2019 – 06/2021
Coordinator:	Pavol Spanik
Co-operators:	Pavol Rafajdus, Branislav Dobrucky, Michal Frivaldsky, Michal Prazenica, Slavomir Kascak, Vladimir Vavrus, Marek Hoger, Daniela Franekova

Submitted Proposals of International Research Projects in 2019

Typ / výzva	**Názov projektu**	**Outcome of evaluation**
PECS (SLOVAKIA)	ADVANCED ELECTRONICS FOR SPACE ROBOTIC ARM MOTORISATION	Under evaluation
H2020 - IA	H2020-LC-SC3-EE-2019 Smart intelligent solutions facilitating powerful performances of your sustainable energy requests - SNAPPY	Not supported
COST	OC-2019-124201 Reliable and Intelligent Electrical Networks with Distributed Energy Resources	Under evaluation
H2020 MSCA-RISE-2019	Smart Electric Vehicle Ecosystem for Suitenable Cities - SMARTEVS	Not supported

Outputs from Solved Research Tasks

Monographs

[1]	KAJANOVÁ, Martina - BRACINÍK, Peter – ROCH, Marek: Utilization of finite state machine approach for microgrid modeling, In: Electrical Engineering, New York, USA, Vol. 11/2019, ISSN: 0948-7921, , p. 11
[2]	OTČENÁŠOVÁ, Alena – BOLF, Andrej – ALTUS, Juraj – REGUĽA, Michal: The influence of power quality indices on active power losses in a local distribution grid. In: Energies [electronic] ISSN 1996-1073 (online), Vol. 12/7 (2019), p. 1-31, {IF: 2.676, Q3}

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: Katedra elektrických strojov a prístrojov, Katedra elektroenergetiky;
- TU Košice: Katedra elektroenergetiky, Katedra elektrických pohonov;
- 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,
- PPA Power DS s.r.o.
- PV SŽKV Zvolen,
- Regionálne poradenské a informačné centrum Považská Bystrica,
- SIEMENS,
- Slovenské centrum produktivity Žilina, Žilinská univerzita,
- Stredoslovenská energetika, a.s. Žilina,
- SEPS, a.s. Bratislava,
- SEZ Krompachy
- Schneider Electric Slovakia spol. s r.o.,
- Sungwoo hitech, s.r.o. Žilina,
- Technický skúšobný ústav Piešťany,
- Vinuta Rajec, s.r.o.,
- VUKI, a.s. Bratislava,
- VUVT Engineering, a.s. Žilina,
- VVÚŽ Vrútky,
- ZSSK Divízia 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,
- ABD Praha, s.r.o. závod Technika – prof. Kejzlar, Ing. Němeček,
- AD Developments Milton Keynes, UK – p. Frank Shepard,
- Appraisals Services – Znalecký ústav Praha, Ing. Karel Šimek,
- AŽD Praha, dr. Ing. Aleš Lieskovský, dr. Ing Ivo Myslivec,
- Cinvestav Guadalajara, Mexico, Dr. A. G. Loukjanov, prof. Bernardino Castillo-Toledo, prof. Alexander. G. Loukjanov,
- Control Technique Dynamics, Andover, UK – p. Suji Jayasoma,
- CZ Loko, a.s., Česká Třebová, Ing. Bohumil Skála,
- České dráhy O12 Praha, Ing. Jan Plomer,
- ELCOM Praha, Ing. Jiří Korenc, Ing. Jiří Holoubek,
- NXP Semiconductors Rožnov pod Radhoštem
- ŠKODA Transportation Plzeň, Ing. Milan Šrámek,
- ŠKODA Electric Plzeň, dr. Ing. Ladislav Sobotka,
- Telmining, s.r.o. / T-Machinery, s.r.o., Ratíškovice, ČR
- Železniční zkušební okruh VÚŽ Cerhenice, CZ – Ing. Eduard Novák, CSc.
- ESIN construction, a.s.

Non-contractual Cooperation with Academic Institutions

- Aalto University, Finland, School of Science and Technology, Department of Electrical Engineering, Prof. Tapani Jokinen,
- Aalto University, School of Electrical Engineering, prof. Matti Lehtonen
- ČVUT Praha, CZ, Katedra elektroenergetiky, prof. Tlustý, doc. Müller,
- Lappeenranta University of Technology Finland, Faculty of Electric Engineering – prof. Juha Pyrhőnen,
- Politechnika Gdańska, Prof. Krzysztof Karwowski,
- Politechnika Warszawa, Instytut Maszyn Elektrycznych, Prof. Ing. Jan Kacprzak, DrSc., Prof. Ing. Adam Szelag, PhD.,
- Ruská akadémia vied, Institút riadenia M. Trapeznikova, prof. Ing. Sergej Ryvkin, DrSc.
- Hochschulle für Technik und Wirtschaft, Dresden, Fachbereiches Elektrotechnik, Prof. Dr.-Ing. habil. Gerhard Hofmann,
- Technical University of Bochum, prof. Andreas Steimel,
- Technische Universität Darmstadt, Nemecko, Institut für Elektrische Energiewandlung – Prof. Dr. Ing. Andreas Binder,
- Technische Universität Dresden, Nemecko, Lehrstuhl Elektrische Antriebe und Grundlagen der Elektroenergietechnik – Prof. Dr. Ing. habil. P. Büchner,
- Technische Universität Dresden, Nemecko, Institut für Energieversorgung und Hochspannungs-Technik – Prof. Dr. Ing. habil. Peter Schegner,

- Technische Universität Graz, Rakúsko, Fakultät für Elektrotechnik – Prof. Dr. Ing. Manfred Rentmeister,
  Institut für Elektrische Machines und Antriebe – Prof. Dr. Ing. Hansjőrg Kőfler, Institut der El. Leistungssysteme – Prof. Dr. Ing. Manfred Sakulin,
- Technical University Cluj-Napoca, Rumunsko - prof. Lorand SZABO, prof. Ioan-Adrian Viorel
- TU Budapest, Hungary
- University of Bradford, Leeds, UK, Dr. Li Zhangová,
- University of East London, Department of Electrical and Electronic Engineering, Dr. Roy Perryman, Prof. Stephen Dodds, dr. Wada Hosny
- University of Nottingham, UK – Dr. Pat Wheeler,
- Universidade do Porto, PT – prof. F. Maciel Barbosa,
- University of Maribor, SLO – Institute of Electrical Power Engineering, doc. dr. Deželak Klemen, univ.dipl.inž. el.
- University of Picardie – Jules Verne, Amien, Francúzsko – Prof. Gérard-André Capolino,
- VŠB-TU Ostrava, CZ - doc. Ing. Robert Čep, PhD., Ing. Lenka Čepová, PhD. – strojnícka fakulta
- VŠB-TU Ostrava, CZ – Katedra elektroenergetiky
- VŠB-TU Ostrava, CZ – Katedra kybernetiky a biomedicínského inženýrství
- VÚT Brno, CZ – Ústav elektroenergetiky
- Západočeská univerzita Plzeň, CZ – doc. Ing. Jiří Danzer, CSc., prof. Ing. Václav Kus, CSc., prof. Ing. Zdeněk Peroutka, PhD.
- Institut National des Telecommunications Paris/Evry, Francúzsko – Dr. Jean-Pierre Vidal, Dr. J. C. Chimenez, Dr. Michele Merlier,
- Montanuniversität Leoben Austria, Insitut fur Elektrotechnik, prof. Helmut Weiss
- Berner Fachhochschule, Hochschule für Technik und Architektur Burgdorf, CH, prof. Jean-Pierre Steger – vizedirektor,

Visitors to the Department

Name	**Institution**	**Length of stay**
Ing. Aleš Hromádka	ZČU Plzeň	4 months
doc. Ing. Pavel Drábek, PhD.	ZČU Plzeň	1 week
doc. Ing. Bohumil Skala, PhD.	ZČU Plzeň	1 week
Ing. Aleš Hromádka	ZČU Plzeň	4 months

Visits to Foreign Institutions

Name	**Institution**	**Length of stay**
Ing. Kajanová Martina, PhD.	University of California, Berkeley, USA	160 days
doc. Ing. Braciník Peter, PhD.	RAMBOLL UK Ltd., Glasgow, UK	31 days

Other Activities

Conferences, Workshops, Symposiums Organized by the Department

- Technology in Electrical Engineering 2019, 21.5. - 23.5.19, Zuberec, Miloslav Buzek, Josef Beran

Membership in International Institutions/Committees

Individual membership of employees of international organizations		**Function**
Alena Otcenasova	IEEE	Member
Peter Bracinik	HORIZONT 2020 – Program committee for safe, clean and effectively used energy, EU, Belgium	National delegate
Peter Bracinik	IEEE	Senior member
Juraj Altus	IEEE	Senior member
Juraj Altus	CIRED, Czechia	University delegate
Juraj Altus	IAE, Paris, France	National delegate
Matej Pacha	CZLOKO, Czechia, R&D Committee	Senior member
Matej Pacha	IEEE	Senior member
Matej Pacha	IEEE Czechoslovakia Section	Vice-chair
Matej Pacha	IEEE Region 8, Action for Industry Subcommittee	Member
Pavol Rafajdus	IEEE	Senior member
Valeria Hrabovcova	IEEE	Senior member
Pavol Makys	IEEE	Member
Vladimir Vavrus	IEEE	Member
Marek Roch	IEEE	Member
Marek Hoger	IEEE	Member
Juraj Makarovic	IEEE	Member
Martina Kajanova	IEEE	Member
Michal Regula	IEEE	Member

Individual membership of employees in the scientific committees of international conferences		**Function**
Juraj Altus	Elektrotechnologia 2019, Zuberec, SK	Scientific Committee Chair
Juraj Altus	13th International Conference ELEKTRO 2020, Taormina, Italy	Scientific Committee member
Alena Otcenasova	Electric Power Engineering, EPE 2019, Czechia	Scientific Committee member
Alena Otcenasova	13th International Conference ELEKTRO 2020, Taormina, Italy	Scientific Committee member
Peter Bracinik	Elektrotechnologia 2019, Zuberec, SK	Scientific Committee member

Peter Bracinik	13th International Conference ELEKTRO 2020, Taormina, Italy	Scientific Committee member
Peter Bracinik	ELECTRONICS 2019, Palanga, Litva	Scientific Committee member
Valeria Hrabovcova	13th International Conference ELEKTRO 2020, Taormina, Italy	Scientific Committee member
Pavol Rafajdus	13th International Conference ELEKTRO 2020, Taormina, Italy	Scientific Committee member
Pavol Rafajdus	25th International Conference SPEEDAM 2020, Sorrento, Italy	Scientific Committee member
Marek Roch	13th International Conference ELEKTRO 2020, Taormina, Italy	Scientific Committee member
Pavol Makys	13th International Conference ELEKTRO 2020, Taormina, Italy	Scientific Committee member
Matej Pacha	13th International Conference ELEKTRO 2020, Taormina, Italy	Scientific Committee member
Michal Regula	13th International Conference ELEKTRO 2020, Taormina, Italy	Scientific Committee member

Individual membership of employees in scientific boards and trade committees abroad		**Function**
Milan Pospisil	Committee for PhD Theses, Power Engineering, TU Ostrava	Vice-chair
Milan Pospisil	Committee for Assoc.Prof., Power Engineering, TU Ostrava	Member
Pavol Rafajdus	CTU, FEL, Czechia	Scientific board member

Membership in National Institutions/Committees

Individual membership of employees in organizations of the SR		**Function**
Alena Otcenasova	Teacher's attestation committee	Vice-chair

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

Individual membership of employees in scientific boards and trade committees outside of FEEIT UNIZA		**Function**
Pavol Rafajdus	CTU FEL, Prague, Czechia	Scientific Board Member

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