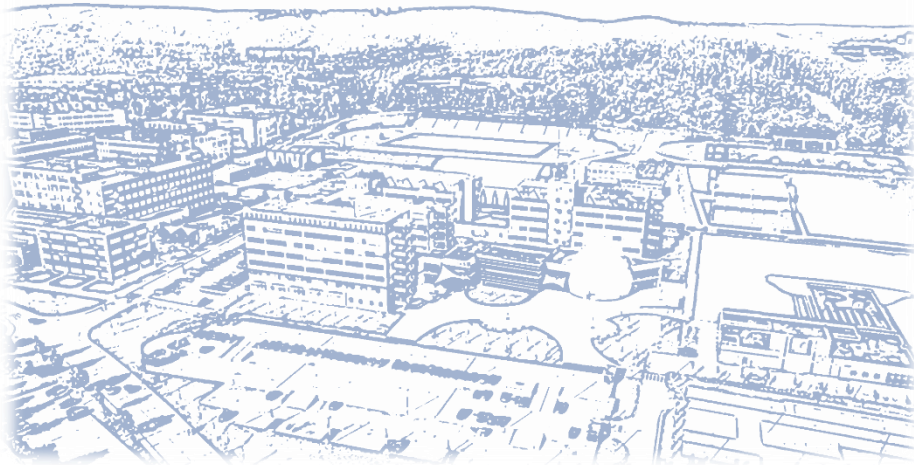


# **ANNUAL REPORT 2018**

**FACULTY OF ELECTRICAL ENGINEERING AND  
COMMUNICATION**

**BRNO UNIVERSITY OF TECHNOLOGY**



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# 1 Introduction

## 1.1 Brief History of the Faculty

Faculty of Electrical Engineering and Communication has always been an integral part of Brno University of Technology. Therefore, history of these two institutions is firmly linked.

Brno University of Technology was founded on 24 January 1849 when the Moravian Diet approved foundation of a technical school. The school was bilingual with instruction both in Czech and German; students could study technical, agricultural and commercial specialisations. However, in consequence of political and national disputes, Czech gradually ceased to be used as a language of instruction until in 1899 the Czech Technical High School was established in Brno. After World War I and the founding of Czechoslovakia this school merged with the German Technical School to form the High Technical School in Brno. In the interwar period this school (under a new name of High Technical School of Dr. Edvard Beneš in Brno) was very successful and ranked among the best technical high schools in Europe. Unfortunately, during World War II the school was, as all other Czech high schools were, closed and the premises were used by German military. Immediately after the war students and teachers started to work to resume instruction, which started again in December 1945. In 1951 the high school was closed and had to leave the building in Veverří, which from then on housed Military Technical Academy. Most teachers moved to the newly established military academy.

Brno University of Technology, then consisting of three faculties: Faculty of Construction Engineering (FCE), Faculty of Architecture and Building Construction (FABC) and Faculty of Energy (FE), was founded on 24 July 1956. The Government Order 58 of 12/08/1959 divided the Faculty of Energy into Faculty of Mechanical Engineering and Faculty of Electrical Engineering. This is the beginning of an independent electrical engineering faculty in Brno.

In 1990s the faculty responded to the technological advance, broadened its scope and renamed to Faculty of Electrical Engineering and Computer Science. In the course of time it became evident that electrical engineering and information technologies would diverge. As a result, in 2002, Faculty of Information Technology (FIT) was founded and the original Faculty of Electrical Engineering and Information Technology transformed on 1st January 2002 to the Faculty of Electrical Engineering and Communication Technology (FEEC). A significant milestone in the faculty history was 2013 when the construction of new faculty premises was completed. After more than fifty years of its existence, the whole faculty, all departments and workplaces, moved to one location in the BUT campus Pod Palackého vrchem.

## 1.2 The Faculty in 2018

The beginning of February 2018 saw the change of the dean: Prof. Ing. Jarmila Dědková, CSc. was replaced by Prof. RNDr. Vladimír Aubrecht, CSc. who was elected by the Academic Senate. Apart from the dean, the faculty management consists of four vice deans and the faculty bursar: Prof. Ing. Jarmila Dědková, CSc. (education, acting dean), doc. Ing. Jaroslav Koton, Ph.D. (creative activities and doctoral study), doc. Ing. Jiří Háze, Ph.D. (external and foreign relations), doc. Ing. Petr Fiedler, Ph.D. (development) and Ing. Miloslav Morda (faculty bursar).



The faculty is housed in a modern university campus in Technická st.

### 1.2.1 Faculty in Numbers:

Number of academic employees (full professors, associate professors, assistant professors, assistants, lecturers and other pedagogical staff members) – recalculated towards full-time		187.90
Number of recalculated research workers:		39.46
Number of students studying with state support:		3 106
	Bachelor degree programmes	1 774
	follow-up Master degree programmes	903
	doctoral degree programmes	297
Number of graduates:		738
	Bachelor degree programmes	380
	follow-up Master degree programmes	331
	doctoral degree programmes	27
Number of admissions:		1 748
	Bachelor degree programmes	1 058
	follow-up Master degree programmes	638
	doctoral degree programmes	52
Number of students studying in English in self-paid study		2
Number of successfully completed habilitations		5
Number of successfully completed appointments to professorship		3
<i>Note: Data as of 31/12/2018</i>		

### 1.2.2 Important Activities of the Faculty

- operation of the interactive playroom 'Elektrikárium',
- operation of the multifunctional room for students 'Studentárium', in which students can spend their free time, solve group projects and prepare collectively
- supportive events for potential FEEC students aimed at increasing their admission chances such as preparatory courses for entrance exams in mathematics and physics organized by the Department of Mathematics and Department of Physics
- three 'Open Days' (January, November, December 2018), visits by students to secondary schools, secondary school advisors visiting FEEC, 'Night of Scientists'
- faculty presentation at the European trade fair of higher and lifelong education 'GAUDEAMUS 2018, 22-25 October 2018', trade fairs in Bratislava, Nitra and Prague
- meeting of the management of Czech and Slovak faculties of electrical engineering and associated faculties 22-24 May 2018 in Ostrava,
- participation in a march 'Aj svetlá naše nech im svietia...' held to commemorate 50th anniversary of the tragedy at Kubínska Hoľa, where 6 students of the Faculty of Electrical Engineering died
- '24<sup>th</sup> STUDENT EEICT Conference and Competition 2018' with 169 Bachelor, Master, Ph.D. and secondary school students, sponsored by ABB, ON Semiconductor, Thermo Fisher Scientific and many others
- successful '6th Merkur perFEKT Challenge', the top creative competition for secondary school students, with 55 teams from all over Czech Republic
- systematic participation in the programme Erasmus+ and other European programmes
- continuation of the project 'Energy in Conditions of Sustainable Development (ENPUR)' of the regional centre CVVOZE (Centre for Renewable Electric Energy Sources) funded from NPU I, investigator prof. RNDr. Vladimír Aubrecht, CSc.
- continuation of the project 'Interdisciplinary Research of Wireless Technologies' (INWITE) of the regional centre SIX (Centre for Sensor, Information and Communication Systems) funded from NPU I, investigator doc. Ing. Martin Slanina, Ph.D.
- operation of the mini nursery 'Edisonka' in the sustainability period supported by the faculty
- activities of Academic Senate member Ing. Ivana Jakubová in her capacity as a member of the Higher Education Council
- activities of prof. Ing. Evy Gescheidtová, CSc., doc. Ing. Miloslava Steinbauer, Ph.D. and Ing. Daniel Janík in the Academic Senate of Brno University of Technology,



- activities of Academic Senate, namely Chairman doc. Ing. Miloslav Steinbauer, Ph.D., focused on organisational issues and economic interests of FEEC
- activities of Advisor for Equal Opportunities doc. Ing. Vlasta Sedláková, Ph.D. focused on consultancy for female students and study opportunities for handicapped students
- work on applications for accreditation of the follow-up Master degree study programmes Cybernetics, Control and Measurement, Electronics and Communications, Microelectronics, Power Electrical Engineering and Power Electronics, Power Electrical Engineering, Telecommunications and Information Technology, Information Security, Electrotechnical Manufacturing and Management and Biomedical and Ecological Engineering
- traditional 51th faculty ball organised in cooperation with Faculty of Information Technology



The FEEC – FIT faculty ball was a usual success

## 2 Basic Faculty Facts

### 2.1 Full Name, Usual Abbreviation and Seat

#### Faculty of Electrical Engineering and Communication - FEEC

Address: FEKT VUT, Technická 3058/10, 616 00 Brno

Telephone: exchange 54114 1111, extension 54114 xxxx

E-mail: [info@feec.vutbr.cz](mailto:info@feec.vutbr.cz)

Internet: <http://www.fekt.vutbr.cz>

Facebook: <http://www.facebook.com/FEKTVUT>

Youtube: <http://www.youtube.com/user/perFEKTniFakulta>

Twitter: <https://twitter.com/JSMEperFEKTni>

Instagram: <https://www.instagram.com/fektbrno/>

### 2.2 Organisation Structure

#### 2.2.1 Faculty Management

Dean

Vice-Dean for Education, Acting Dean

Vice-Dean for Development

Vice-Dean for External Relations

Vice-Dean for Creative Activities

Faculty Bursar

Prof. RNDr. Vladimír Aubrecht, CSc.

Prof. Ing. Jarmila Dědková, CSc.

doc. Ing. Petr Fiedler, Ph.D.

doc. Ing. Jiří Háze, Ph.D.

doc. Ing. Jaroslav Koton, Ph.D.

Ing. Miloslav Morda

Academic Senate

Scientific Board

Study Programmes Board

Disciplinary Commission

#### 2.2.2 Student Advisor to the Dean

Ing. Daniel Janík

#### 2.2.3 Advisor for Equal Opportunities

doc. Ing. Vlasta Sedláková, Ph.D.

#### 2.2.4 Trade Unions Representative

Prof. Ing. Vítězslav Hájek, CSc. / Bc. Šárka Krejčí

#### 2.2.5 Organisational Structure Departments

Organisational Department

Study Department

Scientific and Foreign Department

HR and Legal Department

Economic Department

Department of Information Systems Management

Facility Management Technická

#### 2.2.6 Departments and Research Centers

Department of Control and Instrumentation

Department of Biomedical Engineering

Department of Power Electrical Engineering

Department of Electrical and Electronic Engineering

Department of Physics

Department of Languages

Department of Mathematics

Department of Microelectronics

Department of Radioelectronics

Department of Telecommunications

Department of Theoretical and Experimental Electrical Engineering

Department of Power Electrical and Electronic Engineering

Centre for Research and Utilization of Renewable Energy

Centre for Sensor, Information and Communication Systems

## 2.3 Scientific Board, Academic Senate and Other Bodies

### 2.3.1 Scientific Board

#### Internal Members

Prof. RNDr. Vladimír Aubrecht, CSc.  
doc. Ing. Petr Bača, Ph.D.  
Prof. Ing. Lubomír Brančík, CSc.  
Prof. Ing. Jarmila Dědková, CSc.  
doc. Ing. Petr Fiedler, Ph.D.  
Prof. Ing. Lubomír Grmela, CSc.  
doc. Ing. Jan Hajný, Ph.D.  
doc. Ing. Jiří Háze, Ph.D.  
doc. Ing. Jaromír Hubálek, Ph.D.  
doc. Ing. Jaroslav Koton, Ph.D.

Prof. Ing. Tomáš Kratochvíl, Ph.D.  
Prof. Ing. Ivo Provazník, Ph.D.  
doc. Ing. Martin Slanina, Ph.D.  
Prof. Ing. Zdeněk Smékal, CSc.  
doc. RNDr. Zdeněk Šmarda, CSc.  
doc. Ing. Petr Toman, Ph.D.  
Prof. Ing. Pavel Václavěk, Ph.D.  
doc. Ing. Ondřej Vítek, Ph.D.  
Prof. Ing. Radimír Vrba, CSc.

#### External Members

Prof. Ing. Ivan Baroňák, Ph.D.  
doc. Ing. Otto Dostál, CSc.  
Ing. Jiří Holoubek  
doc. Dr. Ing. Pavel Horský  
Prof. Ing. Miroslav Husák, CSc.  
Prof. RNDr. Ludvík Kunz, CSc.

doc. Ing. Jiří Masopust, CSc.  
Ing. Ilona Müllerová, DrSc.  
Ing. Jiří Potěšil  
Prof. Ing. Aleš Richter, CSc.  
Ing. Roman Schiffer  
doc. Ing. Jaroslav Zendulka, CSc.

### 2.3.2 Academic Senate

In 2018 the Senate was composed of the following members (department and membership in committees given: LK – legislative committee, EK – economic committee, KK – quality committee)

#### Chair

doc. Ing. Miloslav Steinbauer, Ph.D., EK, LK, KK (UTEE)

#### Academic Staff Chamber

Ing. Ivana Jakubová, EK, LK, KK (UREL), chair  
doc. Ing. Petr Číka, Ph.D., EK, PK (UTKO)  
RNDr. Petr Fuchs, Ph.D., EK (UMAT)  
Ing. Martin Jílek, EK (UJAZ) – till April 2018  
Mgr. Pavel Sedláček, EK (UJAZ) – since April 2018  
Ing. Stanislav Klusáček, Ph.D., EK, PK (UAMT)  
doc. Ing. Petr Mastrný, Ph.D., EK, PK, KK (UEEN)  
Prof. Ing. Vladislav Musil, CSc., EK, LK (UMEL)  
Ing. Helena Polsterová, CSc., EK (UETE)  
doc. Ing. Vlasta Sedláková, Ph.D., EK, LK, KK (UFYZ)  
doc. Ing. Miloslav Steinbauer, Ph.D., EK, PK, KK (UTEE)  
Ing. Martin Vítek, Ph.D. EK, LK (UBMI)  
doc. Ing. Pavel Vorel, Ph.D., PK (UVEE)

#### Student Chamber

Ing. Daniel Janík, EK, LK, PK, KK, chair  
Jiří Dvořáček, LK, KK  
Kateřina Chroustovská, EK, PK  
Bc. Vojtěch Kučírek, EK, LK – till June 2018  
Bc. David Michalík, PK, KK  
Bc. Michal Mitrenga – since June 2018  
Bc. Martin Šelíng, PK, KK  
Bc. Hana Vrtělková, PK, KK

In 2018, the Senate held 9 regular meetings to discuss legislative, economic and pedagogical matters. The average attendance of the senators was 86%. The meetings were constructive; all proposals were debated in advance and submitted for commenting to senators.

In the legislative area the Academic Senate of FEEC discussed amendments to the internal faculty guidelines resulting from amendments of the BUT guidelines. The 'Implementation Plan of Strategic Intent for 2018' was discussed and approved, the 'Annual Report 2017' and the 'Economic Annual Report 2017' of the faculty were passed. Several accreditation proposals of new study programmes were discussed.



In the economic area the Senate discussed and approved the proposal for distribution of financial means for 2018 and the proposal on distribution of the Balanced Fund. Budget rules were drafted at several joint meetings of economic committee and faculty management.

## 2.4 Mission, Vision and Strategic Plans of the Faculty

The faculty mission is to bring up university trained experts in its accredited study programmes, especially in the area of education 'Electrical Engineering, Power Engineering, Information Technology and Economical Areas', develop scientific research in these areas and produce research outcomes with high level of social relevance.

The main vision of the faculty is, thanks to its quality study programmes, excellent research and highly qualified graduates, to remain a renowned faculty of electrical engineering both at national and international levels. This vision is formed in the following slogans (with initials forming the Czech abbreviation of the faculty, FEKT):

**F**aculty as an integral part of Brno University of Technology – a modern and internationally renowned university with a long tradition.

**E**xcellent institution of education training universal graduates able to participate in a dynamic development of advanced technology.

**K**(C)ompetitive research university workplace with activities leading to development of scientific knowledge with high level of social relevance.

**T**op choice for those interested in quality university education in electrical engineering areas with a guarantee of good employment.

The main priority of the faculty development is increasing quality in educational and research activities, transfer of technologies and innovations into industry and internationalisation. Our goal is to increase prestige of the faculty among professionals and general public and to increase interest of secondary school students, Bachelor and Master students in our faculty, development of cooperation with the applicational sphere, and increasing mobilities between the faculty and foreign research centers and universities.

# 3 Education and Study

## 3.1. Study Programmes and Educational Activities

In 2018 two types of study programmes existed at FEEC: those accredited before the amendment of The Higher Education Act ('original programmes' further on) and the ones accredited after the amendment, which do not define study areas within study programmes ('transformed programmes' further on).

### 3.1.1. Accredited study programmes – original ones

#### 3.1.1.1. Bachelor Degree Programmes

##### **Electrical, Electronic, Communication and Control Technology (EEKR-B)**

Study areas: Control and Measurement Technology  
Electronics and Communication  
Microelectronics and Technology  
Power Electrical and Electronic Engineering  
Teleinformatics

##### **Biomedical Technology and Bioinformatics (BTBIO-A)**

Study area: Biomedical Technology and Bioinformatics

##### **English in Electrical Engineering and Information Technology (AJEI-H)**

Study area: English in Electrical Engineering and Information Technology

##### **Audio Engineering (AUDIO-J)**

Study area: Audio Engineering

##### **Information Safety (IBEP-T)**

Study area: Information Security

#### 3.1.1.2. Follow-up Master Degree Programmes

##### **Electrical, Electronic, Communication and Control Technology (EEKR-M)**

Study areas: Biomedical and Ecological Engineering  
Power Electrical Engineering  
Electronics and Communications  
Electrotechnical Manufacturing and Management  
Cybernetics, Control and Measurement  
Microelectronics  
Power Electrical Engineering and Power Electronics  
Telecommunications and Information Technology

##### **Biomedical Engineering and Bioinformatics (BTBIO-F)**

Study area: Biomedical Engineering and Bioinformatics

##### **Audio Engineering (AUDIO-P)**

Study area: Audio Engineering

##### **Information Security (IBEP-V)**

Study area: Information Security

#### 3.1.1.3. Doctoral Degree Study Programmes

##### **Electrical Engineering and Communication Technology**

Study areas: Biomedical Electronics and Biocybernetics  
Electronics and Communications  
Physical Electronics and Nanotechnology  
Cybernetics, Control and Measurement  
Mathematics in Electrical Engineering  
Microelectronics and Technology

Power Electrical and Electronic Engineering  
Teleinformatics  
Theoretical Electrical Engineering

### **Biomedical Technology and Bioinformatics**

Study area: Biomedical Technology and Bioinformatics

## **3.1.2. Newly accredited study programmes – transformed ones**

### **3.1.2.1. Bachelor Degree Study Programmes**

Automation and Measurement (BPC-AMT)  
Electronics and Communication Technologies (BPC-EKT, BKC-EKT)  
Microelectronics and Technology (BPC-MET)  
Power Electrical and Electronic Engineering (BPC-SEE)  
Telecommunication and Information Systems (BPC-TLI, BKC-TLI)  
Audio Engineering (BPC-AUD)  
Specialisation: Audio Production and Recording  
Audio Technology  
Information Security (BPC-IBE)

### **3.1.2.2. Follow-up Master Study Programmes**

Biomedical Engineering and Bioinformatics (MPC-BTB)  
Audio Engineering (MPC-AUD)  
Specialisation: Audio Production and Recording  
Acoustics and Audio-Visual Technology

Key to the abbreviations of the newly accredited programmes:

the first letter denotes the degree (**B**- Bachelor, **M** – follow-up Master, **D**- doctoral)

the second letter denotes the form of study (**P** – attended, **K**- combined)

the third letter denotes the language of instruction (**C** – Czech, **A** – English)

the three-letter abbreviation of the programme follows after the hyphen (in most cases)

## **3.2. Education Support**

In the area of education support the faculty encourages continual use and improvements of the university information system in its modules related to student agenda and spreading information among students as, given the number of students, managing the student agenda without the information system would be almost impossible. The system was also used as a platform for the annual evaluation of teaching activities done by students at the end of winter and summer semesters.

Improved electronic texts and multimedia teaching materials were prepared in 2018 in order to support students of both the attended and combined forms of study of Bachelor and Master degree study programmes. For students of the faculty, all texts are accessible via the university information system.

## **3.3. Other Educational Activities Independent from Existing Accredited Study Programmes**

For several years the faculty has participated in the system of lifelong education (Amendment The Higher Education Act 111/98 Coll.) Apart from a range of specialised courses for professionals, the faculty offers paid study of subjects in its Bachelor and follow-up Master study programme EEKR. Having completed the courses, the graduates are entitled to join the regular study programme without being required to pass entrance examination, and their earned credits are recognised. In 2018 there were 13 students in the lifelong education programme..

## **3.4. Students**

### **3.4.1. Bachelor's Degree**

The faculty has provided training in its Bachelor degree study programme Electrical, Electronic, Communication and Control Technology (EEKR) in the attended form of study since the academic year 2002/03 and in the combined form of study since the academic year 2004/05. Until 2018, the programme was divided into the following study areas:

- Control and Measurement Technology (AMT),
- Electronics and Communication (EST),

- Microelectronics and Technology (MET),
- Power Electrical and Electronic Engineering (SEE),
- Teleinformatics (TLI).

Furthermore, the faculty offers the following one-study-area interdisciplinary Bachelor degree programmes:

- Biomedical Technology and Bioinformatics (BTBIO-A)

The programme was launched in the academic year 2007/08. Significant part of instruction in this programme is provided by the Faculty of Medicine, Masaryk University in Brno. This study programme prepares mostly practically oriented graduates and prospective students of follow-up Master study programmes of universities offering education in biomedical engineering, medical informatics and mathematical biology (Brno University of Technology, Czech Technical University in Prague, Charles University, Masaryk University). Students gain theoretical knowledge in mathematics, physics and chemistry, basic knowledge in biology, human anatomy and physiology, needed to understand the basic biological processes taking place in human organism and to communicate with doctors and medical staff. They get acquainted with operation principles and use of medical technology and informatics, and gain ability to work with them. Moreover, they are offered information on medical legislative and learn how to apply it in practice. Emphasis is put on general and professional language skills. This Bachelor programme includes a four-week professional training in hospitals, health centres, institutions and companies focused on running clinics, treatment, research and trade in biomedical technology and bioinformatics in the Czech Republic and abroad. The training is arranged by the students themselves and takes place outside scheduled instruction (mainly during the summer holidays) before completion of the Bachelor studies.

- English in Electrical Engineering and Information Technology (AJEI-H)

The programme was launched in the academic year 2012/13. Until then, such a program, which is a specific professional variety, had not been offered anywhere in the Czech Republic even though English is a lingua franca of engineering specialisations. The programme also includes courses of management skills, which together with professional English, awareness of cultural aspects of English speaking countries, and knowledge of basics of electrical engineering and economics prepares graduates meeting needs of industry, administration, government administration, research institutions, management and professional translating. The graduates will acquire basic knowledge of electrical engineering and professional language competences on level C1 of the 'Common European Reference Framework'.

- Audio Engineering (AUDIO-J)

The programme was launched in the academic year 2013/14. It was prepared and is being implemented in cooperation with the Faculty of Music, Janáček Academy of Music and Performing Arts in Brno (HF JAMU). The programme provides university training in the area of audio engineering. It focuses on training experts – audio technicians with technical and artistic range of knowledge in audio technology, audio signal processing, musical production and studio practice.

- Information Security (IBEP-T)

The programme was launched in the academic year 2015/16 in the attended form of study, and in 2016/17 in the combined form of study. The programme is being implemented in cooperation with the Faculty of Law, Masaryk University and provides university training in the area of safety of information and communication technologies (ICT). During their training students learn details of both technical aspects of ICT security issues and related legal and economic aspects.

**Starting from 2019 the faculty is replacing the original EEKR, AUDIO-J and IBEP-T study programmes with newly accredited programmes, which transformed from the original study areas.**

From 2019/20 the faculty will be offering the following newly accredited Bachelor degree study programmes:

- Automation and Measurement (BPC-AMT),
- Electronics and Communication Technologies (BPC-EKT, BKC-EKT)
- Microelectronics and Technology (BPC-MET, BKC-MET),
- Power Electrical and Electronic Engineering (BPC-SEE),
- Telecommunication and Information Systems (BPC-TLI, BKC-TLI),
- Information Security (BPC-IBE),
- Audio Engineering (BPC-AUD)

and original programmes

- Biomedical Technology and Bioinformatics (BTBIO-A),
- English in Electrical Engineering and Information Technology (AJEI-H).

Trends of numbers of students in accredited Bachelor degree programmes over the last five years are given in Table 1 (as of 31/10 of the respective years).

Table 1: Numbers of students in Bachelor degree study programmes over the last five years

Programme (study area)	2014		2015		2016		2017		2018	
	P	K	P	K	P	K	P	K	P	K
AMT	302	45	296	45	287	16	336	10	316	2
EST	225	32	202	30	156	31	134	30	133	39
MET	190	33	198	38	175	35	149	39	159	40
SEE	352	73	323	60	305	30	304	9	292	4
TLI	411	53	368	51	315	51	194	39	182	41
BTBIO-A	230		218		204		210		188	
AJEI-H	162		179		171		163		150	
AUDIO-J	100		139		134		124		141	
IBEP-T			52		112 11		153 25		174 10	
Total	1972	236	1975	224	1859	174	1767	152	1735	136
<b>Bc. total</b>	<b>2208</b>		<b>2199</b>		<b>2033</b>		<b>1919</b>		<b>1869</b>	

### 3.4.2. Follow-up Master's Degree

The faculty provides training in a follow-up Master study programme Electrical, Electronic, Communication and Control Technology (EEKR). The attended form of study of the programme was launched in the academic year 2005/06; the combined form of study was launched in 2007/08. The programme has the following study areas:

- Biomedical and Ecological Engineering (BEI),
- Power Electrical Engineering (EEN),
- Electronics and Communications (EST),
- Electrotechnical Manufacturing and Management (EVM),
- Cybernetics, Control and Measurement (KAM),
- Microelectronics (MEL),
- Power Electrical Engineering and Power Electronics (SVE),
- Telecommunications and Information Technology (TIT).

Furthermore, the faculty offers the following one-study-area interdisciplinary Master degree programmes:

- Biomedical Engineering and Bioinformatics (BTBIO-F)

The programme was launched in the attended form of study in the academic year 2010/11.

- Audio engineering (AUDIO-P)

The programme was launched in the attended form of study in the academic year 2010/11.

- Information Security (IBEP-V)

The programme was launched in the attended form of study in the academic year 2018/19.

**Starting from 2019 the faculty is replacing the original BTBIO-F and AUDIO-P study programmes** with newly accredited programmes, which transformed from the original study areas.

- Biomedical Engineering and Bioinformatics (MPC-BTB),
- Audio engineering (MPC-AUD)

Trends of numbers of students in accredited Master degree programmes over the last five years are given in Table 2 (as of 31/10 of the respective years).

Table 2: Numbers of students in follow-up Master degree study programmes over the last five years

Programme (study area)	2014		2015		2016		2017		2018	
	P	K	P	K	P	K	P	K	P	K
BEI	50	13	49	27	47	16	45	13	51	4
EEN	80	13	89	17	100	13	77	18	61	11
EST	118	11	106	9	112	11	95	18	60	14
EVM	79	31	74	31	76	30	73	29	56	19
KAM	138	17	138	26	115	26	95	21	112	20
MEL	80	19	90	21	71	17	55	18	63	11
SVE	73	18	73	19	63	9	74	0	66	0
TIT	180	51	171	62	166	44	148	47	132	46
BTBIO-F	137		108		76		55		66	
AUDIO-P					25		53		59	
IBEP-V									31	
Total	935	173	898	212	851	166	770	164	757	125
<b>Mgr. total</b>	<b>1108</b>		<b>1110</b>		<b>1017</b>		<b>934</b>		<b>882</b>	

### 3.4.3. Doctoral Degree

The faculty provides training in a doctoral study programme Electrical Engineering and Communication Technology since the academic year 2007/08 (both in the attended and combined forms of study). The programme has the following study areas:

- Biomedical Electronics and Biocybernetics (BEB)
- Electronics and Communications (EST)
- Physical Electronics and Nanotechnology (FEN)
- Cybernetics, Control and Measurement (KAM)
- Mathematics in Electrical Engineering (MVE)
- Microelectronics and Technology (MET)
- Power Electrical and Electronic Engineering (SEE)
- Teleinformatics (TLI)
- Theoretical Electrical Engineering (TEE)

Furthermore, the faculty offers the following one-study-area interdisciplinary doctoral degree programme:

- Biomedical Technology and Bioinformatics (BTB)

The programme was launched in the attended form of study in the academic year 2013/14.

Trends of numbers of students in accredited doctoral degree programmes over the last five years are given in Table 3 (as of 31/10 of the respective years).



Table 3: Numbers of students in doctoral degree study programmes over the last five years

Programme (study area)	2014		2015		2016		2017		2018	
	P	K	P	K	P	K	P	K	P	K
BEB	15	30	15	32	13	29	8	26	6	18
EST	29	26	26	35	29	30	21	27	19	25
FEN	12	13	8	11	9	7	5	9	4	7
KAM	20	27	20	30	19	27	19	22	15	17
MVE	4	3	6	3	4	3	5	3	2	4
MET	38	45	37	44	33	28	26	29	26	34
SEE	23	29	33	28	29	29	27	26	25	27
TLI	38	39	37	48	35	39	33	29	33	31
TEE	3	8	4	7	6	4	4	3	5	4
BTB	6	1	6	4	11	4	9	6	10	7
Total	188	221	192	242	188	200	157	180	145	174
<b>Ph.D. total</b>	<b>409</b>		<b>434</b>		<b>388</b>		<b>337</b>		<b>319</b>	

### 3.5 Graduates and their Employment

Numbers of graduates of study programmes accredited at FEEC (over the last five years) are given in tables 4-6.

Table 4: Numbers of graduates of Bachelor degree study programmes over the last five years

Programme (study area)	2014		2015		2016		2017		2018	
	P	K	P	K	P	K	P	K	P	K
AMT	76	2	62	2	56	2	43	2	59	4
EST	57	3	45	3	51	2	38	6	30	2
MET	74	2	45	0	41	6	48	4	32	2
SEE	87	5	82	3	80	4	54	5	50	5
TLI	87	9	82	12	83	2	66	7	61	4
BTBIO-A	84		55		44		46		52	
AJEI-H			18		18		27		36	
AUDIO-J					26		27		21	
IBEP-T									22	
Total	46	5	38	9	39	9	34	9	363	17
<b>Bc. total</b>	<b>486</b>		<b>409</b>		<b>415</b>		<b>373</b>		<b>380</b>	

Graduates of the Bachelor degree study programmes can be employed as specialists in various areas of designing, operation, maintenance and service of advanced technologies, machines and systems. In all these areas they can also occupy lower technical, leading and managing positions. The practically oriented university education is suitable for employing the graduates in production, maintenance or service activities and gives them solid background for their possible further theoretical training in follow-up Master degree programmes.

Table 5: Numbers of graduates of follow-up Master degree study programmes over the last five years

Programme (study area)	2014		2015		2016		2017		2018	
	P	K	P	K	P	K	P	K	P	K
BEI	13	2	20	1	10	1	14	1	15	0
EEN	31	0	31	3	25	1	39	0	38	3
EST	47	5	42	3	43	2	38	0	38	2
EVM	28	12	25	9	28	10	21	9	31	7
KAM	42	9	48	3	64	2	56	6	30	9
MEL	39	5	26	1	36	8	32	3	20	6
SVE	30	8	25	6	38	4	20	7	32	1
TIT	89	18	72	14	64	15	63	20	62	7
BTBIO-F	41		53		52		44		21	
AUDIO-P									9	
IBEP-V										
Total	360	59	342	40	360	43	327	46	296	35
<b>Mgr. total</b>	<b>419</b>		<b>382</b>		<b>403</b>		<b>373</b>		<b>331</b>	

Graduates of the Master degree study programmes will be able to join professionals in multidisciplinary international team projects in research centers. They are trained to discuss professional issues in English. Their solid background and acquired skills will give them chances for further employment.

Graduates of the Master degree study programmes undergo theoretical training in matters of applied and experimental research in their respective study areas, which makes them suitable candidates for positions in enterprises dealing with design, production, distribution and maintenance of electrotechnological devices, machines and software used in the applicational sphere. The graduates can also work as operational specialists in industry or in commercial and other services.

The graduates are well prepared to apply their knowledge in follow-up doctoral degree programmes.

Table 6: Numbers of graduates of doctoral degree study programmes over the last five years

Programme (study area)	2014		2015		2016		2017		2018	
	P	K	P	K	P	K	P	K	P	K
BEB	0	2	0	2	0	2	0	5	0	5
EST	4	5	1	2	0	6	1	3	0	6
FEN	0	3	0	6	0	1	0	2	0	0
KAM	0	1	0	7	0	1	0	8	0	2
MVE	2	2	0	1	0	0	0	0	1	1
MET	1	11	0	16	0	5	0	3	0	3
SEE	1	5	0	2	0	5	0	5	1	1
TLI	0	11	0	7	0	6	2	8	0	6
TEE	0	4	0	1	0	3	0	1	0	0
BTB	0	0	0	0	0	0	0	0	0	1
Total	8	44	1	44	0	29	3	35	2	25
<b>Ph.D. total</b>	<b>52</b>		<b>45</b>		<b>29</b>		<b>38</b>		<b>27</b>	

A great number of graduates of doctoral degree study programmes of 2018 continues their research activities as faculty staff members at departments which guarantee their study programme. They are members of teams investigating basic or applied research projects. Other graduates are employed in enterprises (mostly in Brno headquarters) as research workers or at key executive or managing positions.

### 3.6. Interest in Study

Accredited study programmes are constantly popular with potential students; only their combined form of study saw some decrease of interest. For exact data see Tables 7-9 which give numbers of applicants over the last five years.

Table 7: Interest of full-time students in Bachelor degree study programmes / areas over the last five years

Programme (study area)	2014		2015		2016		2017		2018	
	P	K	P	K	P	K	P	K	P	K
AMT	238	56	240	45	242		296		209	
EST	162	35	184	33	141	45	145	41	126	44
MET	160	29	185	29	168	44	118	47	127	37
SEE	232	72	243	47	242		214		211	
TLI	322	51	286	58	257	57	141	44	152	40
BTBIO-A	199		183		170		158		159	
AJEI-H	142		136		120		115		114	
AUDIO-J	148		157		131		105		120	
IBEP-T			142		203	32	141	44	166	
Total	1603	243	1756	212	1674	178	1433	176	1384	121
<b>Bc. total</b>	<b>1846</b>		<b>1968</b>		<b>1852</b>		<b>1609</b>		<b>1505</b>	

Table 8: Interest of full-time students in follow-up Master degree study programmes / areas over the last five years

Programme (study area)	2014		2015		2016		2017		2018	
	P	K	P	K	P	K	P	K	P	K
BEI	41	16	55	28	44	23	57	12	42	9
EEN	62	12	67	21	53	16	40	20	40	8
EST	68	8	54	6	62	13	51	16	31	10
EVM	77	20	59	17	74	20	55	20	46	19
KAM	83	19	77	19	68	24	58	8	78	15
MEL	63	15	49	7	31	15	33	13	45	6
SVE	56	10	38	13	44		41		40	
TIT	105	32	103	47	93	27	79	42	93	32
BTBIO-F	91		59		56		44		58	
AUDIO-P					31		36		30	
IBEP-V									33	
Total	646	132	561	158	556	138	494	131	536	99
<b>Mgr. total</b>	<b>778</b>		<b>719</b>		<b>694</b>		<b>625</b>		<b>635</b>	

Table 9: Interest of full-time students in doctoral degree study programmes / areas over the last five years

Programme (study area)	2014		2015		2016		2017		2018	
	P	K	P	K	P	K	P	K	P	K
BEB	3	4	9	0	2	0	1	0	0	0
EST	10	4	9	7	14	6	6	1	5	1
FEN	2	1	1	0	1	0	2	0	0	0
KAM	4	3	5	0	6	1	8	0	2	2
MVE	4	0	2	4	0	1	1	0	0	0
MET	14	3	11	6	14	2	10	0	12	2
SEE	13	1	17	1	16	6	13	0	8	1
TLI	18	3	20	3	20	5	18	3	10	3
TEE	1	0	3	0	4	0	1	1	3	0
BTB	6	0	1	2	9	0	3	1	6	0
Total	75	19	78	23	86	21	63	6	46	9
<b>Ph.D. total</b>	<b>94</b>		<b>101</b>		<b>107</b>		<b>69</b>		<b>55</b>	

Structure of applicants in the academic year 2018/19 (grammar schools, female applicants) is given in Table 10.

Table 10: Number of applicants from grammar schools and of female applicants

applicants	total	from grammar schools	female
Bachelor study programmes	<b>1585</b>	444 (28%)	238 (15%)
Master study programmes	<b>608</b>	182 (30%)	158 (26%)

Distribution of nationalities among applicants in the academic year 2018/19 is given in Fig. 1.

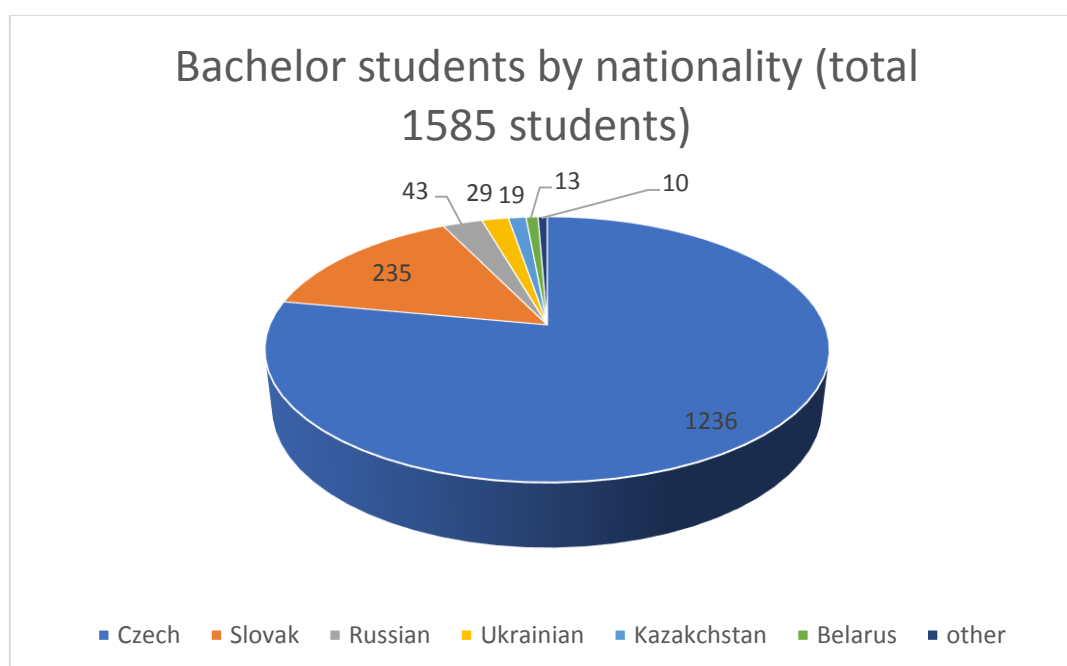


Fig. 1: Numbers of applicants in Bachelor degree study programmes by country

### 3.7. Entrance Examinations

Entrance examinations as well as conditions for its exemption are defined by the following directives of the dean

- Directive 6/2018 – Conditions for the admission procedure in Bachelor degree study programmes
- Directive 7/2018 – Conditions for the admission procedure in follow-up Master degree study programmes
- Directive 7/2017 - Conditions for the admission procedure in doctoral degree study programmes of FEEC BUT and are carried out in accordance with these directives.

Additional conditions are defined by Guidelines of the Dean RD 59-18, RD 60-18 and RD 61-18.

Tables 11 and 12 give numbers of applicants and admissions in Bachelor and follow-up Master degree study programmes.

Table 11: Numbers of applicants and admissions in Bachelor degree study programmes in 2018

Attended study area / programme	Applicants	Admissions	Combined study area / programmes	Applicants	Admissions
BPC-AMT	209	136	-		
BPC-EKT	126	72	BKC-EKT	44	27
BPC-MET	127	74	BKC-MET	37	29
BPC-SEE	211	135			
BPC-TLI	152	115	BKC-TLI	40	31
BTBIO-A	159	100	-		
AJEI-H	114	73	-		
AUDIO-J	120	73	-		
IBEP-T	166	82	-		
<b>Bc. total</b>	<b>1384</b>	<b>860</b>		<b>121</b>	<b>87</b>

Table 12: Numbers of applicants and admissions in follow-up Master degree study programmes in 2018

Attended study area / programme	Applicants	Admissions	Combined study area / programmes	Applicants	Admissions
M-BEI	42	30	ML-BEI	9	6
M-EEN	40	31	ML-EEN	8	5
M-EST	31	25	ML-EST	10	6
M-EVM	46	38	ML-EVM	19	11
M-KAM	78	59	ML-KAM	15	13
M-MEL	45	36	ML-MEL	6	4
M-SVE	40	33	ML-SVE	0	0
M-TIT	93	70	ML-TIT	32	27
BTBIO-F	58	39	-		
AUDIO-P	30	20	-		
IBEP-V	33	32	-		
<b>Mgr. total</b>	<b>536</b>	<b>413</b>		<b>99</b>	<b>72</b>

### 3.8. Applicants Recruitment and Activities for Secondary Schools

Activities, which increase admission chances of applicants and facilitate transition of students from secondary to tertiary training, include preparatory courses of mathematics and physics organized by the Department of Mathematics and the Department of Physics, respectively. Information on the complete range of study options and qualifications such as Certificate of Qualification in Electrical Engineering, Teacher Training Certificate, Microsoft

Certificate, Cisco Academy Certificate, etc. are annually published in media or given during events such as Open days, visits of students or teachers at secondary schools, 'Merkur perFEKT Challenge' (a contest for secondary school students) or GAUDEAMUS trade fair of tertiary education. All of these activities promote studies at FEEC and are meant to draw attention of potential applicants and students.



Winners of the 6<sup>th</sup> year of 'Merkur perFEKT Challenge' from SŠIEŘ Rožnov pod Radhoštěm



The faculty also participated in a nationwide event 'Night of Scientists'



# 4 Research, Development and Other Creative Activities

## 4.1. Research and Development at the Faculty

The academics of FEEC actively participate in basic and applied research in most areas of electrical engineering:

- [Control, robotics, sensors](#)
- [Biomedicine, signal processing](#)
- [Electrical Engineering](#)
- [Information and Cyber-security](#)
- [Micro and nanoelectronics](#)
- [Radioengineering and Communication Technology](#)
- [Telecommunications and information systems](#)
- [Power Electrical Engineering](#)

Students of doctoral degree study programmes also take part in creative activities in these areas.

Apart from the institutional support of the Ministry of Education, Youth and Sports, research and development at FEEC is financed mostly from grants investigated especially under regional research centers CVVOZE – Center of Research and Utilisation of Renewable Energy Sources – and SIX – Sensors, Information and Communication Systems. These centers were established at FEEC between 2010 and 2013 with the help of European structural funds.

Important sources of financial means in 2018 were projects of TA ČR, GA ČR and two projects of the National Sustainability Programme I (NPU). Faculty staff members also participate in international projects. At the moment several Horizon 2020 projects are being investigated and further projects in relevant calls are being prepared with our colleagues from research and development centers and universities abroad. Trends and distribution of financial means over the last 5 years are given in Fig. 2.

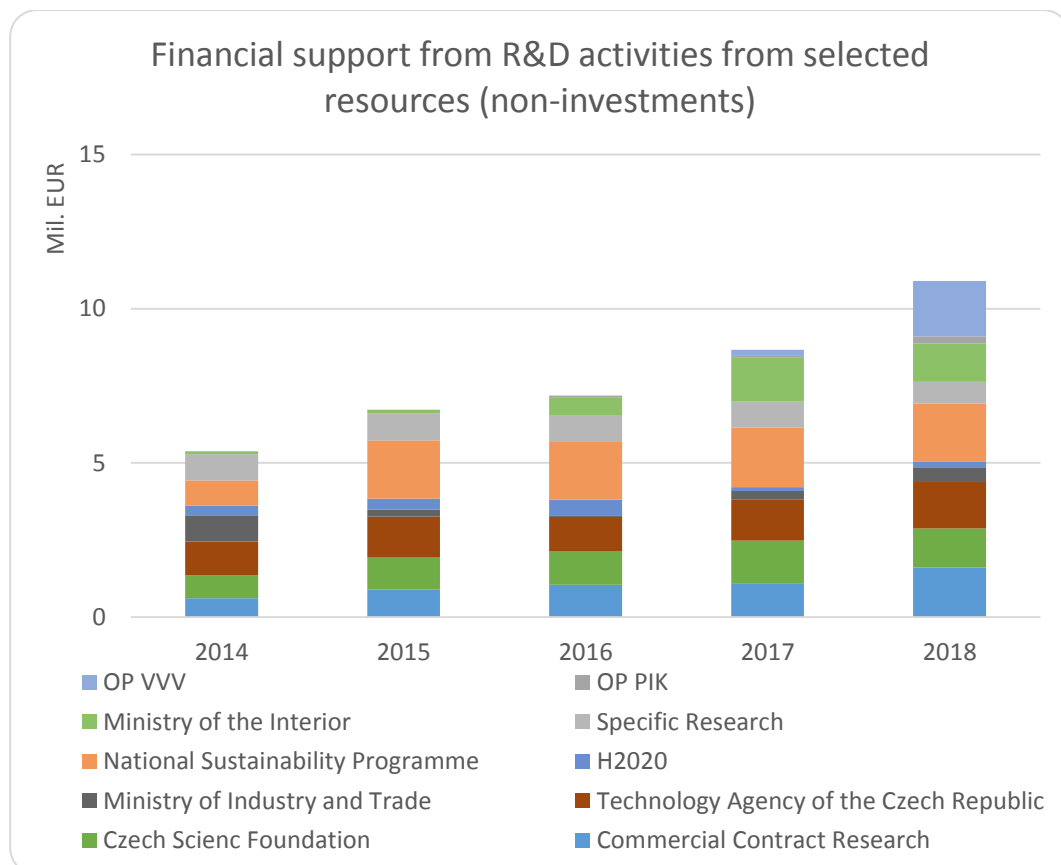


Fig. 2: Research and development financial support at FEEC between 2014 and 2018.

The faculty puts great emphasis on applied research and development performed in cooperation with industrial partners. Apart from collaborative projects financed from TA ČR and ministries of the Czech Republic, the amount of commercial research, financed directly from private sphere, is increasing.

Outcomes of commercial contracts in 2018 brought FEEC almost 42 mil. CZK with a substantial share of CVVOZE and SIX regional centers. This type of research is based either on commercial contracts or on diploma or doctoral theses (specific research). For trends in our participation in commercial research see Fig. 3.

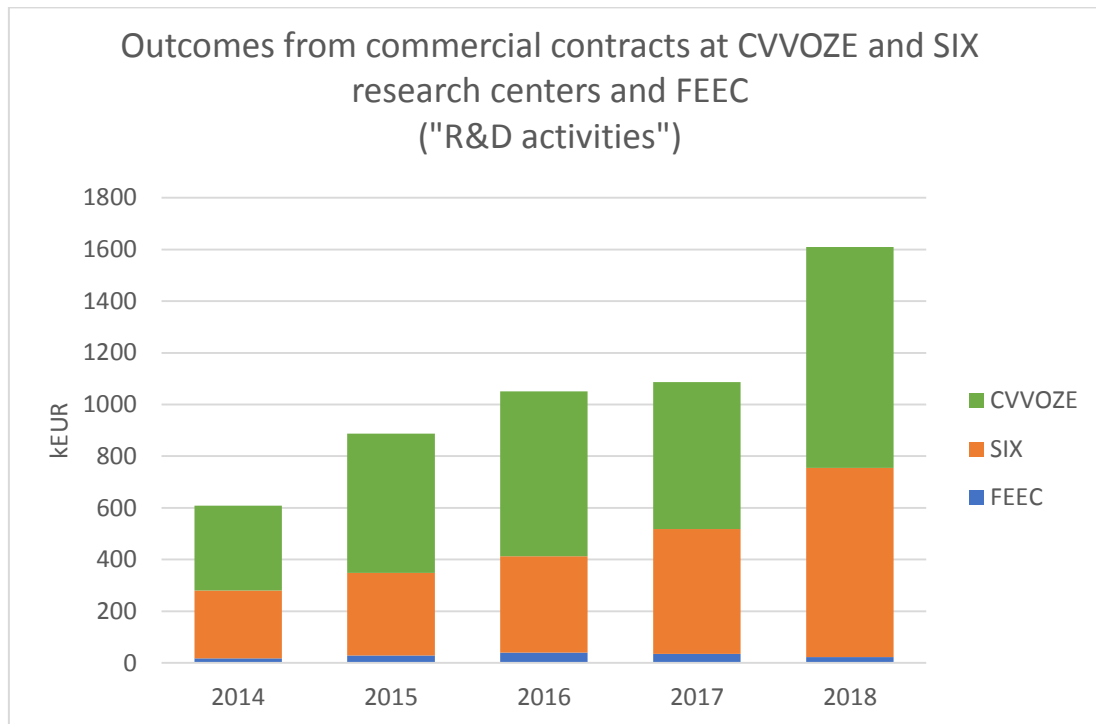


Fig. 3 Trends in FEEC commercial research between 2014 and 2018

An outcome from commercial contracts in 2018 with the share of our regional centers is given in Fig. 4.

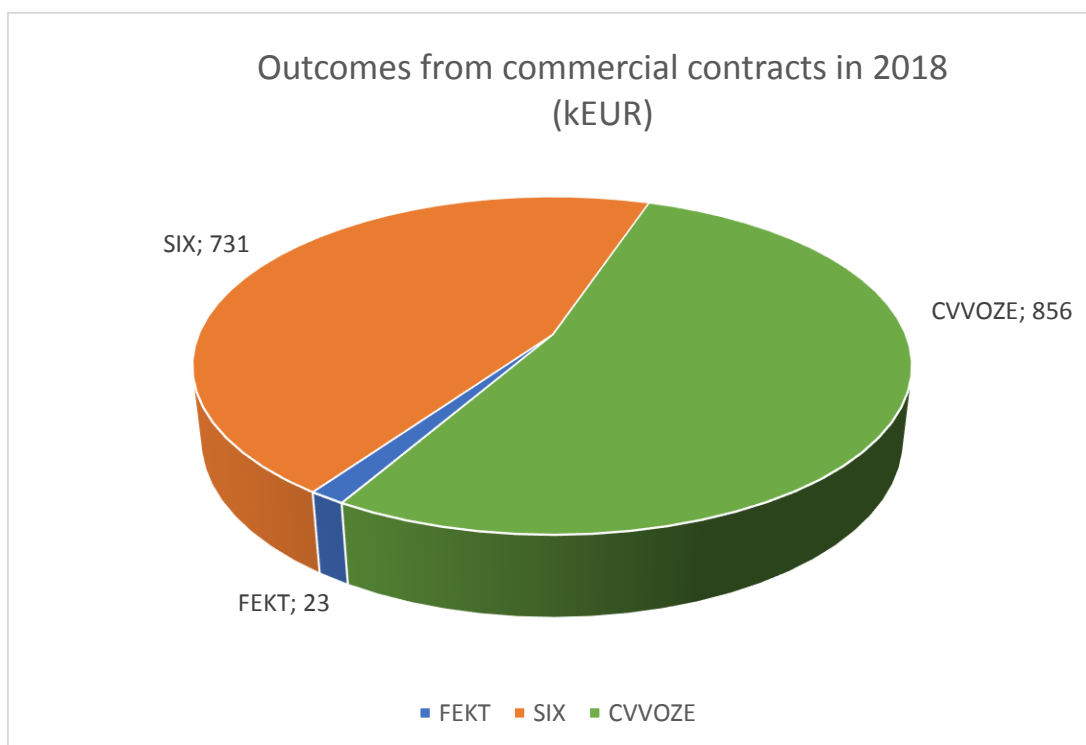


Fig. 4 Outcome from commercial research contracts in 2018

For detailed information regarding co-operation options with FEEC, see our [web pages](#)<sup>1</sup> Every research area has its specific research teams; for details click [here](#)<sup>2</sup>.

In 2018, research outcomes and scientific works of FEEC academic and research staff members were published in 157 papers included in IF journals. In many of these doctoral students were active co-authors; see Fig. 5.

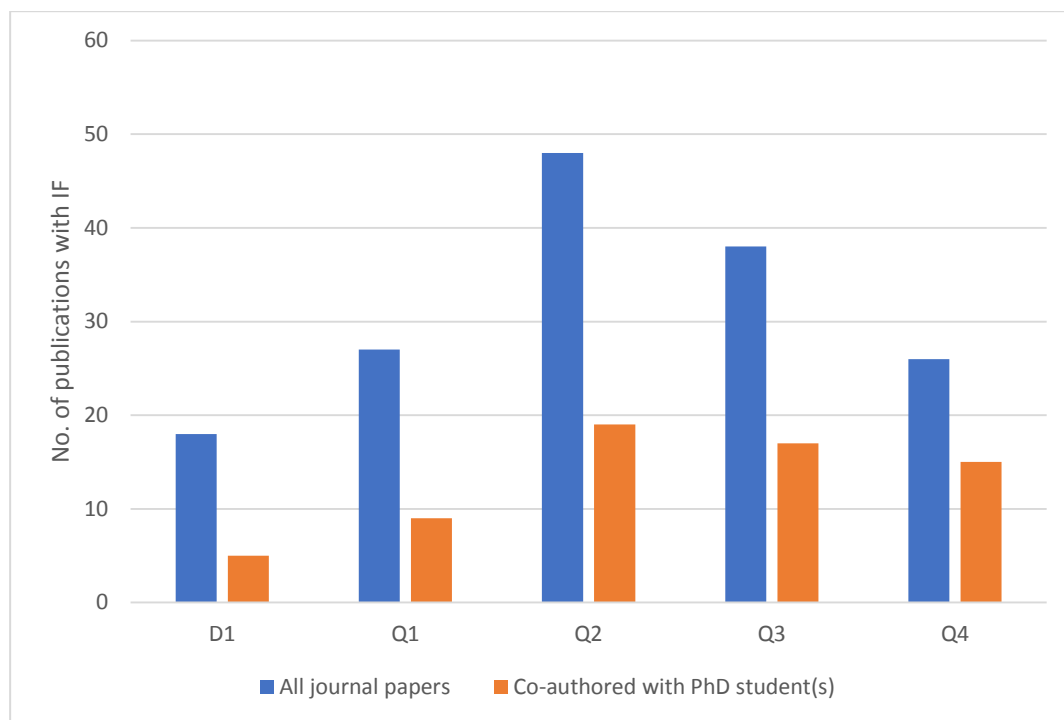


Fig 5. Publications in IF journals and their numbers by quartiles and 1<sup>st</sup> decile (2018)

On behalf of the faculty 2 international and 4 national patents were applied for and obtained:

- PTÁČEK, K.; BURTON, R.; SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC: Receiver for resonance-coupled signaling. 9954523, patent.
- PTÁČEK, K.; BURTON, R.; SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC: Resonance-coupled signaling between IC modules. 10008457, patent.
- KHATEB, F.; VLASSIS, S.; KULEJ, T.; SOULIOTIS, G.; VUT v Brně.: A bulk-driven voltage attenuator. 307308, patent. (2018)
- OTÁHAL, A.; JANKOVSKÝ, J.; SOMER, J.; Vysoké učení technické v Brně: A method of forming solder spherical outlets on a housing of an electronic component by means of a template and a template for implementing this method. 307441, patent.
- VESELKA, F.; Vysoké učení technické v Brně: Brush holder for electric machine. 307514, patent.
- HOLCMAN, V.; MACKŮ, R.; ŠKARVADA, P.; Konštrukta-TireTech, 911 01 Trenčín, SK: Detector and locator of ferromagnetic inclusions in a continuously passing environment. 307498, patent.

<sup>1</sup> Cooperation with FEEC: [https://www.fekt.vutbr.cz/spoluprace\\_s\\_fekt/firemni\\_spoluprace](https://www.fekt.vutbr.cz/spoluprace_s_fekt/firemni_spoluprace)

<sup>2</sup> Research teams at FEEC: [https://www.fekt.vutbr.cz/veda\\_a\\_vyzkum/vyzkumne\\_tymy](https://www.fekt.vutbr.cz/veda_a_vyzkum/vyzkumne_tymy)

#### 4.1.1. Regional Research Centers

In 2018 two regional research centers continued their research and development activities.

##### 4.1.1.1. Center of Research and Utilisation of Renewable Energy (CVVOZE)

Prof. RNDr. Vladimír Aubrecht, CSc.  
Director



Centre for Research  
and Utilization  
of Renewable Energy



The centre coordinates research, development and innovation capacities for research on renewable energy sources. The research team focuses on chemical and photovoltaic energy sources, electromechanics, electrotechnology, electric drives, power electrical engineering, mobile robots and industrial electronics. In 2018 CVVOZE focused on research in five research areas:

- optimisation of electrochemical energy conversion
- chemical and photovoltaic energy sources
- generation, transmission, distribution and utilisation of electrical energy
- control and sensor technologies
- switch-off process in switching devices



Equipment of high-voltage laboratory in the technological part of CVVOZE

An important source of research funding in 2018 was the project of National Sustainability Programme 'Energy in Conditions of Sustainable Development (EN-PUR)'.

Activities of the center are focused not only on basic research but also on applications and acceleration of transfer of novel technologies into industrial use. All CVVOZE laboratories form a unique infrastructure that will undoubtedly attract important industrial partners whose areas of interest are closely related to research carried out in the centre. In 2018, 24 projects of applied research were investigated in cooperation with industrial enterprises (TA ČR and MPO projects). The income generated for the center by projects of applied research was 30 mil. CZK. The income from commercial research was over 22 mil. CZK.

A major part of the centre is an extensive infrastructure established in compliance with Act 130/2002 Coll. called CVVOZEPowerLab located in **Professor List Technology Park (VTTPL)**. The park focuses on support of technologically oriented enterprises and research institutes working in the area of renewable energy sources, power electrical and electronic engineering, microelectronics and automatization and control including areas of electrochemistry, electrotechnology, power electrical engineering, electric motor drives and industrial electronics. The VTTPL makes use of its advantage in strategic positioning in the very center of technological activities and in direct links to research and student capacities of the Faculty of Electrical Engineering and Communication. The premises of the park consist of two parts: one with research laboratories of switchgears and high-voltage laboratories, and another one with administrative facilities available for renting. The parks aims at developing new technologies, products and services in areas closely related to the research activity of the Faculty of Electrical Engineering and Communication of Brno University of Technology. Commercial services offered by the Laboratory of switchgear include standard short-circuit tests of low voltage of AC (up to 150 kA) or DC (up to 50 kA), short-time current withstand tests up to 40 kA/3s and especially scientific analysis of very fast or very short events with a high-speed camera (up to 1 million frames / s). The High-voltage laboratory offers highly specialised services as well. These include AC, DC and pulse voltage testing, insulation diagnostic by means of partial discharge (output AC voltage max. 300 kV, total max. power 300 kVA), and pulse voltage tests with atmospheric impulse max. 920 kV. In 2015 VTPPL ranked 3<sup>rd</sup> in 'Entrepreneurial project of 2014' in the category 'Infrastructure for innovative enterprise (PROSPERITA)'. In 2018, VTPPL was included in 'Where EU funds help', a book mapping a selection of successful projects funded from EU funds. The cooperation with industry is active, commercial research contracts in 2018 in the above laboratories generated almost 7 mil. CZK.

For details on activities and mission of CVVOZE and VTPPL see [www.cvvoze.cz](http://www.cvvoze.cz) or [www.vtppl.cz](http://www.vtppl.cz).

#### 4.1.1.2. Sensors, Information and Communications (SIX Research Centre)

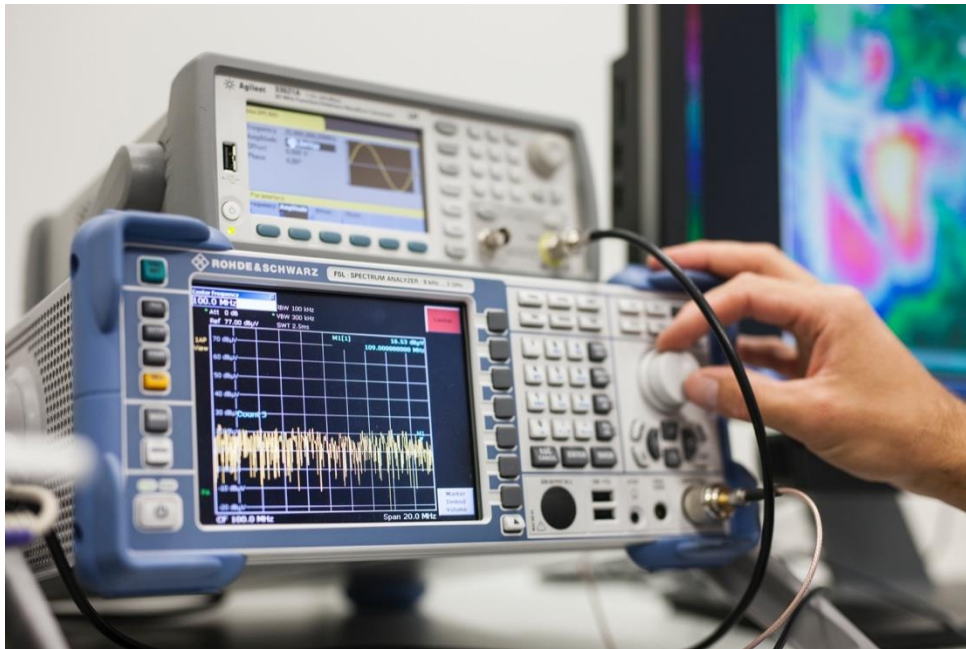
Doc. Ing. Martin Slanina, Ph.D.

Director



Centre SIX was established in 2010 as a joint initiative of FEEC departments involved in research and development of sensor systems, information and communication technologies. The aim was to interconnect research interests and utilise achieved synergy in work on extensive and complex research projects.

The involved departments offered their laboratories that were upgraded and extended in the period 2011 - 2013 owing to support from the operational programme 'Research and Development for Innovations'. In 2014, the centre started full operation without direct financial support from public sources. In spite of the lack of direct support, the centre grew, not only in terms of numbers of involved researchers and their loads, but also results, grants and commercial contracts. And the growth continued in 2015, 2016 and 2017. Between 2017 and 2018 the amount of investigated projects as well as recalculated research loads stabilised.



Spectrum and signal analysers for evaluation of physical communication signals

Since 2015 the centre has been supported by the National Sustainability Programme ‘Interdisciplinary Research of Wireless Technologies’ (INWITE), designed to increase the volume and quality of basic research and thus increase the centre’s chances to make a good use of acquired knowledge in projects of applied and commercial research. The project is conducted by a team of five groups jointly led by professors from Vienna Technical University and Centre SIX. The groups involved in project INWITE focus on six specialisations (sensors, signals, radio frequency systems, mobile communication systems, antennas and high frequency circuits, advanced cyber security). In recent years the share of applied research has been growing, which proves that the centre has succeeded in interconnecting academic and industrial sectors. The growing interest of industrial companies in professional cooperation resulted in increasing number of applied research projects and contract research projects. While in 2016 commercial research contracts yielded 8 mil. CZK, in 2017 it grew by more than a half. In 2018, the amount of commercial research contracts was 19 mil. CZK.

For detailed information on SIX see [www.six-centre.cz](http://www.six-centre.cz)

## 4.2. Habilitations and Appointments to Professorship

The faculty has accreditation for habilitations and appointments to professorship in the following areas:

- Biomedical engineering
- Electronics and Communication
- Electrical and Electronic Technology
- Power Electrical Engineering
- Technical Cybernetics
- Teleinformatics
- Theoretical Electrical Engineering

The habilitation procedure evaluates the scientific or artistic qualification of the applicant, especially with respect to the habilitation thesis and its defence, and other scientific, research or artistic achievements, and the pedagogical capacity based on the assesment of the habilitation lecture and pedagogical practice (Higher Education Act, § 72 Sec. 1). Associate professors are named by rectors on completion of their habilitation procedures.

The appointment to Professorship evaluates the pedagogical and scientific or artistic qualification of the applicant, who is an outstanding and respected scientific or artistic figure in his specialisation. The procedure can be initiated only after the applicant had been named associate professor on successful completion of his/her habilitation procedure on condition that the procedure included submitting a thesis. In exceptional cases, when the appointment is considered for someone who already had been named professor on a renowned university abroad, the rector can – upon a proposal of the Scientific Board of the university – waive this condition (The Higher Education Act , § 74 Sec. 1).

In 2018, five academics habilitated at FEEC:

**doc. Ing. Radoslav Cipín, Ph.D.** – Power Electrical Engineering

**doc dr. Ing. Tomáš Götthans** – Electronics and Communication



**doc. Ing. Lucie Hudcová, Ph.D.** – Electronics and Communication

**doc. Ing. Karel Máslo, CSc.** – Power Electrical Engineering

**doc. Ing. Ladislav Polák, Ph.D.** – Electronics and Communication

The following academics completed their appointment to professorship at the level of the FEEC Scientific Board:

**doc. Ing. Dan Komosný, Ph.D.** – Teleinformatics

**doc. Ing. Jaroslav Koton, Ph.D.** – Teleinformatics

**doc. dr. Ing. Pavel Neužil** – Electrical and Electronic Technology

### 4.3 Involvement of Students in Creative Activities

Students of Bachelor's, Master's and especially doctoral study programmes mentored by their tutors, often actively participate in investigation of research and development projects at positions of research team members; their activities are linked to topics of their theses. Outcomes of such creative activity are presented to the scientific audience in the form of publications. The outcomes have tangible form but they also include experience and awareness of one's responsibility for their quality. As regards research papers, publication in prestige journals with quality quartile rankings is encouraged. The level of student involvement in creative activities can thus be deduced from their co-authorship of publicational outcomes as given in Fig. 5.



The faculty regularly organizes the conference of the best student works 'Student EEICT' and 'perFEKT JobFair'.

In order to increase the quality of presentational skills of students and to enable comparison of their creational activities, the faculty organized on 26 April 2018 the '24<sup>th</sup> Student EEICT 2018'. The abbreviation of this contest and conference stands for 'Electrical Engineering, Information and Communication Technologies' and makes reference to priorities of research, development and instruction of the faculty. In the 24<sup>th</sup> year of the conference there were 157 contributions, out of which 45 were Bachelor, 48 Master and 62 doctoral ones. In a special secondary school category, 2 talented students from secondary schools presented their posters. The main sponsors of the contest were SCG Czech Design Center, s.r.o., Honeywell, ABB, s.r.o., ASICentrum, spol. s.r.o., Thermo Fisher Scientific, Valeo, AT&T Global Network Services Czech Republic, and HELLA AUTOTECHNIK NOVA, s.r.o.

The contest contributions were defended in front of one of 21 professional committees whose members were faculty academics, sponsor representatives and representatives of the 'Students for Students' club. The best or outstanding contributions were awarded at the closing ceremony. For details of the contest see <https://conf.feec.vutbr.cz/eeict/>.

### 4.4 Cooperation with applicational sphere

External relations of the faculty include promoting publicity of faculty activities so that the general public could receive latest and accurate information on study options, study programmes, respective study areas and other activities of the faculty related to student agenda. New webpages, new presentations, videopresentations and faculty Facebook profile, Youtube channel and newly also Instagram and Twitter helped the faculty to target

successfully the group of our potential students, grammar school students, and students of technical secondary schools. This success can be attributed also to a 'roadshow' – a series of visits of faculty staff members, who popularised science at grammar schools and technical secondary schools.

Very popular is the competition of four-person secondary-school teams 'Merkur perFEKT Challenge'. The competition offered 9 topics, selected by the teams at registration. For capacity reasons only the first 55 applications could be accepted. This number was reached one month after the call. Secondary schools from all over Moravia and part of Bohemia registered 200 students, including several girls. The competition was conducted in an atmosphere of fair-play, and generally the performance and knowledge of students in areas such as electrical engineering, robotics, programming, etc. must be appreciated. In January 2019 the winners in individual categories competed in the superfinals, with 'Ajtáci' from Střední škola informatiky, elektrotechniky a řemesel, Rožnov pod Radhoštěm as winners. For this year they are owners of the challenge cup for the overall winner.

Increased attention was paid to the media, presentation of FEEC achievements in basic and applied research, development and cooperation with the industrial sector.

On FEEC websites, BUT portals and other subjects, information is given on research and education at FEEC departments and workplaces, habilitations and appointments to professorship, research intents and centres and development projects of the Czech Science Foundation, Ministry of Trade and Industry, Ministry of Education and other projects including EU framework programmes. The websites are fully bilingual; they are available in Czech and English.

Contacts have been maintained with industrial companies in the Brno region and other parts of the Czech Republic. These contacts are mainly based on cooperation with FEEC departments in specific research, expert's reports and consultancy. The major cooperating companies are Thermo Fisher Scientific, ABB s.r.o., Siemens AG, Honeywell s.r.o., T-Mobile Czech Republic, a.s., ON Semiconductor Czech Republic, AT&T Czech, EATON Czech Republic, Rockwell/Allen Bradley, Škoda Volkswagen Mladá Boleslav, Motorola Solutions, NXP, ČEZ, a.s., Linet, s.r.o., BD Sensors, s.r.o. and others.

Cooperation continued within the two regional centres CVVOZE and SIX and research centre of excellence 'CEITEC - Central European Institute of Technology', where the faculty is significantly involved.

Another recent and remarkable contribution to cooperation with industrial partners is the Partner Programme constituting a platform for presentation of industrial companies, increased cooperation with research teams and these projects.

Close cooperation of many years has been maintained with the Institute of Instrument Technology of Czech Academy of Sciences in Brno in research projects of joint interest. Members of the Institute's staff are external staff members of FEEC in Master and doctoral degree study programmes. Academy of Sciences can offer Ph.D. study based on a contract with the faculty. Academic staff, mainly of departments of mathematics and physics, have cultivated longterm cooperation with secondary schools in the Brno region in preparing their students for studies at FEEC BUT.



Popularisation of technical sciences and promotion of study options during Open Days

# 5 Internationalisation

## 5.1 Faculty Strategy in International Cooperation, Priorities and Promotion Abroad

International activities have been focused on increasing the prestige of FEEC by presenting results of research projects at international conferences and participating in international research and education projects. These activities have the form of placements of FEEC students at partner universities abroad, and offering instruction in English to international students.

Among our priorities is student and teacher mobility involving universities cooperating within the framework of European Commission programmes. FEEC is one of the most active faculties at Brno University of Technology. We have had good cooperation with the BUT Department of International Relations responsible for organisational and economic support of programme Erasmus+. As a result there were 73 student placements of 276 months, 22 teaching mobilities of 22 weeks and 11 training mobilities of 14 weeks (see Table 6). The faculty had 139 incoming students for 529 months. For the overview of the types of mobilities see Table 14. For the list of Erasmus+ partners see Table 16.

In 2018 funding was received for long-term international placements of students of all study programmes from the mobility development programme of Ministry of Education 'International Mobility Support for of BUT Students' in the amount of 510 thousand CZK. Owing to this support 12 students could be placed for 24.5 months.

Mobility figures for outgoing and incoming students in all programmes are given in Table 15. The number of outgoing mobilities was slightly higher than in 2017. In total, the faculty had 306 outgoing student months. The number of incoming students was almost the same.

The faculty supports cooperation of academics and departments with international institutions based on interfaculty and Erasmus+ agreements, and encourages seeking new contacts. In 2018, 71 thousands CZK was provided in support of such activities. Targeted international relations were financed by departments through operational programmes. The funds were used to cover travel expenses of internationally recognised academics coming to short lecture stays at FEEC.

Faculty of Electrical Engineering and Communication invites renowned international researchers to give lectures or take part in teaching or in research projects. They help to upgrade the professional and general level of education and create an atmosphere of international environment in implementation of research projects.

An amount of 247 thousand CZK was obtained from the development programme of Ministry of Education 'Support of International Mobility of Academics'. These funds were used to cover expenses on stays of 10 outgoing faculty members and 7 incoming international experts who gave lectures and lead seminars for faculty staff members and Ph.D. students.

The faculty obtained 350 thousand CZK from the Ministry of Education development programme 'Support of International Cooperation of BUT Brno' for cooperation of academics and Ph.D. students with international institutions and framework agreements.

## 5.2 International Mobility of Students and Faculty Staff Members

Table 13: Student and teacher Erasmus+ mobilities from 2014 to 2018

<i>Type of Erasmus + activity</i>	<i>2014</i>	<i>2015</i>	<i>2016</i>	<i>2017</i>	<i>2018</i>
Students	46	81	49	63	73
Months	191	324	214	229	276
Teaching mobilities	23	22	15	22	22
Weeks of teaching mobilities	25	22	15	22	22
Training mobilities	4	3	2	1	11
Weeks of training mobilities	4	3	2	1	14

Table 14: Student placements at FEEC and abroad by programmes in 2018

<b>Activity</b>	<b>Incoming</b>		<b>Outgoing</b>	
	<b>Students</b>	<b>Months</b>	<b>Students</b>	<b>Months</b>
Erasmus +	114	444	73	276
Bilateral agreements	11	43	-	-
Development programme of Ministry of Education, Youth and Sports	-	-	13	24
Other mobilities	14	42	2	6

Table 15: Student placements at FEEC and abroad in all mobility programmes from 2014 to 2018

		<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
<b>Incoming</b>	Students	83	99	100	99	139
	Months	378,5	380	383,5	380	529
<b>Outgoing</b>	Students	62	102	57	79	88
	Months	227,5	361,5	236	253	306

Table 16: List of universities having Erasmus+ bilateral agreements with FEEC for 2018/19

<b>University</b>	<b>Country</b>
University of Applied Sciences Upper Austria School of Engineering and Environmental Sciences	Austria
Technische Universität Wien- Vienna University of Technology Faculty of Electrical Engineering and Information Technology	Austria
Kunstuniversität Graz (KUG) - University of Music and Performing Arts Graz	Austria
UMIT - Universität für Gesundheitswissenschaften, Medizinische Informatik und Technik	Austria
Technische Universität Graz	Austria
University of Applied Sciences Technikum Wien	Austria
University for Continuing Education Krems	Austria
UC Limburg (= UC Leuven-Limburg, Limburg Campuses)	Belgium
KU Leuven Faculty of Engineering Technology	Belgium
Technical University of Gabrovo	Bulgaria
Technical University of Sofia	Bulgaria
Technical University of Sofia, branch Plovdiv	Bulgaria
Angel Kanchev University of Ruse	Bulgaria
Hochschule RheinMain - RheinMain University of Applied Sciences	Germany
Technische Universität Dresden	Germany

Hochschule Augsburg - University of Applied Sciences	Germany
Universität Ulm	Germany
Friedrich-Alexander- Universität Erlangen-Nürnberg	Germany
Hochschule für Technik, Wirtschaft und Kultur Leipzig (Leipzig University of Applied Sciences)	Germany
Hochschule Furtwangen University	Germany
Aalborg Universitet	Denmark
University of Southern Denmark	Denmark
Tallinn University of Technology School of Information Technologies	Estonia
TTK University of Applied Sciences, Talin	Estonia
Universidad politécnica de Madrid – ETS Ingeniería y Sistemas de Tellecomunicación	Spain
Universitat Rovira i Virgili School of Engineering	Spain
Universitat de Vic Escola Politecnica Superior	Spain
Universidad de Cantabria	Spain
Universitat Politecnica de Valencia Escuela Politécnica Superior de Alcoy (EPSA)	Spain
Universitat Politècnica de Valencia Escuela Técnica Superior de Ingenieros de Telecomunicación	Spain
Universidad de Granada - Escuela Técnica Superior de Ingenierías Informática y de Telecomunicación (ETSIIT - UGR)	Spain
Universidad de Zaragoza	Spain
Escola Superior Politecnica (Fundació TecnoCampus Mataró – Maresme)	Spain
Universidad del País Vasco/Euskal Herriko Unibertsitatea	Spain
Universidad de Malaga School of Industrial Engineering	Spain
Universitat de Valencia	Spain
Universidad de Las Palmas Gran Canaria	Spain
Institut Supérieur d'Electronique de Paris (ISEP)	France
INSA Rennes Dpt Communication Systems and Network Dpt Electronics and Computer Engineering	France
ESIEE Paris	France
Institut Polytechnique de Grenoble	France
ESIGELEC Rouen School of Engineering	France
ESIEE Amiens	France
Université Joseph Fourier Polytech School of Engineering	France
Universite du Maine	France

Eastern Macedonia and Thrace Institute of Technology	Greece
TEI of Crete Branch Chania	Greece
Technological Educational Institute (TEI) of Thessaly	Greece
University of Patras	Greece
Università degli Studi di L'Aquila Dipartimento di Ingegneria Industriale e dell'Informazione e di Economia	Italy
Seconda Università degli Studi di Napoli	Italy
University of Palermo	Italy
Università degli Studi Mediterranea di Reggio Calabria	Italy
Università degli Studi di Padova	Italy
Vilnius Gediminas Technical University	Lithuania
Kaunas University of Technology	Lithuania
Goce Delcev University	North Macedonia
University of Malta	Malta
Ostfold University College	Norway
Norwegian University of Science and Technology Faculty of Natural Sciences and Technology	Norway
University of Stavanger Department of Music and Dance	Norway
Gdansk university of Technology Faculty of Electronics, Telecommunications and Informatic / Faculty of Electrical and Control Engineering	Poland
Politechnika Wroclawska	Poland
AGH University of Science and Technology Faculty of Computer Science, Electronics and Telecommunications	Poland
Politechnika Poznańska	Poland
Nencki Institute of Experimental Biology PAS	Poland
University of Bialystok	Poland
University of Porto Faculty of Engineering	Portugal
Instituto Politécnico de Lisboa (IPL) Instituto Superior de Engenharia de Lisboa (ISEL)	Portugal
Universidade Católica Portuguesa - Escola Superior de Biotecnologia	Portugal
Polytechnic Institute of Coimbra	Portugal
Universidade de Coimbra	Portugal
Tecnico Lisboa Department of Electrical Engineering and Computer Science	Portugal
Technical University of Cluj-Napoca	Romania



Malmö University Faculty of Technology and Society	Sweden
Aalto University School of Electrical Engineering	Finland
Tampere University of Technology	Finland
University of Eastern Finland	Finland
Univerza v Novi Gorici/University of Nova Gorica	Slovenia
University of Maribor	Slovenia
Žilinská univerzita v Žilini Fakulta humanitných vied	Slovakia
Technická univerzita v Košiciach - Fakulta elektrotechniky a informatiky - Faculty of Mining, Ecology, Process Control and Geotechnologies	Slovakia
Yildirim Beyazit University	Turkey
Yildiz Technical University - Dept. of Electronics and Communication Engineering - Dept. of Mathematics (Faculty of Sciences and Arts)	Turkey
T.C. Dogus University	Turkey
Bogazici University Department of Electrical & Electronics Engineering	Turkey
Istanbul Teknik Universitesi	Turkey
Suleyman Demirel University	Turkey
Işık University Faculty of Engineering	Turkey
University College London School of Engineering Sciences	United Kingdom

## 6 Other Faculty Activities

### 6.1. Equal Opportunities

The consultancy centre for support of equal education opportunities continued its activities in 2018. The centre provided professional and personal consultancy for FEEC students, and organised promotion and information events for the public aimed at removing the barriers female students face when choosing careers in technical fields. In 2017, the centre focused its attention on improving conditions for students with specific needs in terms of financial and operational support. The center also provided activities for integration of students with various handicaps in the attended and combined forms of study programmes. These include promotion of study opportunities and individual approach to students with specific needs.

The Centre cooperated with Department of Physics, club 'Students for Students' and members of faculty departments.

Contact: Doc. Ing. Vlasta Sedláková, Ph.D., [sedlaka@feec.vutbr.cz](mailto:sedlaka@feec.vutbr.cz)

### 6.2. Institute of Experimental Technology

'Institute of Experimental Technology' (IET), established in 2008, shall also be mentioned. The institute draws on longterm experience of the Department of Theoretical and Experimental Electrical Engineering in involving students in research pursued by the department's staff. It maintains close ties with industry in the applicational phase of research. The institute advocates the innovative approach to education with a key element of involving student research teams in solving real-life applicational projects. The teams consist of secondary school and university students as well as IET research workers. Student project calls are published at the Institute homepage <http://www.utee.feec.vutbr.cz/projekty/>. In 2018, 113 project calls were published. Other activities of the Institute include organizing competitions such as the annual 'Microcontrollers are in'.



### 6.3. Interactive Playroom 'Elektrikárium'

An interactive playroom 'Elektrikárium', opened three years ago, aims at publicizing science and technology to a wide spectrum of visitors in the manner of big research centers. Since the playroom can be found at the premises of FEEC, its exhibits are related to electrical engineering, electronics and related areas.

There are 15 exhibits for the visitors' hands-on experience and entertainment, which demonstrate the principles of electricity, electrical engineering, physics etc.

The visitors can compete in production of electricity, examine robots or laser harp. The composition of exhibits is being changed regularly to motivate the visitors to re-entry.

We are pleased that the playroom draws attention of elementary and secondary schools, general public and various clubs. 'Elektrikárium' or 'PerFEKT electro games' are open to visitors aged 5+ and the admission is free of charge.

The world of electrical engineering can be enjoyed from Tuesday to Thursday in the afternoons or on Saturday for the whole day. For more information see <http://www.feec.vutbr.cz/elektrikarium>.

### 6.4. Student Room – 'Studentárium'

A significant event was the completion and opening of 'Studentárium' - a multifunctional room for students to spend their free time, work in joint projects, revise. Available in the room is AV technology and board. The students can also use a kitchen, where they can heat meals, make coffee or tea. The room was open for the whole calendar year and was popular with students who usually fill its capacity. The room is open on workdays from 6.00 to 22.00.



Popularizing technical sciences is one of the many activities of the faculty – a laser harp in the interactive playroom 'Elektrikárium'.

## 6.5. Student Activities

Active at FEEC are two student organizations – the Student Chamber of the Academic Senate of FEEC (SK AS FEKT) and the voluntary club 'Students for Students' (SPS). Both organisations closely co-operate. The Student Chamber acts as an intermediary between faculty leadership and students, helps to tackle students' problems and organises instruction quality assessment to increase the quality of instruction. Activities of the 'Students for Students' club are focused on leisure time. Its role is to enrich the students' life. The membership is voluntary, all those interested in student activities at FEEC and BUT can apply. The club concentrates on two areas:

### Assistance to the Faculty

The club assists the faculty to mediate communication towards students, assists at faculty or university events such as Open days, Gaudeamus, immatriculation, student conference EEICT or the Night of Scientists.

### Magazine e-FEKT

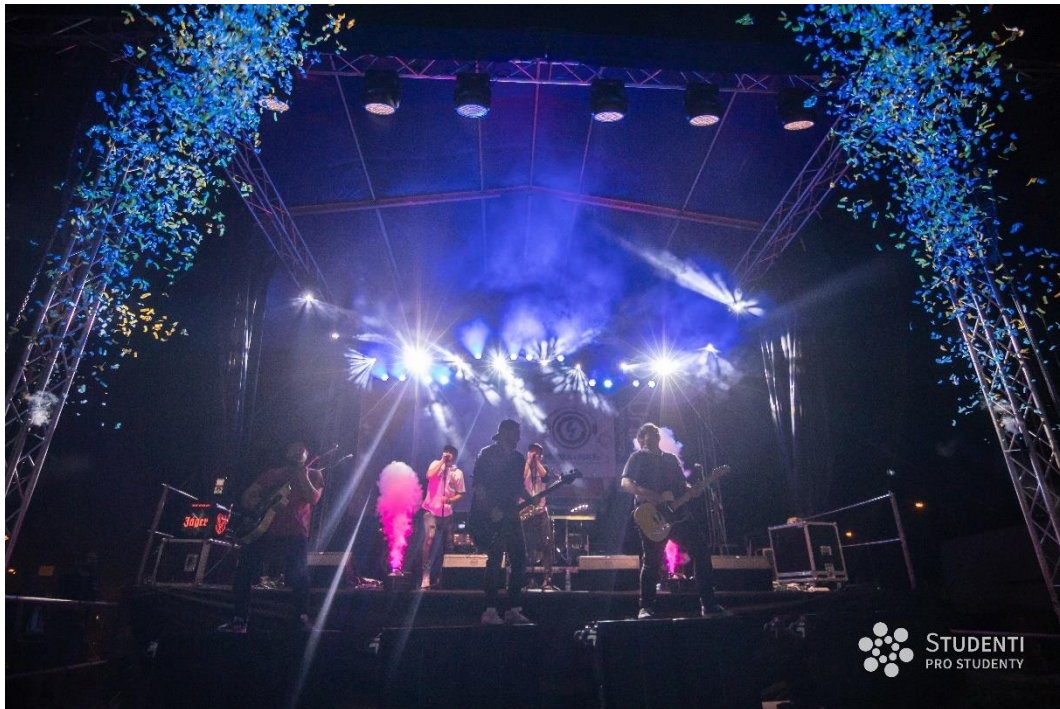
Student magazine e-FEKT is issued usually twice in a semester. Not only does it communicate current events of the faculty, but it also publishes technical, satirical and other texts. Everyone interested in publishing texts in this magazine can join.

### Assistance to Students

The club helps first-year students to adapt to life in an unfamiliar environment of the faculty, halls of residence and the town of Brno. Freshman students receive 'Freshman's Manual' which offers all necessary information they will need at the beginning and during their studies. The club also communicates information and helps meeting students before the start of the winter semester at an event called 'Zaškolovák'. Students are invited to the event called 'PerFEKT start' organised at the weekend before the start of the semester where they can meet each other, explore the premises or get some tips for places to go to with the fellow students after lessons. For students who wish to meet during the winter semester, there are sports, cultural and entertainment events every week within the programme 'PerFEKT assistance'.

### Cultural Events

Organizing social, cultural and educational events is a significant area of the club activity. The biggest such event was the 11th year of an open-air festival – student bands contest 'Music from FEEC' held on 19 September 2018 from 12:00 at the parking lot between two faculty buildings. In the afternoon, several student bands contested; over 4.000 spectators came to see 'UDG' and 'Volant'. Numerous other activities could be enjoyed.



Music from FEEC – the biggest student open-air festival in the Czech Republic

Sport-loving students were invited to take part in the fun race 'Run to 53'. The task was to run the distance from school to the 53 bus stop in the shortest possible time. The event took place along the pavement at Technická 12. There were several student categories and, as every year, VIP management relays. The main prizes were vouchers for public transport three-months tickets.

During the year, several 'Tabletop Days' were organised for students who wanted to use their free time between lectures or compete in tournaments. A contest in virtual reality games was also organised in cooperation with other student clubs. We are also proud to be one of the few faculties which have a multifunctional room for students – 'Studentárium'. A small kitchenette, computers, board, projector and premises to work out student projects or take a rest are available. The room is open on workdays from 6:00 to 22:00.



The "Students for Students" club organises numerous activities for students such as "Tabletop Days"



# 7 Faculty Departments

## 7.1 Department of Control and Instrumentation

**doc. Ing. Václav Jirsík, CSc.**

Head

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### Professors

prof. Ing. Pavel Jura, CSc.  
prof. Ing. Petr Pivoňka, CSc.  
prof. Ing. Pavel Václavěk, Ph.D.  
prof. Ing. František Zezulka, CSc.  
prof. Ing. Luděk Žalud, Ph.D.

### Associate Professors

doc. Ing. Petr Beneš, Ph.D.  
doc. Ing. Petr Blaha, Ph.D.  
doc. Ing. Zdeněk Bradáč, Ph.D.  
doc. Ing. Petr Fiedler, Ph.D.,  
doc. Ing. Václav Jirsík, CSc.

### Lecturers

Ing. František Burian, Ph.D., Mgr. Terezie Filipenská, Ph.D., Ing. Marie Havlíková, Ph.D., Ing. Zdeněk Havránek, Ph.D., Ing. Radovan Holec, CSc., Ing. Peter Honec, Ph.D., Ing. Karel Horák, Ph.D., Ing. Adam Chromý, Ph.D., Ing. Ilona Janáková, Ph.D., Ing. Tomáš Jílek, Ph.D., Ing. Miroslav Jirgl, Ph.D., Ing. Václav Kaczmarczyk, Ph.D., Ing. Stanislav Klusáček, Ph.D., Ing. Lukáš Kopečný, Ph.D., Ing. Tomáš Macho, Ph.D., Ing. Petr Málek, CSc., Ing. Jan Pásek, CSc., Ing. Petr Petyovský, Ph.D., Ing. Lukáš Pohl, Ph.D., Ing. Miloslav Richter, Ph.D., Ing. Soňa Šedivá, Ph.D., Ing. Radek Štohl, Ph.D., Ing. Libor Veselý, Ph.D.

### Ph.D. Students

Interní: Ing. Jakub Arm, Ing. Ondřej Bartík, Ing. Ondřej Baštán, Ing. Tomáš Beneš, Ing. Ondřej Boštík, Ing. Martin Čala, Ing. Daniel Davídek, Ing. Jan Glos, Ing. Vilém Kárský, Ing. Jan Klečka, Ing. Matúš Kozovský, Ing. Jakub Krejčí, Ing. Jan Kunz, Ing. Tomáš Lázna, Ing. Adam Ligocki, Ing. Štefan Mišík, Ing. Michal Skalský, Ing. Jakub Streit, Ing. Michal Šindelář

Externí: Ing. Luděk Buchta, Ing. Vladimír Burlak, Ing. Michaela Fendrychová, Ing. Tomáš Florián, Ing. Petr Gábrlík, Ing. Miroslav Graf, Ing. Daniel Haupt, Ing. Tomáš Hynčica, Ing. Ondřej Hynčica, Ing. Jan Klusáček, Ing. Aleš Lebeda, Ing. Jaroslav Lepka, Ing. Stanislav Mašláň, Ing. Zbyněk Mynář, Ing. Lukáš Otava, Ing. Milan Papež, Ing. Stanislav Pikula, Ing. Karel Stibor, Ing. Ladislav Šťastný, Mgr. Martin Tůma, Ing. Miroslav Uher, Ing. Michal Vašina, Ing. Ivo Veselý

### Administrative and Technical Staff

Ing. Luděk Anděra, Ing. Jakub Arm, Ing. Ondřej Baštán, Ing. Ondřej Boštík, Ing. Martin Čala, Ing. Daniel Davídek, Ing. Jan Klečka, Ing. Jakub Krejčí, Ing. Jan Kunz, Lenka Petrová, Ing. Stanislav Pikula, Ing. Michal Šindelář, Ing. Miroslav Uher, Ing. Soběslav Valach, Ing. Ivo Veselý, Jan Vodička

### Main Interests

The department provides instruction in the Bachelor degree programme 'Control and Measurement' and the follow-up Master degree programme 'Cybernetics, Control and Measurement'. Instruction and research are conducted by

five specialised groups. The main interest of the group involved in automatic control was robust and predictive electrical drives control. Research of nonlinear estimators for sensor-free drives control continued. The outcomes have been applied within the competence centre projects, namely TA ČR CAK3 – ‘Centre of Applied Cybernetics’ and CIDAM – ‘Centre of Intelligent Drives and Advanced Machine Control’. In cooperation with the ‘Centre of Excellence CEITEC’, the group was involved in international projects H2020 ‘3Ccar Integrated Components for Complexity Control in Affordable Electrified Cars’ and OSEM-EV ‘Optimised and Systematic Energy Management in Electric Vehicles’. In 2018 the group started, in cooperation with CEITEC, research on systems for autonomous vehicles in frame of the project ‘H2020 AutoDrive’, which is the cornerstone of ‘European Light-house initiative Mobility E’, and the technology project ‘H2020 I-MECH’ for Industry 4.0. Intensive research was carried out in the field of theoretical probability filtration of dynamical systems, automatic setting algorithms of filter parameters with possible suppression of system model vagueness. The group continued its cooperation with NXP Semiconductors Czech Republic and Infineon Technologies in the development of robust and predictive algorithms for alternating electric drives. A remarkable achievement is a participation in the competence centre at Cybernetics and Artificial Intelligence resulting into long-term research activities.

The group of measurement technology focuses on electrical and electronic measurements, virtual instruments in the LabView environment, sensors of non-electrical characteristics, measurements and evaluation of nonelectrical characteristics with focus on vibrodiagnostics, thermodiagnosics, acoustic emission, flux and noise measurement. The group is involved in several research projects, such as TA ČR, MPO and MŠMT, and they cooperate in the long run with industrial partners in vibrations and climatic tests. The group also runs the accredited test laboratory and accredited calibration laboratory. The instruction in nine courses ranges from sensors, analogue and digital signal processing to complex measuring systems design.

The group involved in industrial automation deals with real-time embedded systems, wireless communication systems and industrial Ethernet with focus on operational safety and protection against external and internal errors, faults and attacks. Furthermore, the group is involved in research of decentralised and distributed control and communication systems. Research is also centred on control systems for buildings and complex units. Instruction is focused on subjects dealing with control and automation of industrial technology (embedded systems, programmable automatics, SCADA systems, Industry 4.0 technology, functional safety). The group closely cooperates with BD Sensors, Beta Control, ModemTec, Siemens, Rockwell Automation, Škoda Auto etc.

The group of artificial intelligence and robotics is involved in research of service mobile robotics. Research is mainly concerned with telepresence control of mobile robots in difficult terrain, self-localisation in outer environment, in urban areas and interiors of buildings, design of highly reliable land-based and airborne robotic systems for work under extreme conditions, and automatic map-making. Now we entered the fourth year of research on employment of elements of advanced optical scanning and virtual/extended reality in biomedical engineering. This is mainly used in podology for monitoring the diabetic leg syndrome. Recently, a new cooperation has been established with several foreign research centres for the diagnostics of sleep apnoea (OSAS) in children. Instruction encompasses introduction into stationary and mobile robotics and sections dealing with above mentioned research issues. A new subject Practical Robotics and Computer Vision was introduced in 2016, and it still goes on, where the students can assemble their own robot and can earn credits for racing.

The long-term prime interest in computer vision is applied research and development of industrial, transport and other experimental visual systems. The group cooperates with a number of commercial companies and university departments. Academics are involved in research project solution and research contracts, and provide instruction in signal and image processing and analysis, localisation, recognition and reconstruction of 3D bodies. Part of the group deals with specialised hardware design on the basis of FPGA/DSP platforms for processing of extensive data files in real time. The staff is involved in more than ten subjects in Bachelor and Master programmes, and TA ČR, MPO, MŠMT, UAMT and CEITEC research projects. Research teams are engaged in the project of European ‘Centre of Excellence’ OP VaVpI CEITEC – ‘Central European Technology Institute’, group ‘Cybernetics for Materials Science’ involved in cutting-edge research on control, sensors, robotics and embedded systems.

The department’s two laboratories are part of the ‘Centre for Research and Utilisation of Renewable Energy’(CVVOZE). They focus on developing a smart grid model with different renewable sources to test grid stabilisation algorithms, operation of certified rooms for vibration and climate testing, and training and testing laboratories for safety control systems.



Computer vision laboratory

### Major Achievements

The group focused on automatic control joined international projects H2020 3Ccar and OSEM-EV, AutoDrive and MECH and it cooperates with the 'Centre of Excellence CEITEC' and leading international partners and the participation in the national competence centre at Cybernetics and Artificial Intelligence is a significant success leading to prospective research activities. The group publishes in leading journals (e.g. IEEE Transaction on Industrial Electronics) and attends conferences on theory (e.g. 'IEEE Conference on Decision and Control') and applications (e.g. IECON – 'Annual Conference of IEEE Industrial Electronics Society').

The group of measurement technology involved in projects VaVPI invested in upgrading of the laboratories for measurement of noise, vibrations and temperature. The Climate and Vibration Test Laboratory was re-accredited, and a new Calibration Laboratory for Vibration Sensors has been accredited. The structure of instruction was completely re-organised, with introduction of new compulsory subjects.

The group of industrial automation dealt with several significant projects in cooperation with the centre of excellence CEITEC, e.g. Novel Products for Filling Stations Based on Development of Alternative Technologies (CNG, LNG, electromobility) and Research and Development of an Intelligent Low-Noise T Micromotor.

The group of artificial intelligence and robotics is involved in research of service mobile robotics. Research is mainly concerned with telepresence control of mobile robots in difficult terrain, self-localisation in outer environment, in urban areas and interiors of buildings, design of highly reliable land-based and airborne robotic systems for work under extreme conditions, and automatic map-making. Now we entered the fourth year of research on employment of elements of advanced optical scanning and virtual/extended reality in biomedical engineering. This is mainly used in podology for monitoring the diabetic leg syndrome. Recently, a new cooperation has been established with several foreign research centres for the diagnostics of sleep apnoea (OSAS) in children. Instruction encompasses introduction into stationary and mobile robotics and sections dealing with above mentioned research issues. A new subject Practical Robotics and Computer Vision was introduced in 2016, where the students can assemble their own robot and can earn credits for racing.

The group of computer vision continued research in TAČR CK TE01020197 project 'Centre of Applied Cybernetics', as investigator of the package 'Camera systems and methods of image analysis for monitoring in transportation and industry'. Research activities of CAK are centred on sophisticated computer vision problems in traffic applications, driving assistance systems and industrial camera inspection systems. Another important research objective is the development of our own systems for processing large volumes of data on the basis of FPGA/DSP platforms. Cooperation on the development of power illumination systems for industrial cameras in Application MPO programme is a newly acquired project.



## Major Research Projects

**International Mobility of BUT Researchers – Ministry of Education, Youth and Sports OP VVV CZ.02.2.69/0.0/0.0/16\_027/0008371,**

Investigator: BUT, investigator at ÚAMT: Karel Horák

**Illumination Systems with Defined Characteristics for Industrial Camera Systems and Power Illumination Systems – MPO Aplikace CZ.01.1.02/0.0/0.0/16\_084/0010376,**

Investigator: CGT s.r.o., BUT Investigator: Ing. Karel Horák, Ph.D., Ing. Ilona Janáková, Ph.D.

**Centre of Intelligent Drives and Advanced Machine Control – Technology Agency of the Czech Republic – CK– CKTE02000103,**

Investigator: Zdeněk Peroutka, investigator at UAMT Pavel Václavek,

**Research, design and pilot function verification of the integrated system of intelligent parking (ISIP) – Technology Agency of the Czech Republic – ALFA TA03030333,**

Investigator: Peter Honec

**Centre of Competence, Technology Agency of the Czech Republic – Advanced Sensors and Sensor Data Processing Techniques – Project TA ČR TE02000202**

Investigator: Antonín Platil, Czech Technical University, investigator at UAMT Petr Beneš

**Centre of Applied Cybernetics III. – Technology Agency of the Czech Republic – CK TE01020197,**

Investigator: Vladimír Kučera, Czech Technical University, investigator at UAMT Pavel Václavek, Ph.D.

**Novel Products for Filling Stations Based on Development of Alternative Technologies (CNG, LNG, electromobility) – OP PIK CZ.01.1.02/0.0/0.0/16\_084/0010312**

Investigator: Zdeněk Bradáč

## Selected Publications

BOŠTÍK, O.; HORÁK, K.; KLEČKA, J. Evaluation of Randomly Generated Fonts for Bubble Captcha. Mendel Journal series, 2018, vol. 2018, no. 24, p. 143-150. ISSN: 1803-3814.

KÁRSKÝ, V. PARAMETERIZING GENERALIZED LAGUERRE FUNCTIONS TO COMPUTE THE INVERSE LAPLACE TRANSFORM OF FRACTIONAL ORDER TRANSFER FUNCTIONS. Mendel Journal series, 2018, vol. 2018, no. 24, p. 79-84. ISSN: 1803-3814.

KLEČKA, J.; BOŠTÍK, O. Effects of Environment Model Parametrization on Photogrammetry Reconstruction. Mendel Journal series, 2018, vol. 2018, no. 24, p. 151-158. ISSN: 1803-3814.

KACZMARCZYK, V.; BRADÁČ, Z.; BENEŠL, T.; STREIT, J. Gabriela.NET: Modular platform for 1D and 2D data acquisition, processing and presentation. IFAC-PapersOnLine (ELSEVIER), 2018, vol. 51, no. 6, p. 190-195. ISSN: 2405-8963.

KACZMARCZYK, V.; BAŠTÁN, O.; BRADÁČ, Z.; ARM, J. An Industry 4.0 Testbed (Self-Acting Barman): Principles and Design. IFAC-PapersOnLine (ELSEVIER), 2018, vol. 51, no. 6, p. 163-270. ISSN: 2405-8963.

JIRGL, M.; BRADÁČ, Z.; FIEDLER, P. Testing the E-PEAS Energy Management Circuit for Embedded Systems. IFAC-PapersOnLine (ELSEVIER), 2018, vol. 51, no. 6, p. 432-437. ISSN: 2405-8963.

JIRGL, M.; BRADÁČ, Z.; FIEDLER, P. Human-in-the-Loop Issue in Context of the Cyber-Physical Systems. IFAC-PapersOnLine (ELSEVIER), 2018, vol. 51, no. 6, p. 225-230. ISSN: 2405-8963.

KLÍMA, O.; NOVOBILSKÝ, P.; MADEJA, R.; BAŘINA, D.; CHROMÝ, A.; ŠPANĚL, M.; ZEMČÍK, P. Intensity-based non overlapping area registration supporting "drop-outs" in terms of model-based radiostereometric analysis. multi science- Journal of Healthcare Engineering, 2018, vol. 2018, no. 1, p. 1-10. ISSN: 2040-2295.

PUTNOVÁ, L., ŠTOHL, R., VRTKOVÁ, I. Genetic monitoring of horses in the Czech Republic: A large-scale study with a focus on the Czech autochthonous breeds. JOURNAL OF ANIMAL BREEDING AND GENETICS, 2018, vol. 135, no. 1, p. 73-83. ISSN: 0931-2668.

LÁZNA, T.; GÁBRLÍK, P.; JÍLEK, T.; ŽALUD, L. Cooperation between an unmanned aerial vehicle and an unmanned ground vehicle in highly accurate localization of gamma radiation hotspots. International Journal of Advanced Robotic Systems, 2018, vol. 15, no. 1, p. 1-16. ISSN: 1729-8814.

## Bachelor's Courses

Computer Control

(prof. Ing. Petr Pivoňka, CSc.)

Databases Systems

(Ing. Radovan Holek, CSc.)

Logical Circuits and Systems

(Ing. Radovan Holek, CSc.)

Measurement of Physical Quantities

(doc. Ing. Petr Beneš, Ph.D.)

Measurement in Electroengineering

(Ing. Soňa Šedivá, Ph.D.)

Microprocessors

(Ing. Tomáš Macho, Ph.D.)

Modeling and Simulation  
(prof. Ing. Pavel Václavek, Ph.D.)  
Modern Means in Automation  
(doc. Ing. Václav Jirsík, CSc.)  
Computers and Programming 1  
(Ing. Tomáš Macho, Ph.D.)  
Computers and Programming 2  
(Ing. Miloslav Richter, Ph.D.)  
Practical Robotics and Computer Vision  
(prof. Ing. Luděk Žalud, Ph.D.)  
Practical Programming in C++  
(Ing. Miloslav Richter, Ph.D.)  
Programmable Logic Controllers  
(Ing. Radek Štohl, Ph.D.)  
Industrial Automation  
(Ing. Radek Štohl, Ph.D.)  
Control Theory 1  
(doc. Ing. Petr Blaha, Ph.D.)

### Master's Courses

Process Control  
(Ing. Václav Kaczmarczyk, Ph.D.)  
Distributed Systems and Networks  
(doc. Ing. Petr Fiedler, Ph.D.)  
Electronic Measurement Systems  
(Ing. Marie Havlíková, Ph.D.)  
Embedded Systems for Industrial Control  
(doc. Ing. Petr Fiedler, Ph.D.)  
Machinery Safety for Industry Automation  
(Ing. Radek, Štohl, Ph.D.)  
Fuzzy systems  
(prof. Ing. Pavel Jura, CSc.)  
Measuring Techniques for Technical Diagnostics  
(Ing. Stanislav Klusáček, Ph.D.)  
Modelling and Identification  
(doc. Ing. Petr Blaha, Ph.D.)  
Operating Systems and Networks  
(Ing. Tomáš Macho, Ph.D.)  
Optimization of Controllers  
(prof. Ing. Petr Pivoňka, CSc.)  
Embedded Systems for Industrial Control

### Ph.D. Courses

Selected Chaps from Measuring Techniques  
(doc. Ing. Petr Beneš, Ph.D.)

### Laboratories

**Laboratory of Automatic Control** (instruction in automatic control, physical models of controlled processes, Pavel Václavek)

Control Theory 2  
(prof. Ing. Pavel Václavek, Ph.D.)  
Signals and Systems  
(prof. Ing. Pavel Jura, CSc.)  
Sensors  
(doc. Ing. Petr Beneš, Ph.D.)  
PC systems  
(Ing. Soběslav Valach)  
Virtual Instrumentation in Automation  
(Ing. Zdeněk Havránek, Ph.D.)  
Computer Science in Automation  
(Ing. Miloslav Richter, Ph.D.)  
Fundamentals of Robotics  
(prof. Ing. Luděk Žalud, Ph.D.)  
Processing and Digitizing of Analogue Signals  
(Ing. Zdeněk Havránek, Ph.D.)  
Processing of Multidimensional Signals  
(Ing. Karel Horák, Ph.D.)

(doc. Ing. Zdeněk Bradáč, Ph.D.)  
Computer Vision  
(Ing. Karel Horák, Ph.D.)  
Robotics  
(prof. Ing. Luděk Žalud, Ph.D.)  
Robust and Algebraic Control  
(doc. Ing. Petr Blaha, Ph.D.)  
Recognition  
(Ing. Karel Horák, Ph.D.)  
Data Acquisition, Analysis and Processing  
(Ing. Marie Havlíková, Ph.D.)  
Special Sensors  
(Ing. Stanislav Klusáček, Ph.D.)  
Machine Learning  
(Ing. Karel Horák, Ph.D.)  
Discrete Event Systems  
(prof. Ing. Pavel Václavek, Ph.D.)  
Theory of Dynamic Systems  
(doc. Ing. Petr Blaha, Ph.D.)  
Artificial Intelligence  
(doc. Ing. Václav Jirsík, CSc.)

Selected Chaps from Automatic Control  
(prof. Ing. Petr Pivoňka, CSc.)

**Laboratory of Electrical Measurement** (second-year study areas B-AMT, B-MET, B-SEE and part-time second year study areas BK-AMT, BK-SEE, Ing. Soňa Šedivá, Ph.D.)

**Laboratory of Electronic Measurement** (instruction in Measurement in Electrical Engineering for first-year study areas BAMT, B-MET, Soňa Šedivá)

**Laboratory of Intelligent Controllers** (instruction in control algorithms, physical models, design and verification of control algorithms on principles of artificial intelligence, Petr Pivoňka)

**Laboratory for Measurement of Non-Electrical Characteristics** (instruction in Measurement of Non-Electrical Characteristics and Sensors of Non-Electrical Characteristics, Petr Beneš)

**Laboratory of Flux and Pressure Measurement** (workplace for flux and pressure measurement – experimental testing air flow, Ludvík Bejček.)

**Laboratory of Modern Methods** (control systems Siemens – Schneider – Modicon, research and instruction in computer control of physical models, instruction and development of software for control by programmable automatics – PLC, instruction and development of communication via Profibus and Profinet, Petr Fiedler)

**Optoelectronics Laboratory** (optical fiber sensors and optical methods for measurement of non-electrical characteristics, Karel Horák)

**Laboratory of Computer Vision** (instruction, research and development of devices for image recording and methods of image processing and analysis for recognition and modelling of objects, Karel Horák)

**Laboratory of Process Automation** (CAK laboratory, research and development of communication technology for industrial applications including wireless communication technology, research of Real-Time Control systems and Fault-Tolerant systems, František Zezulka)

**Laboratory of Programmable Automatics** (control systems Rockwell, instruction and development of software for PLC of Rockwell, instruction and development of communication via DeviceNet and Ethernet IP, Radek Štohl)

**Laboratory of Robotics** (research and development of non-conventional drives and robotic soccer, Lukáš Kopečný, František Burian)

**Laboratory of Drives Control** (research of intelligent algorithms for control of electric drives, Pavel Václavěk)

**Laboratory of PC Subsystems** (instruction, research and development of advanced peripheral devices and elements based on FPGA/DSP for real-time processing of large volumes of data, Soběslav Valach)

**Laboratory of Telepresence** (research and development of autonomous and remote control robots, Luděk Žalud)

**Laboratory of Embedded Systems** (instruction in embedded control systems and real-time operation systems, Zdeněk Bradáč)

**Laboratory of Vibrodiagnostics** (acoustic emission sensors and measurement, calibration, laser vibrodiagnostics, Petr Beneš)

**CVVOZE Laboratory of Automation** (safe control systems, experimental power grid, František Zezulka)

**CVVOZE Testing Laboratory** (accredited testing of machines, electrotechnical and electronic components, products and parts, ČSN EN 60068-2-xx tests (vibrations, shocks, cold, heat, moisture, combined, Petr Beneš.)

**CVVOZE Calibration Laboratory** (accredited calibration laboratory for primary and secondary calibration of images of vibrations, laser vibrometers, reference sensors, calibrators and sensors with very low calibration uncertainty, Petr Beneš)



Instruction in UAMT laboratory

## 7.2 Department of Biomedical Engineering

### prof. Ing. Ivo Provazník, Ph.D.

Head

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### Professors

prof. Ing. Jiří Jan, CSc.

prof. Ing. Ivo Provazník, Ph.D.

### Associate Professors

doc. Ing. Radim Kolář, Ph.D.

doc. Ing. Jana Kolářová, Ph.D.

doc. Ing. Jiří Kozumplík, CSc.

doc. Ing. Daniel Schwarz, Ph.D.

### Lecturers

RNDr. Mgr. Michal Bittner, Ph.D., Ing. Vratislav Čmiel, Ph.D., Ing. Oto Janoušek, Ph.D., Ing. Radovan Jiřík, Ph.D., Ing. Vratislav Harabiš, Ph.D., Ing. Denisa Maděránková, Ph.D., Ing. Martin Mézl, Ph.D., Ing. Jan Odstrčilík, Ph.D., Ing. Marina Ronzhina, Ph.D., Sudeep Roy, Ph.D., Ing. Jiří Sekora, Mgr. Josef Skopalík, Ph.D., Ing. Lukáš Smital, Ph.D., Ing. Helena Škutková, Ph.D., Ing. Martin Vítek, Ph.D.

### Ph.D. Students

Ing. Larisa Baiazitova, Ing. Vojtěch Bartoň, Ing. Jakub Hejč, Ing. Branislav Hesko, Ing. Michal Hracho, Ing. Jiří Chmelík, Ing. Roman Jakubiček, Ing. Robin Jugas, Ing. Kateřina Jurečková, Ing. Jakub Kašpar, Ing. Martin Králík, Ing. Kristýna Kupková, Ing. René Labounek, Ing. Martin Lamoš, Ing. Ivana Labounková (roz. Liberdová), Ing. Lucie Maršánová, Ing. Pavel Leinveber, Ing. Ondřej Macíček, Ing. Magdaléna Matejková, Ing. Andrea Němcová, Ing. Petra Novotná, Ing. Markéta Nykrýnová, Ing. Jakub Ruzs, Mgr. Ing. Karel Sedlář, Ph.D., Ing. Jiří Sekora, Ing. Tomáš Slaviček, Ing. Radovan Smíšek, Ing. Ladislav Soukup, Ing. Ondřej Svoboda, Ing. Veronika Svozilová, Ing. Petra Štohanzlová (roz. Podlipná), Ing. Eva Valterová, Ing. Tomáš Vičar, Ing. Petr Walek

### Administrative and Technical Staff

Ing. Gabriela Petrovičová, Miroslava Prášilová, Hana Rýznarová

### Main Interests

The department provides instruction in processing of signals and images, biomedical and ecological engineering, environmental studies, biomedical technology and bioinformatics in Bachelor, Master and Ph.D. programmes.

The department is involved in basic and applied research on engineering principles in neuroscience, cardiology, physiology, electrochemistry, botany, genetics and molecular biology. The main areas of interest are digital processing and analysis of especially cardiological signals, including experimental cardiology in cooperation with Faculty of Medicine, Masaryk University. Other research interests are analyses of polysomnographic data, EEG signals as related to temporal studies or fMRI acquisition, digital processing and analysis of medical images for different imaging modalities, mainly ultrasonography, MRI, CT, microscopy and computer vision. The latest methods of processing large data volumes are applied including methods of deep learning or parallelisation of complex calculations on GPU. Research is also focused on cell biology. It is mainly utilisation of confocal microscopy or fast fluorescence microscopy for study of viability and proliferation of cells, impact of nanoparticles on cellular behaviour, measurement of intracellular calcium of cardiomyocytes or using optical methods to study mechanical properties of cells. There has been rapid development in research on bioinformatics, proteomics, genomics, and lately metagenomics. Projects are centred on methods of evolutionary and similarity analysis of genomic and proteomic data,



methods for construction of bacterial genomes from de novo sequence data, search for genes in all genome data and analysis of pharmacofore of natural molecules of potentially healing substances.

Research issues relate to education. The department supports a wider education of students. In 2018 Bachelor and Master programme students visited a number of top research institutions (National Tissue Centre, Masaryk Oncological Institute, Institute of Instrument Technology, Academy of Sciences etc.)

In research and instruction the department closely cooperates with Ophtalmological Clinic of Friedrich-Alexander-University Erlangen (Germany), University of Bergen (Norway), Max Planck Institute of Molecular Cell Biology and Genetics (Germany), Institute of Information and Communication Technologie, Universitat Politecnica de Valencia (Spain), the companies Philips Czech Republic, Philips Nederlands, MIKRO s.r.o., VUP Medicem, MDT-Medical Data Transfer, s.r.o., Touchless Biometric Systems s.r.o., Smart Brain Sale, s.r.o., Institute of Instrument Technology of Academy of Sciences, Faculty of Medicine of Masaryk University in Brno, Mendel University, Research Institute of Veterinary Medicine, University of Chemistry and Technology in Prague, University Hospital Brno and St. Anne's University Hospital in Brno.



Lecture on The Insight in the world of medical devices production and sales

## Major Achievements

In 2018 members of the department published almost 20 papers, most of them in non-zero impact factor journals. Among the most notable achievements are papers in Proceedings of the National Academy of Sciences of the United States of America and Medical Image Analysis. Scientific outcomes were presented at conferences such as Computing in Cardiology, International conference on Traffic and Transport Engineering, and World Congress on Medical Physics and Biomedical Engineering.

Some members of the department also organised various scientific activities, namely a requested educational section „Novel digital signal processing tools in cardiac electrophysiology“ at the conference World Congress on Medical Physics and Biomedical Engineering, requested lectures at the University of Macau or Lappeenranta University of Technology or requested lecture at the conference organised by the International Society for Computerized Electrocardiology. Organisational team members cooperate with four main scientific institutions in Brno in organising the international conference Computing in Cardiology that will be held in 2021. Its 48's year offers an opportunity for Brno's recognition as a Czech scientific research centre.

The cooperation with the industry was intensified by seminars and workshop organisation. A workshop on thermography and thermal mapping in diagnostics was organised in cooperation with the TMVSS company. A one-day seminar for students and graduates on the Insight into the world of medical devices production and sales was held in cooperation with the Association of Medical Devices Producers and Vendors. Master students were offered a one-day workshop in ThermoFisherScientific company as well as the possibility to visit the international fair of medical tools and devices Medica 2018 in Düsseldorf (Germany).

Educational activities of the department reach far beyond the Bachelor and Master study. The department organised educational activities for talented secondary school students, such as T-excursions (organised by JCMM), excursions in cooperation with the Vesmír magazine or the contest Merkur PerFEKT challenge. They also focused on elementary school pupils in their programme Following the Inventors as well as the programme BUT Junior. Interactive biomedical exhibits had a great success at the september Night of Scientists 2018.

A newly accredited Sports Technologies Bachelor programme can be considered another milestone in the history of the department as it combines the study with the Centre of Sport Activities and it will start from 2019/2020.

## Major Research Projects

### **Output Techniques for Construction and Annotation of Bacterial Genome Using Digital Processing of Genomic Signals** – standard GAČR projects

Investigator: Helena Škutkova

### **Quantitative Phase Microscopy for Tumoral Cells Characterisation**, standard GAČR project

Investigator: Ivo Provazník

### **Complex Driver's Physiological Monitoring Related to Psychological Factors Influencing Driving, Technology Agency of the Czech Republic Ěta project,**

Investigator: Radim Kolář

### **Advanced Detection of Paroxysmal Atrial Fibrillation in Short-term ECG Recordings, TAČR Zéta project,**

Investigator: Marina Ronzhina, Ph.D.

### **Development of Infrastructure for Interdisciplinary Research of Technologies in Biomedical Engineering** – development project of MŠMT

Investigator: Radim Kolář

### **Development of Interdisciplinary Ph.D. Programme Biomedical Technology and Bioinformatics** – development project MŠMT

Investigator: Ivo Provazník

### **Infrastructure for Instruction in New Study Programme Sports Technology at Brno University of Technology** – development project of MŠMT

In cooperation with Centre of Sports Activities

Investigator: Pavel Korvas

## Selected Publications

SMÍŠEK, R.; VIŠČOR, I.; JURÁK, P.; HALÁMEK, J.; PLEŠINGER, F. Fully automatic detection of strict left bundle branch block. *JOURNAL OF ELECTROCARDIOLOGY*, 2018, vol. 51, no. 5, p. 1-17. ISSN: 0022-0736.

MACÍČEK, O.; JIŘÍK, R.; MIKULKA, J.; BARTOŠ, M.; ŠPRLÁKOVÁ, A.; KEŘKOVSKÝ, M.; STARČUK, Z.; BARTUŠEK, K.; TAXT, T. Time-Efficient Perfusion Imaging Using DCE- and DSC-MRI. *Measurement Science Review*, 2018, vol. 18, no. 6, p. 262-271. ISSN: 1335-8871.

TORNOW, R.; ODSTRČILÍK, J.; KOLÁŘ, R. Time-resolved quantitative inter-eye comparison of cardiac cycle-induced blood volume changes in the human retina. *Biomedical Optics Express*, 2018, vol. 9, no. 12, p. 6237-6254. ISSN: 2156-7085.

UCHIYAMA, R.; KUPKOVÁ, K.; SHETTY, S.; LINFORD, A.; PRAY-GRANT, M.; WAGAR, L.; DAVIS, M.; HAQUE, R.; GAULTIER, A.; MAYO, M.; GRANT, P.; PETRI, W.; BEKIRANOV, S.; AUBLE, D. Histone H3 lysine 4 methylation signature associated with human undernutrition. *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*, 2018, vol. 115, no. 48, p. E11264 (E11273 p.)ISSN: 0027-8424.

KRÁLÍK, M.; KOZUMPLÍK, J.; HESKO, B. Detekce syndromu spánkové apnoe ze záznamu dýchání pomocí nasálního senzoru. *Elektrorevue - Internetový časopis (<http://www.elektrorevue.cz>)*, 2018, roč. 20, č. 5, s. 140-145. ISSN: 1213-1539.

HESKO, B.; HARABIŠ, V.; KRÁLÍK, M. White Blood Cell Segmentation Using Fully Convolutional Neural Networks. *Elektrorevue - Internetový časopis (<http://www.elektrorevue.cz>)*, 2018, vol. 20, no. 5, p. 1-9. ISSN: 1213-1539.

CHMELÍK, J.; JAKUBÍČEK, R.; WALEK, P.; JAN, J.; OUŘEDNÍČEK, P.; LAMBERT, L.; AMADORI, E.; GAVELLI, G. Deep convolutional neural network-based segmentation and classification of difficult to define metastatic spinal lesions in 3D CT data. *MEDICAL IMAGE ANALYSIS*, 2018, vol. 49, no. C, p. 76-88. ISSN: 1361-8415.

SMÍŠEK, R.; HEJČ, J.; RONZHINA, M.; NĚMCOVÁ, A.; MARŠANOVÁ, L.; KOLÁŘOVÁ, J.; SMITAL, L.; VÍTEK, M. Multi-stage SVM approach for cardiac arrhythmias detection in short single-lead ECG recorded by a wearable device. *PHYSIOLOGICAL MEASUREMENT*, 2018, vol. 39, no. 9, p. 1-14. ISSN: 0967-3334.

CHATURVEDI, A.; VERMA, A.; THAKUR, J.; ROY, S.; TRIPATHI, S.; KUMAR, B.; KHWAJA, S.; SACHAN, N.; SHARMA, A.; CHANDA, D.; SHANKER, K.; SAIKIA, D.; NEGI, A. A novel synthesis of 2-arylbenzimidazoles in molecular sieves-MeOH system and their antitubercular activity. *BIOORGANIC & MEDICINAL CHEMISTRY*, 2018, vol. 26, no. 15, p. 4551-4559. ISSN: 0968-0896.

CALUORI, G.; PŘIBYL, J.; ČMIEL, V.; PEŠL, M.; POTOČNÁK, T.; PROVAZNÍK, I.; SKLÁDAL, P.; ROTREKL, V. Simultaneous study of mechanobiology and calcium dynamics on hESC-derived cardiomyocytes clusters. *JOURNAL OF MOLECULAR RECOGNITION*, 2018, vol. 2018, no. e2760, p. 1-10. ISSN: 0952-3499.

SVOBODA, O.; FOHLEROVÁ, Z.; BAIAZITOVA, L.; MLÝNEK, P.; SAMOUYLOV, K.; PROVAZNÍK, I.; HUBÁLEK, J. Transfection by Polyethyleneimine-coated Magnetic Nanoparticles: Fine-tuning the Condition for



Electrophysiological Experiments. J BIOMED NANOTECHNOL, 2018, vol. 14, no. 8, p. 1505-1514. ISSN: 1550-7033.

NĚMCOVÁ, A.; SMÍŠEK, R.; MARŠÁNOVÁ, L.; SMITAL, L.; VÍTEK, M. A Comparative Analysis of Methods for Evaluation of ECG Signal Quality after Compression. BioMed Research International, 2018, no. 2018, p. 1-26. ISSN: 2314-6133.

SEDLÁŘ, K.; KOŠČOVÁ, P.; VASYLKIVSKA, M.; BRANSKÁ, B.; KOLEK, J.; KUPKOVÁ, K.; PATÁKOVÁ, P.; PROVAZNÍK, I. Transcription profiling of butanol producer *Clostridium beijerinckii* NRRL B-598 using RNA-Seq. BMC GENOMICS, 2018, vol. 19, no. 415, p. 1 (1 s.). ISSN: 1471-2164.

ENGJOM, T.; NYLUND, K.; ERCHINGER, F.; STANGELAND, M.; LAERUM, B.; MÉZL, M.; JIŘÍK, R.; GILJA, O.; DIMCEVSKI, G. Contrast-enhanced ultrasonography of the pancreas shows impaired perfusion in pancreas insufficient cystic fibrosis patients. BMC Medical Imaging, 2018, vol. 18, no. 14, p. 1-8. ISSN: 1471-2342.

LANGER, P.; JURÁK, P.; VONDRA, V.; HALÁMEK, J.; SOUKUP, L.; MATEJKOVÁ, M.; ZÁVODNÁ, E.; LEINVEBER, P. Respiratory induced hemodynamic changes measured by whole body multichannel impedance plethysmography. Physiological Research, 2018, vol. 99, no. 99, p. 1-11. ISSN: 0862-8408.

LAMOŠ, M.; MAREČEK, R.; SLAVÍČEK, T.; MIKL, M.; REKTOR, I.; JAN, J. Spatial-temporal-spectral EEG patterns of BOLD functional network connectivity dynamics. Journal of Neural Engineering, 2018, vol. 15, no. 3, p. 1-12. ISSN: 1741-2552.

ABO KHAYAL, L.; GRÜNHAGEN, J.; PROVAZNÍK, I.; MUNDLOS, S.; KORNAK, U.; ROBINSON, P.; OTT, C. Transcriptional profiling of murine osteoblast differentiation based on RNA-seq expression analyses. BONE, 2017, vol. 2017, no. 1, p. 1-10. ISSN: 8756-3282.

LABOUNEK, R.; BRIDWELL, D.; MAREČEK, R.; LAMOŠ, M.; MIKL, M.; SLAVÍČEK, T.; BEDNAŘÍK, P.; BAŠTINEC, J.; HLUŠTÍK, P.; BRÁZDIL, M.; JAN, J. Stable Scalp EEG Spatiospectral Patterns Across Paradigms Estimated by Group ICA. BRAIN TOPOGRAPHY, 2018, vol. 31, no. 1, p. 76-89. ISSN: 0896-0267.

## Bachelor's Courses

Algorithms and Programming (doc. Ing. Jana Kolářová, Ph.D.)	(prof. Ing. Ivo Provazník, Ph.D.)
Biological Signal Analysis (doc. Ing. Jiří Kozumplík, CSc.)	Practics of Bioinformatics (doc. Ing. Jana Kolářová, Ph.D.)
Bioelectric Phenomena (doc. RNDr. Ing. Jiří Šimurda, CSc.)	Radiology and Nuclear Medicine (prof. MUDr. Vlastimil Válek, CSc.)
Biochemistry (prof. RNDr. Eva Táborská, CSc.)	Heavy Current and Equipment Electronics (Ing. Jiří Sekora, Ph.D.)
Bioinformatics (prof. Ing. Ivo Provazník, Ph.D.)	Standardization in Medicine (doc. Ing. Milan Chmelař, CSc.)
Biostatistics (doc. RNDr. Ladislav Dušek, Ph.D.)	Therapeutic and Prothetic Instruments (doc. Ing. Jana Kolářová, Ph.D.)
Digital Signal Processing and Analysis (prof. Ing. Jiří Jan, CSc.)	Artificial Intelligence in Medicine (doc. Ing. Jiří Kozumplík, CSc.)
Digital Signal and Image Processing (prof. Ing. Jiří Jan, CSc.)	Introduction to Biology of Man (prof. MUDr. Jindřich Vomela, CSc.)
Ecology in Electrotechnical Profession (doc. Ing. Jiří Rozman, CSc.)	Introduction to Clinical Medicine (doc. MUDr. Miroslav Souček, CSc.)
Ecology in Healthcare (Ing. Lukáš Smital, Ph.D.)	Introduction to Medical Informatics (prof. Ing. Ivo Provazník, Ph.D.)
Electronic Systems and Measurement (Ing. Jiří Sekora)	Introduction to Molecular Biology and Genetics (doc. Ing. Petr Dvořák, CSc.)
Medical Diagnostic Devices (doc. Ing. Radim Kolář, Ph.D.)	Basics of Anatomy and Histology (doc. MUDr. Pavel Matonoha, CSc.)
Models in Biology and Epidemiology (Ing. Martin Vítek, Ph.D.)	Basics of First Aid (MUDr. Lukáš Dadák)
General Biophysics (prof. MUDr. Vojtěch Mornstein, CSc.)	Health Ethics (Mgr. Josef Kuře, Dr. phil.)
Pathological Physiology (prof. MUDr. Anna Vašků, CSc.)	Health Legislation and Law (Ing. Oto Janoušek Ph.D.)
Computers and Programming 1	Medical Imaging Systems (doc. Ing. Daniel Schwarz, Ph.D.)

## Master's Courses

Analysis and Interpretation of Biological Data

(doc. Ing. Jiří Kozumplík, CSc.)

Analysis of Biological Sequences

(prof. Ing. Ivo Provazník, Ph.D.)

Analysis of Biomedical Images

(prof. Ing. Jiří Jan, CSc.)

Analysis of Signals and Images

(prof. Ing. Jiří Jan, CSc.)

Bioethics

(Ing. Iva Pipalová)

Biophysics

(doc. RNDr. Ing. Jiří Šimurda, CSc.)

Human Biology

(prof. MUDr. Jindřich Vomela, CSc.)

Diagnostics of the Bio- and Ecosystems

(doc. Ing. Radim Kolář, Ph.D.)

Ecological Engineering

(Ing. Lukáš Smital, Ph.D.)

Evolution Algorithms

(doc. Ing. Jiří Kozumplík, CSc.)

Traditional Medical and Ecological Imaging Systems

(doc. Ing. Daniel Schwarz, Ph.D.)

Clinical Physiology

(prof. MUDr. Jindřich Vomela, CSc.)

Laboratory Technology for Genomics and Proteomics

(doc. Ing. Jana Kolářová, Ph.D.)

Medical Information Systems

(prof. Ing. Ivo Provazník, Ph.D.)

Microscopic Imaging Technology

(doc. Ing. Radim Kolář, Ph.D.)

Biological System Modelling

(Ing. Martin Vitek, Ph.D.)

Molecular Biology

(doc. PharmDr. Petr Babula, Ph.D.)

Computer-Aided Medical Diagnostics

(prof. Ing. Ivo Provazník, Ph.D.)

Advanced Analysis of Biological Signals

(doc. Ing. Jiří Kozumplík, CSc.)

Advanced Methods in Biostatistics

(doc. RNDr. Ladislav Dušek, Ph.D.)

Programming in Bioinformatics

(doc. Ing. Jana Kolářová, Ph.D.)

Special Devices for Healthcare and Ecology

(Ing. Oto Janoušek Ph.D.)

System Biology

(prof. Ing. Ivo Provazník, Ph.D.)

Tomographic Imaging Systems

(doc. Ing. Daniel Schwarz, Ph.D.)

Introduction to Environmental Studies

(RNDr. Mgr. Michal Bittner, Ph.D.)

Biomedical Data Visualization

(Ing. Vratislav Harabiš, Ph.D.)

Advanced Methods of Signal Processing

(prof. Ing. Jiří Jan, CSc.)

Basics of Research Methodology

(doc. Ing. Radim Kolář, Ph.D.)

Healthcare

(prof. MUDr. Jindřich Vomela, CSc.)

Urgent Health Care

(doc. MUDr. Vladimír Šrámek, Ph.D.)

Medical Information Systems

(prof. Ing. Ivo Provazník, Ph.D.)

(prof. Ing. Ivo Provazník, Ph.D.)

Advanced Microscopic Techniques in Biology

(doc. PharmDr. Petr Babula, Ph.D.)

Selected Problems of Biomedical Engineering

(prof. Ing. Ivo Provazník, Ph.D.)

Advanced Methods of Processing and Analysis of

Images

(prof. Ing. Jiří Jan, CSc.)

## Ph.D. Courses

Modern Methods in Electrophysiology Research

(prof. MUDr. Marie Nováková, Ph.D.)

Modern Approaches of Biomedical Image Analysis

(doc. Ing. Radim Kolář, Ph.D.)

New Trends in the Analysis and Classification of

Biomedical Data

(doc. Ing. Jiří Kozumplík, CSc.)

Advanced Analysis of Large Genomic Data

## Laboratories

**Laboratory of Electronics** (manufacture and testing of electromechanical and electronic components for research and student projects, Jiří Sekora)

**Laboratory of Biophysics I and II** (instruction in Biophysics, Bioelectric Phenomena, research on electrophysiology of cells, Vratislav Čmiel)

**Laboratory of Biomedical Technology** (instruction in Design and Operation of Complex Systems, Electronic Systems and Measurement, experimental research and student projects, Jiří Sekora)

**Laboratory of Bionics** (instruction in Human Biology, Biophysics, Clinical Physiology, Healthcare, Therapeutic and Prosthetic Technology, experimental measurements for research and student projects, Oto Janoušek)

**Laboratory of Diagnostic Technology** (instruction in Medical Diagnostic Technology, Diagnostics of bio- and ecosystems, experiments for research and student projects, Vratislav Harabiš)

**Laboratory of Environmental Technology** (instruction in Special Medical and Ecological Technology, Ecology in Electrical Engineering, Ecology in Healthcare, experiments for research and student projects, Jiří Lukáš Smital)

**Laboratory of Functional Diagnostics** (instruction in Electronic Systems and Measurements, research of brain and muscle electrophysiology, Marina Ronzhina)

**Laboratory of Genomics and Proteomics I and II** (clean environment for isolation and handling of biological samples, measurement and diagnostics of DNA, RNA and proteins, instruction in Molecular Biology, research on bioinformatics, Helena Škutková)

**Laboratory of Information Systems** (instruction in Evolution Algorithms, Medical Information Systems, Artificial Intelligence in Medicine, Bioinformatics, Algorithmisation and Programming, Computers and Programming, Analysis of Biological Sequences, Bioinformatics Practice, Denisa Maděránková)

**Laboratory of Microscopy I and II** (instruction in Microscopic Imaging Technology, experiments for research and student projects, research on optical coherent tomography, Jan Odstrčilík)

**Laboratory of Rehabilitation Technology** (experimental measurements for research and students projects, research on rehabilitation technology, Marina Ronzhina)

**Laboratory of Ultrasound Tomography** (research and measurement of ultrasonographic data, calibration of devices and ultrasound probes, Vratislav Harabiš)

**Laboratory of Imaging Systems** (instruction in Introduction in Medical Informatics, Medical Information Systems, experiments for research and student projects, Radim Kolář)

**Laboratory of Image Processing** (instruction in Analysis of Biological Signals, Bioinformatics, Conventional Imaging Systems in Medicine, Advanced Analysis of Biological Signals, Analysis and Interpretation of Biological Data, Digital Processing of Signals and Images, Tomography Imaging Systems, Jiří Sekora)

**Laboratory of Signal Processing** (instruction in Programming in Bioinformatics, Computer Support for Medical Diagnostics, Introduction in Medical Informatics, Analysis of Signals and Images, Biomedical Data Visualisation, Analysis of Biomedical Images, Models in Biology and Epidemiology, System Biology, Digital Signal Processing and Analysis, Martin Vitek)



Students in Laboratory of Microscopy

## 7.3 Department of Power Electrical Engineering

### doc. Ing. Petr Toman, Ph.D.

Head

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### Associate Professors

doc. Ing. Petr Baxant, Ph.D.

doc. RNDr. Oldřich Coufal, CSc.

doc. Ing. Jiří Drápela, Ph.D.

doc. Ing. Ilona Lázníčková, Ph.D.

doc. Ing. Karel Máslo, CSc.

doc. Ing. Petr Mastný, Ph.D.

doc. Ing. Jaroslava Orságová, Ph.D.

doc. Ing. Petr Toman, Ph.D.

### Lecturers

Jindřich Adam, CSc., Ing. Branislav Bátora, Ph.D., Ing. Karel Katovský, Ph.D., Ing. Michal Krbal, Ph.D., Ing. Jan Macháček, Ph.D., Ing. Jan Morávek, Ph.D., Ing. Martin Paar, Ph.D., Ing. Michal Ptáček, Ph.D., Ing. Lukáš Radil, Ph.D., Ing. Stanislav Sumec, Ph.D., Ing. Jan Škoda, Ph.D., Ing. David Topolánek, Ph.D., Ing. Martin Vojtek, Ph.D.

### Ph.D. Students

Ing. Zuzana Bukvišová, Ing. Mayada Daboul, Ing. Štěpán Foral, Susanna Gaginyan, M.Sc., Ing. Tomáš Hála, Mgr. Robert Holomb, Ing. Daniel Janík, Ing. Marek Kopicčka, Ing. Jan Koudelka, Ing. Dušan Král, Elmira Melyan, M.Sc., Ing. Peter Mičian, Ing. Martin Motyčka, Ing. Jan Nekvapil, Ing. Jiří Pěcha, Ing. Luděk Pelikán, Taron Petrosyan, M.Sc., Ing. Jaroslav Štěpánek, Ing. Kamil Števanek, Ing. Jan Varmuža, Ing. Jitka Vojáčková, Ing. Michal Vrána, Ing. Václav Vyčítal, Ing. Kinan Wannous, Ing. Vojtěch Wasserbauer, Ing. Miroslav Zeman

### Administrative and Technical Staff

Ing. Filip Koval, Ing. Miloš Křivan, Jitka Langerová, Bc. Tereza Lázníčková, Josef Němec, Ing. Josef Šenk, CSc.

### Major Interests

The department together with the UVEE guarantees the Bachelor's study programme Power Electrical and Electronic Engineering (B-SEE), it also guarantees independently the Master's study programme Power Electrical Engineering (M1-EEN) and together with UVEE it guarantees the Doctoral study programme Power Electrical and Electronic Engineering. The students are instructed on the electrical energy production from both conventional and renewable sources, on the electrical energy transmission and distribution and on using electrical energy for electric light and heat. They also deal with transient phenomena and solution of system failures in joined electrical framework and they are introduced to principles and guidelines of liberalized energy market.

The department researches the possibilities of securing power for the society with respect to sustainable development, focusing mainly on searching for new ways of energy production from renewable sources and increasing operation efficiency of power sources. The department also focuses on fast localisation of network failures, impact of electrical appliances on electric energy quality, load optimisation in small variable-output power sources, optimisation of the structure of power sources for services in conditions of liberalised market with electrical energy, use of energy accumulation for support services and optimisation of electromobile charging stations operation, analysis of major system failures and appropriate measures, analysis of connection into the network, design and implementation of protection systems for indoor and outdoor illumination evaluation systems.

The department cooperates in solution of technical problems, research and graduate and postgraduate training with a number of companies, e.g. Skupina E. ON, Skupina ČEZ, ČEPS, a.s., ABB, s.r.o., EGC-EnerGoConsult ČB,



s.r.o., EGÚ Brno, a.s., ELVAC, a.s., KMB Systems s.r.o., MEgA – Měřící Energetické Aparáty, a.s., TES, s.r.o., Teplárny Brno, a.s., Siemens, s.r.o., etc. We have had long-term cooperation in research and instruction with departments of power electrical engineering at all Czech and Slovak technical universities.



Participants of the 19<sup>th</sup> International Scientific Conference Electric Power Engineering 2018

### Major Achievements

In 2018 the department was involved in research mainly by the „Centre for Research and Utilisation of Renewable Energy (CVVOZE). Members of the department staff participated in 11 TAČR projects, 2 OP PIK projects, 9 SUJV Dubna projects, 1 OP VVV project and 38 contract research projects. The most significant research project conducted in 2018 was ‘Energy in Conditions of Sustainable Development’ (ENPUR) funded from the ‘National Sustainability Programme I’, where the department is responsible for the research part ‘Generation, Transmission, Distribution and Utilisation of Electrical Energy’.

Research infrastructure of the CVVOZE laboratory (CVVOZE PowerLab) received institutional support from the national budget and therefore since 2016 it has been available to the scientific community within the framework of an open access project.

Cooperation continued with E.ON Česká republika, s.r.o. dealing with issues of electric lines safety in the case of failures and localisation of failures and exploitation of accumulation for operation of the distribution network, with ČEZ, a.s., VŠB TU Ostrava in using accumulation optimisation for electromobility charging stations and E.ON Distribuce, a.s. in noise resistance of electrometers in the 2-150kHz band, and Lucis in development of new types of lighting devices. And the department cooperated with Second University of Naples in quality assessment of electrical energy. The staff was involved in 2 projects focused on an analysis of the possibility of exploitation of data from Smart Metering for operation and development of distribution networks.

In January the department held a 43<sup>th</sup> colloquium of Czech and Slovak Power Electrical university department teachers, which opened 7<sup>th</sup> round of such traditional meetings starting from 1974 on in Brno. Furthermore, in May the department organised a traditional international conference „19<sup>th</sup> International Scientific Conference Electric Power Engineering 2018“ at Hotel Santon by the Brno dam and in September it also held a “ VII. Lighting Conference of The Visegrad Countries – LUMEN V4.”

Newly prepared Bachelor study programme Power Electrical and Electronic Engineering (BPC-SEE) was accredited by NAU.

### Major Research Projects

**Centre of Advanced Nuclear Technologies (CANUT) - TE01020455**

Investigator: Karel Katovský

### **Simulator of Distribution Networks for Training and Certification Employee - TK01020104**

Investigator: Petr Toman

### **Development of System for Asymmetric V-dip Failures Localisation - TK01020107**

Investigator: David Topolánek

### **Certification Power Source for Small Sources, Supposed to Be Connected to LV Networks - TK01020196**

Investigator: Petr Toman

### **Smart energy Network – TK01030094**

Investigator: Jaroslava Orságová

### **Correlations and Computer Codes Calculation of the Boiling Crisis Phenomena in Nuclear Reactors CZ.01.1.02/0.0/0.0 /17\_102/0011478,**

Investigator: Karel Katovský

### **Research of Activation Detectors for Use in Systems with Highly Energetic Neutrons – TJ01000184**

Investigator: Jitka Vojáčková

### **Selected Publications**

SENK, J., LAZNICKOVA, I., JAKUBOVA, I. Updated Version of the Simplified Model of Intensively Blasted Electric Arc. Acta Polytechnica, 2018, vol. 58, no. 4, p. 264-270. ISSN: 1210-2709.

TOPOLÁNEK, D.; VYČÍTAL, V.; TOMAN, P.; CARMAN, B. Application of the probabilistic approach for earthing system evaluation in distribution network. INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS, 2018, vol. 20, no. 110, p. 268-279. ISSN: 0142-0615.

ZÁVORKA, L.; ZEMAN, M.; ADAM, J.; KATOVSKÝ, K.; KOLEKTIV, S. Characterization of a mixed high-energy spallation neutron–proton field using monoisotopic activation detectors. NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT, 2018, no. 903, p. 246-261. ISSN: 0168-9002.

MLÝNEK, P.; MIŠUREC, J.; TOMAN, P.; ŠILHAVÝ, P.; FUJDIK, R.; SLÁČIK, J.; HASIRCI, Z.; SAMOUYLOV, K. Performance Testing and Methodology for Evaluation of Power Line Communication. Elektronika Ir Elektrotechnika, 2018, vol. 24, no. 3, p. 88-95. ISSN: 1392-1215.

VARMUŽA, J.; KATOVSKÝ, K.; ZEMAN, M.; ŠŤASTNÝ, O.; HAYSAK, I.; HOLOMB, R. New experimental research stand SVICKA neutron field analysis using neutron activation detector technique. EPJ Web of Conferences, 2018, vol. 177, no. 01004, p. 1-6. ISSN: 2100-014X.

WANNOUS, K.; TOMAN, P. Evaluation of Harmonics Impact on Digital Relays. ENERGIES, 2018, vol. 11, no. 4, p. 893-893. ISSN: 1996-1073.

KHUSHVAKTOV, J.; ADAM, J.; SVOBODA, J.; ZEMAN, M. et al. Monte Carlo simulations and experimental results on neutron production in the uranium spallation target QUINTA irradiated with 660 MeV protons. APPLIED RADIATION AND ISOTOPES, 2018, no. 137, p. 102-107. ISSN: 0969-8043.

COUFAL, O.; RADIL, L.; TOMAN, P. Magnetic field and forces in a pair of parallel conductors. INTERNATIONAL JOURNAL OF APPLIED ELECTROMAGNETICS AND MECHANICS, 2018, vol. 56, no. 2, p. 243-261. ISSN: 1383-5416.

COUFAL, O.; TOMAN, P. Condensed species in products of the reaction of SF6 with Cu up to 4000 K. Journal of Physics D: Applied Physics, 2018, vol. 51, no. 2, p. 1-16. ISSN: 0022-3727.

### **Bachelor's Courses**

Electrical Power Distribution

(doc. Ing. Petr Toman, Ph.D.)

Economy and Ecology of Power Engineering

(Ing. Michal Ptáček, Ph.D.)

Nuclear Energetic Equipments

(Ing. Karel Katovský, Ph.D.)

Protection of Electrical Power Equipment

(doc. Ing. Petr Toman, Ph.D.)

Computers and Programming 2

(Ing. Stanislav Sumec, Ph.D.)

Design of Power and Data Networks

(Ing. Branislav Bátora, Ph.D.)

Distribution Equipment

(doc. Ing. Jaroslava Orságová, Ph.D.)

Machinery of Power Plants

(Ing. Karel Katovský, Ph.D.)

Technical Mechanics

(doc. Ing. Ilona Lázničková, Ph.D.)

Energy Use

(doc. Ing. Jiří Drápela, Ph.D.)

Electrical Power Generation

(doc. Ing. Petr Mastný, Ph.D.)

Electrical Power Production and Distribution

(doc. Ing. Petr Toman, Ph.D.)

### **Master's Courses**

Electric Arc Application  
(doc. Ing. Ilona Lázničková, Ph.D.)  
Diagnostics in Electricity Industry  
(doc. Ing. Jiří Drápela, Ph.D.)  
Distribution and Industrial Networks  
(Ing. David Topolánek, Ph.D.)  
Economy of Electrical Power Engineering  
(Ing. Lukáš Radil, Ph.D.)  
Power Plants and Heating Power Stations  
(doc. Ing. Jaroslava Orságová, Ph.D.)  
Substations and Lines  
(doc. Ing. Jaroslava Orságová, Ph.D.)  
Electrical Heat Technology  
(doc. Ing. Ilona Lázničková, Ph.D.)  
Integrated Protection Systems  
(doc. Ing. Petr Toman, Ph.D.)  
Nuclear Power Plant  
(Ing. Karel Katovský, Ph.D.)  
The Power Quality and EMC  
(doc. Ing. Jiří Drápela, Ph.D.)

Low Power Electrical Sources  
(doc. Ing. Petr Mastný, Ph.D.)  
Unconvention Conversions  
(Ing. Lukáš Radil, Ph.D.)  
Lighting Systems  
(Ing. Jan Škoda, Ph.D.)  
Power Systems  
(doc. Ing. Petr Baxant, Ph.D.)  
Design of Power and Data Networks  
(Ing. Branislav Bátora, Ph.D.)  
Transient Phenomena  
(Ing. Branislav Bátora, Ph.D.)  
Power Transmission Networks  
(Ing. Michal Ptáček, Ph.D.)  
Power Systems Control  
(doc. Ing. Petr Toman, Ph.D.)  
Lighting Technology  
(doc. Ing. Petr Baxant, Ph.D.)  
High Voltages Technology

### Ph.D. Courses

Mathematical Modelling of Electrical Power Systems  
(doc. Ing. Petr Toman, Ph.D.)

Selected Problems of Electricity Production  
(doc. Ing. Petr Mastný, Ph.D.)

### Laboratories

**Laboratory of Electrical Protection** (instruction in Distribution Facilities, Electrical Stations and Lines, Protection and Security of Facilities, Integrated Protection Systems, preparation of measurements in real networks, research, Jaroslava Orságová)

**Laboratory of Diagnostics** (instruction in Diagnostics in Power Electrical Engineering, research on diagnostics and measurement, Jiří Drápela)

**Laboratory of Electrical Energy Quality and Electromagnetic Compatibility** (instruction in Electrical Energy Quality and EMC and Diagnostics in Power Electrical Engineering, Jiří Drápela)

**Laboratory of Appliance-Electrical Network Compatibility** (impact of appliances on the distribution network under different network conditions, Jiří Drápela)

**Laboratory of Heating Technology** (instruction in Electrical Power Utilisation and Electrical Heating Technology, Ilona Lázničková)

**Laboratory of Light and Illumination Technology** (instruction in Light Technology, Illumination Systems, Testing of Light Sources and Fittings, research projects, Jan Škoda)

**Laboratory of Electrical Networks** (instruction in Electrical Power Distribution, Transmission Networks, Electrical Stations and Line Networks, Distribution and Industrial Networks, research projects, Michal Ptáček)

**Design Laboratory** (instruction in Design of Power and Data Distribution Systems, training and research on modern electroinstallations, Branislav Bátora)

**Laboratory of Electric Energy Generation** (instruction in Electric Energy Generation, Power Stations and Heating Plants, Small Sources of Electric Energy, research and diploma theses, Petr Mastný)

**Laboratory of Ionising Radiation** (instruction in Nuclear Power Facilities, Karel Katovský)

**Laboratory of Non-Conventional Energy Conversion** (instruction in Ecology in Power Engineering, Small Electrical Power Sources, Non-Conventional Energy Conversion, diploma theses and dissertations, research of fuel cells, Petr Mastný)

**Solar Energy Laboratory** (research of full solar energy exploitation, development and verification of operating models in real operation conditions, Petr Mastný)

**Ultra High Voltage Laboratories** (instruction in Distribution Facilities, Electrical Stations and Lines, High Voltage Technology, testing by superimposed and pulse voltage, Jaroslava Orságová)

**Computer Laboratories (2)** (instruction in Computers and Programming 2, planning in power engineering, steady states and transient phenomena in electrification systems, Branislav Bátora)





Final examinations in 2018

## 7.4 Department of Electrical and Electronic Technology

### Doc. Ing. Petr Bača, Ph.D.

Head of the Department

Technická 3058/10  
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fax: 541 146 147  
e-mail: uete@feec.vutbr.cz



### Professors

prof. Ing. Jiří Kazelle, CSc.  
prof. RNDr. Petr Vanýsek, CSc.  
prof. Ing. Jiří Vondrák, DrSc.

### Associate Professors

doc. Ing. Petr Bača, Ph.D.  
doc. Ing. Petr Křivík, Ph.D.  
doc. Ing. Jiří Maxa, Ph.D.  
doc. Ing. Vítězslav Novák, Ph.D.  
doc. Ing. Marie Sedlaříková, CSc.  
doc. Ing. Jiří Vaněk, Ph.D.

### Lecturers

Ing. Ondřej Čech, Ph.D., Ing. Pavel Čudek, Ph.D. Ing. Ladislav Chladil, Ph.D., Ing. Kristýna Jandová, Ph.D., Ing. Tomáš Kazda, Ph.D., Ing. Jiří Libich, Ph.D. Ing. Helena Polsterová, CSc., Ing. Jiří Starý, Ph.D., Ing. Jiří Špinka, Ing. Petr Vyroubal, Ph.D.

### Ph.D. Students

Ing. Robert Bayer, Ing. Michal Bílek, Ing. Tomáš Dvořák, Ing. Daniel Frýda, Ing. Luděk Horák, Ing. Tomáš Gottwald, Ing. Jiří Hudec, Ing. Josef Hylský, Ing. Michal Jahn, Ing. Kamil Jaššo, Ing. Martin Juračka, Ing. Michl Kadlec, Ing. Kateřina Karmazínová, Ing. Pavel Lepík, Ing. Josef Máca, Ing. Michal Musil, Ing. David Pléha, Ing. Marek Solčanský, Ing. Dávid Strachala, Ing. Lucie Šimonová, Ing. Jiří Šubarda, Ing. Jiří Tichý, Ing. Sebastian Vaculík, Ing. Iulia Veselkova, Ing. Jana Zimáková

### Administrative and Technical Staff

Gabriela Dominiková, František Chudáček, Ing. Petr Kahle, František Kořínek, Martin Šturm, Ing. Miroslav Zatloukal

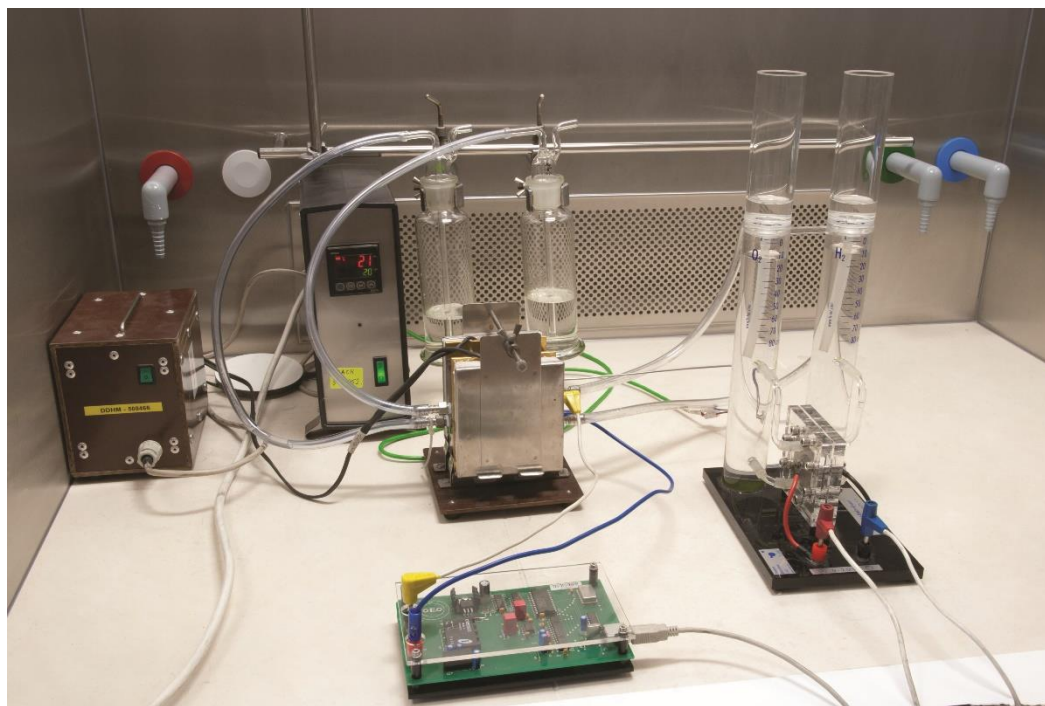
### Main Interests of the Department

The Department of Electrical and Electronic Technology provides instruction in electrotechnical materials, manufacturing processes and their control, printed circuit board and surface mount technology including relevant design systems, diagnostics, testing and reliability of electrotechnical materials and processes, control and quality checking and alternative electrical power sources in the newly accredited Bachelor programme 'Microelectronic and Technology' as well as in the expiring Bachelor and Master programmes 'Electrical, Electronic, Control and Communication Technology' (EECR), in full-time and part-time form of study., The courses in the newly accredited FEEC Bachelor programmes 'Technical Documentation', 'Materials in Electrotechnics', and 'Introduction to Materials in Electrotechnics' are provided for all first-year full-time and part-time students in the newly accredited Bachelor programmes in both full-time and part-time form of study.

Research areas of interest are electrotechnical and electronic materials and components, technologies, diagnostics and prognosis, electron microscopy, electrochemical power sources, as well as lead and alkaline accumulators, development of new materials for lithium-ion batteries, electrocatalysts and ion-exchange membranes for fuel cells, thin-layer electrodes for electrochromic systems, photovoltaic systems, non-destructive diagnostics of defects and quality control, reliability and lifetime of solar cells, detection of signal electrons and

methods of environmental scanning electron microscopy of atomic forces, lead-free soldering, quality and reliability of soldered joints, degradation and diagnostics of dielectric systems.

The department co-operates with a whole range of Czech and foreign institutions, namely Technische Universität Wien, Padova University, Universität Ulm - Zentrum für Sonnenenergie - und Wasserstoff-Forschung, École Polytechnique de Montréal, surface analysis workplace Nanolytics in Feldkirchen, Austria, Graphite AG Kropfmühl AG, Institute of Scientific Instruments, Academy of Sciences CR., Institute of Inorganic Chemistry Academic of Sciences CR, Institute of Physical Chemistry, Academy of Sciences CR, Institute of Macromolecular Chemistry, Academy of Sciences CR, Bochemie Bohumín, EPRONA Rokytnice nad Jizerou, Elmarco Liberec, Solartec Rožnov pod Radhoštěm, ERD Praha, LINET Slaný, ENERGYSERVIS Brno, ČeMeBo Blansko, Honeywell Brno, ALPS Electric Czech Sebranice. The department also cooperates with INIFTA Universidad Nacional de La Plata, Argentina and Università degli Studi di Palermo, Italy in the programme KONTAKT.



Experimental station demonstrating hydrogen cycle during the production of electrical energy

### Major Achievements in 2018 in the field of research, development, and teaching

The department co-organised the 39th international conference 'Non-Conventional Energy Sources' in Hustopeče 9-11 May 2018. The conference was organised in cooperation with the Czech Electrotechnical Society, group for chemical sources of electrical energy.

Members of the department participated in the meeting of Czech and Slovak colleagues in the framework of the 45th international conference 'Electrotechnology', organised by the Department of Technology and Measurement, University of West Bohemia in Plzeň 24-26 May 2018. The event took place in Parkhotel Plzeň.

The Department of Electrical and Electronic Technology organised the 19th international conference 'Advanced Batteries, Accumulators and Fuel Cells' – under the auspices of American Electrotechnical group 'The Electrochemical Society' ECS and European The International Society of Electrochemistry“ .

The conference was attended by 80 experts from all over the world, e.g. Victor Rojas from Chile, Günter Fafilek from Tu Wien (Austria), Grzegorz Lota with a group of his Ph.D. students from Poznan (Poland), Elena Shembel from University in Kiev (Ukraine) and Enerize Corporation Florida, USA Petr Vanysek from University of Illinois (USA), Madani Seyed z University Aalborg (Denmark), MS Ansari from India and other colleagues from Seoul National University Korea, and Petersburg State University and others. The outcome of the conference was a special issue of 'Transactions of Electrochemical Society', volume 87 with full texts of presented papers (published in Scopus).

In 2018, the bilateral project of Ministry of Education, Czech Republic – Austria (Vienna Technical University) 83p2 called 'Gel polymer electrolytes with ionic liquids' was started. The project included exchange placements for two Czech and one Austrian academics. This project continues in 2019. One month doctoral students' exchanges, one student from DEET at TU Wien and two Austrian students at DEET, are also part of the project.

The international project NATO SPS 985148 'Development of New Cathodes for stable and Safer Lithium Sulphur Batteries' with researchers from the Universities in Kiev, Barcelona, Košice, and DEET, BUT continued in 2018.

Under the terms of 'Mobility' programme, a colleague from University of La Plata Argentina, Mariela Ortiz, is on academic stay at DEET (from 1.10.2018 to 30.9.2019) and Jiří Libich from DEET is a participant of the same project staying at TU Wien, Austria, for 14 months (from 1.4.2018 to 31.5.2019).

Project TH02010473 'General Battery Monitoring System – BUMS' within the framework of programme Epsilon, in co-operation with EPRONA, a.s., Rokytnice nad Jizerou, continues in 2019.

Research continued in the 'National Sustainability Programme I' (NPU I) for support of research, experimental development and innovations within the framework of the Regional R&D Centre, called 'Centre for Research and Utilisation of Renewable Energy' (CVVOZE), research programme 2 – 'Chemical and Photovoltaic Energy Sources'.

In 2018 we continued research and commercial activities in the accredited Testing Laboratory CVVOZE where the department tests VA characteristics of photovoltaic panels. The offered verification services for the condition and operability of photovoltaic power stations were used by 7 companies in 2019, and over 35 photovoltaic panels of different types were tested.

## Major Research Projects

### **Project AKTION CZECH REPUBLIC – AUSTRIA 'Gel polymer electrolytes with ionic liquids'**

Investigator: Doc. Ing. Marie Sedlaříková, CSc.

### **Project TH02010473 'General Battery Monitoring System – BUMS'**

Investigator: Prof. Ing. Jiří Kazelle, CSc.

### **Project 1618BS\_CP1 'INVESTIGATION OF THE MUTUAL INTERACTION OF CARBON AND OTHER ADDITIVES IN THE PERFORMANCE OF NEGATIVE LEAD ACCUMULATOR ELECTRODES DURING PSoC OPERATION'**

Investigator: Doc. Ing. Petr Bača, Ph.D.

### **Project NATO SPS 'Lithium Batteries' no. 985148 'Development of New Cathodes for Stable and Safer Lithium Sulphur Batteries'**

Investigator: Doc. Ing. Marie Sedlaříková, CSc.

## Selected Publications

KŘIVÍK, P.; VACULÍK, S.; BAČA, P.; KAZELLE, J. Determination of state of charge of lead acid battery by EIS. *Journal of Energy Storage*, 2018, vol. 15, no. 1, p. 581-585. ISSN: 2352-152X.

VYROUBAL, P.; KAZDA, T.; MAXA, J.; MAČÁK, M. Finite Element Approach of Interior Permanent Magnet Motor Acoustics Noise. *Advances in Military Technology*, 2018, no. 2, p. 223-235. ISSN: 1802-2308.

CHLADIL, L.; ČECH, O.; SMEJKAL, J.; VANÝSEK, P. Study of Zinc Deposited in the Presence of Organic Additives for Zinc-based Secondary Batteries. *Journal of Energy Storage*, 2018, vol. 21, no. EST611, p. 295-300. ISSN: 2352-152X.

JANDOVÁ, K.; JANDA, M. Wind Effect Simulation on Photovoltaic Modules. *ECS Transactions*, 2018, no. 87, p. 411-413. ISSN: 1938-5862.

VYROUBAL, P.; KAZDA, T. Finite Element Model of Nail Penetration into Lithium Ion Battery. *Journal of Energy Storage*, 2018, vol. 11-12, no. EST220, p. 451-458. ISSN: 2352-152X.

MAXA, J.; HLA VATÁ, P.; VYROUBAL, P. Analysis of the Impact of the Conic Aperture in the Differentially Pumped Chamber. *Advances in Military Technology*, 2018, no. 1, p. 50-61. ISSN: 1802-2308.

ČECH, O.; KLVAČ, O.; MÁCA, J.; ČUDEK, P.; VANÝSEK, P. Synthesis of LiFePO<sub>4</sub>/graphene composite with electrochemically prepared few-layered graphene. *Journal of Energy Storage*, 2018, vol. 2018, no. 62, p. 1-4. ISSN: 2352-152X.

LACINA, K.; KUBESA, O.; HORÁČKOVÁ, V.; MORAVEC, Z.; KUTA, J.; VANÝSEK, P.; SKLÁDAL, P. Graphene Oxide from Improved Hummers' Method: Is This Material Suitable for Reproducible Electrochemical (Bio)Sensing?. *ECS Journal of Solid State Science and Technology*, 2018, vol. 7, no. 10, p. M166 (M171 p.) ISSN: 2162-8769.

KŘIVÍK, P.; VACULÍK, S.; BAČA, P.; KAZELLE, J. In situ measurement of PEIS of lead acid battery cell. *ECS Transaction*, 2018, vol. 87, no. 1, p. 307-314. ISSN: 1938-6737.

ZIMÁKOVÁ, J.; VACULÍK, S.; FRYDA, D.; BAČA, P.; BOUŠKA, M. Examination of impact of lignosulfonates added to the negative active mass of a lead-acid battery electrode. *Journal of Energy Storage*, 2018, vol. 2018, no. 18, p. 229-238. ISSN: 2352-152X.

HAVEROVÁ, L.; ORINAKOVÁ, R.; ORIŇAK, A.; GOREJOVÁ, R.; BALÁŽ, M.; VANÝSEK, P.; KUPKOVÁ, M.; HRUBOVČÁKOVÁ, M.; MUDROŇ, P.; RADONÁK, J.; ORSÁGOVÁ KRÁLOVÁ, Z.; MOROVSKÁ TURONOVÁ, A. An In Vitro Corrosion Study of Open Cell Iron Structures with PEG Coating for Bone Replacement Applications. *Metals*, 2018, vol. 8, no. 7, p. 1-21. ISSN: 2075-4701.

HYLSKÝ, J.; STRACHALA, D.; HLADÍK, J.; ČUDEK, P.; KAZDA, T.; VANĚK, J.; VYROUBAL, P.; STARÝ, J. Design of P-Type Photovoltaic Cells Resistant to Potential-Induced Degradation. *IEEE Journal of Photovoltaics*, 2018, vol. 99, no. 99, p. 300-306. ISSN: 2156-3381.

LACINA, K.; SOPOUŠEK, J.; SKLÁDAL, P.; VANÝSEK, P. Boosting of the output voltage of a galvanic cell. *Electrochimica Acta*, 2018, vol. 282, no. 1, p. 331-335. ISSN: 0013-4686.



STOJAN, R.; VANĚK, J. Luminescence Diagnostics of Photovoltaic Cells. International Journal for Research in Applied Science and Engineering Technology (IJRASET), 2018, vol. 1, no. 1, p. 1-4. ISSN: 2321-9653.

VANÝSEK, P.; NOVÁK, V. Availability of Suitable Raw Materials Determining the Prospect for Energy Storage Systems Based on Redox Flow Batteries. Acta Montanistica Slovaca, 2018, vol. 23, no. 1, p. 90-99. ISSN: 1335-1788.

HYLSKÝ, J.; STRACHALA, D.; VYROUBAL, P.; ČUDEK, P.; VANĚK, J.; VANÝSEK, P. Effect of negative potential on the extent of PID degradation in photovoltaic power plant in a real operation mode. Microelectronics Reliability, 2018, no. 85, p. 12-18. ISSN: 0026-2714.

STRAKOVÁ FEDORKOVÁ, A.; CAPKOVÁ, D.; GAVALIEROVA, K.; KAZDA, T. Electrochemical characterization of high-performance sulphur composites as cathodes for Li-S batteries with application in automotive industry. Communications, 2018, vol. 1, no. 20, p. 81-84. ISSN: 1335-4205.

LIBICH, J.; MÁČA, J.; VONDRÁK, J.; ČECH, O.; SEDLAŘÍKOVÁ, M. Supercapacitors: Properties and applications. Journal of Energy Storage, 2018, vol. 2018, no. 17, p. 224-227. ISSN: 2352-152X.

KAZDA, T.; VONDRÁK, J.; VISINTIN, A.; SEDLAŘÍKOVÁ, M.; TICHÝ, J.; ČUDEK, P. Electrochemical performance of Mo doped high voltage spinel cathode material for lithium-ion battery. Journal of Energy Storage, 2018, vol. 11-12, no. EST220, p. 329-335. ISSN: 2352-152X.

VYROUBAL, P.; KAZDA, T. Equivalent Circuit Model Parameters Extraction for Lithium Ion Batteries Using Electrochemical Impedance Spectroscopy. Journal of Energy Storage, 2018, vol. 11-12, no. EST220, p. 1-9. ISSN: 2352-152X.

STARÝ, J.; DUŠEK, K. Solder joint quality evaluation based on heating factor. CIRCUIT WORLD, 2018, vol. 44, no. 1, p. 1-8. ISSN: 0305-6120.

### Bachelor Degree Study Courses

Diagnostics and Testing

(Ing. Jandová Kristýna, Ph.D.)

Electrotechnical Materials and Production Processes  
(prof. Ing. Jiří Kazelle, CSc.)

Materials and Components for Biomedicine  
(Ing. Tomáš Kazda, Ph.D.)

Materials and Technical Documentation  
(doc. Ing. Jiří Vaněk, Ph.D.)

Materials for Electrotechnics  
(doc. Ing. Jiří Vaněk, Ph.D.)

Design and Technology of Electric Devices  
(doc. Ing. Vítězslav Novák, Ph.D.)

Design Systems of Printed Circuit Boards  
(doc. Ing. Petr Bača, Ph.D.)

Selected Topics in Renewable Energy Sources and Energy Storage (doc. Ing. Petr Bača, Ph.D.)

Printed Circuits and Surface Mount Technology  
(Ing. Jiří Starý, Ph.D.)

Computer Projecting of Productions, Logistic and Ecology (Ing. Petr Vyroubal, Ph.D.)

Computer Support for Technical and Managerial Work (doc. Ing. Jiří Maxa, Ph.D.)

Quality Management and Checking  
(Ing. Helena Polsterová, CSc.)

Quality Management and Metrology  
(Ing. Helena Polsterová, CSc.)

Reliability in Electrical Engineering  
(Ing. Helena Polsterová, CSc.)

Technical Documentation  
(doc. Ing. Jiří Maxa, Ph.D.)

Introduction to Materials for Electrotechnics  
(doc. Ing. Jiří Vaněk, Ph.D.)

### Master Degree Study Courses

Alternative Energy Sources  
(doc. Ing. Jiří Vaněk, Ph.D.)

Diagnostic Methods in Electroengineering  
(Ing. Pavel Čudek, Ph.D.)

Ecology in Manufacturing  
(doc. Ing. Petr Bača, Ph.D.)

Climatotechnology in Electrical Engineering  
(Ing. Helena Polsterová, CSc.)

Materials and Components for Biomedicine  
(doc. Ing. Marie Sedlaříková, CSc.)

Interconnection and Assembly Technology  
(Ing. Jiří Starý, Ph.D.)

Renewable Energy Sources  
(Ing. Petr Křivík, Ph.D.)

Computer Systems for Projects  
(Ing. Vítězslav Novák, Ph.D.)

Properties and Production of Electrotechnic Materials  
(Ing. Ladislav Chladil, Ph.D.)

Control and Data Administration  
(doc. Ing. Jiří Maxa, Ph.D.)

Reliability and Quality  
(Ing. Helena Polsterová, CSc.)

Structure and Properties of Materials  
(doc. Ing. Vítězslav Novák, Ph.D.)

Technological Projecting and Logistics  
(Ing. Vyroubal Petr, Ph.D.)

3D Modelling  
(doc. Ing. Jiří Maxa, Ph.D.)

Production Processes  
(prof. Ing. Jiří Kazelle, CSc.)

Fundamentals of Reliability in Electrical Engineering  
(Ing. Helena Polsterová, CSc.)

### Doctoral Degree Study Courses

Electrotechnical Materials, Material Systems and Production Processes  
(prof. Ing. Jiří Kazelle, CSc.)

## Laboratories

**Laboratory of Alkaline Electrochemical Power Sources** (research and development of modern alkaline accumulators (Ni-Cd, Ni-MH) and oxygen-hydrogen fuel cells with alkaline or polymer electrolyte, doc. Ing. Vítězslav Novák, Ph.D.)

**Laboratory of Diagnostics of Photovoltaic Panels** (testing of photovoltaic panels and systems in precisely defined conditions, doc. Ing. Jiří Vaněk, Ph.D.)

**Laboratory of Diagnostic Methods** (instruction in diagnostics of materials and testing methods, experiments for semester projects, Bachelor and Master theses, Ing. Kristýna Jandová, Ph.D.)

**Laboratory of Electrical Insulation Materials** (instruction in diagnostic methods in electrical engineering and climatology, experimental small current measurements and diagnostics of electroinsulation liquids, doc. Ing. Vítězslav Novák, Ph.D.)

**Laboratory of Electrode Materials 1,3** (preparation of specimens and electrode mass for Li-ion, Ni-Cd, Ni-MH and Ni-Zn batteries and supercondensators, thin-film deposition by chemical methods, preparation of polymer gel electrolytes, doc. Ing. Marie Sedlaříková, CSc.)

**Laboratory of Electrode Materials 2** (research and measurement of materials for electrochemical sources, mainly Li-ion, Ni-Cd, Ni-MH and Ni-Zn batteries, supercondensators and polymer gel electrolytes for Li-pol batteries, doc. Ing. Marie Sedlaříková, CSc.)

**Electrometric Measurement Laboratory 1** (analysis of the properties of dielectric materials by measurements on special devices, prof. RNDr. Petr Vanýsek, CSc.)

**Electrometric Measurement Laboratory 2** (diagnostic analysis of the properties of dielectric materials, samples from commercial producers are measured on current measuring devices, Ing. Helena Polsterová, CSc.)

**Laboratory of Electrotechnical Materials 1** (analysis of electrotechnical materials, laboratory exercises for Materials and Technical Documentation, Electrotechnology for FME, Ing. Petr Křivík, Ph.D.)

**Laboratory of Electrotechnical Materials 2** (computer modelling and measurement of parameters of semiconductor and dielectric materials, instruction in Electrotechnical Materials and Manufacturing, Material Structure and Properties, Ing. Jiří Libich, Ph.D.)

**Laboratory of Photovoltaic Systems** (testing of electrical properties of photovoltaic cells; doc. Ing. Jiří Vaněk, Ph.D.)

**Laboratory of Microscopy Techniques** (research of systems for detection of signal electrons, specimen observations in scanning electrode microscope under higher pressure in specimen chamber (VP-SEM) and microscope of atomic forces (AFM), Ing. Pavel Čudek, Ph.D.)

**Laboratory of Renewable Sources 1** (testing of electrical and mechanical properties of photovoltaic cells, laboratory instruction in Renewable Energy Sources and Alternative Energy Sources, doc. Ing. Jiří Vaněk, Ph.D.)

**Laboratory of Renewable Sources 2** (testing of electrical and mechanical properties of photovoltaic cells, laboratory instruction in Renewable Energy Sources and Alternative Energy Sources, Ing. Jiří Libich, Ph.D.)

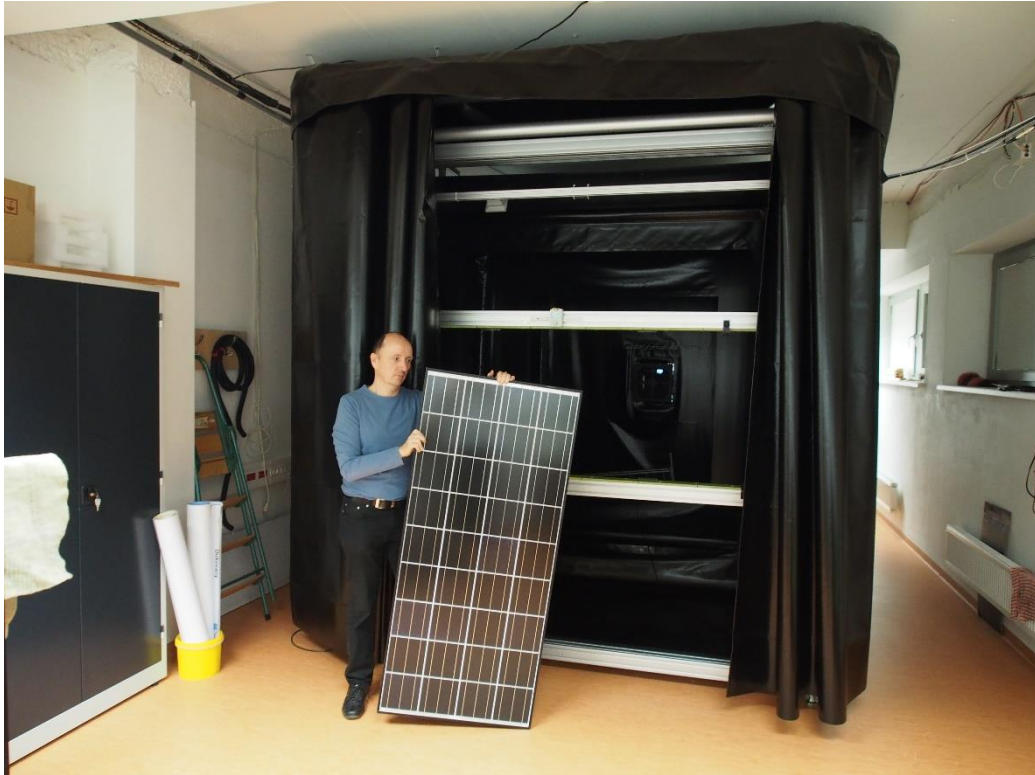
**Laboratory of Lead-Acid Accumulators 1,2** (research and development of new applications of lead-acid accumulators for hybrid electromobility and as renewable energy storage, doc. Ing. Petr Bača, Ph.D.)

**Laboratory of Printed Circuit and Surface Mount Technology** (instruction in Printed Circuit and Surface Mount Technology, Ing. Jiří Starý, Ph.D.)

**Laboratory of Soldering** (research and development of lead-free soldered connections reliability and surface wettability, instruction in Mounting and Assembly Technology, Ing. Jiří Starý, Ph.D.)

**Laboratory of Printed Circuits, PROTOCAD and Photoprocesses** (laboratory production of printed circuit boards, preparation of microsections, instruction in Printed Circuits and Surface Mounting Technology, Mounting and Assembly Technology, Ing. Jiří Starý, Ph.D.)

**Laboratory of Biomaterials** (testing of the content and PH of ions in solutions, corrosion measurements, instruction in Materials and Components for Biomedical Engineering, Ing. Tomáš Kazda, Ph.D.)



The complete VA characteristics of photovoltaic panels is measured by means of a short light impuls of defined length, intensity and spectrum



## 7.5 Department of Physics

### **prof. Ing. Lubomír Grmela, CSc.**

Head

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### **Professors**

prof. Ing. Lubomír Grmela, CSc.  
prof. Ing. Pavel Koktavý, CSc., Ph.D.  
prof. RNDr. Ing. Josef Šíkula, DrSc.

### **Associate Professors**

doc. RNDr. Milada Bartlová, Ph.D.  
doc. Ing. Karel Liedermann, CSc.  
doc. Ing. Petr Sedlák, Ph.D.  
doc. Ing. Vlasta Sedláková, Ph.D.

### **Lecturers**

Ing. Jitka Brüstlová, CSc., RNDr. Pavel Dobis, CSc., Ing. Vladimír Holcman, Ph.D., Ing. Robert Macků, Ph.D., Ing. Pavel Škarvada, Ph.D.

### **Research Workers**

Ing. Jiří Majzner, Ph.D., Ing. Pavel Tofel, Ph.D., Mgr. Dinara Sobola, Ph.D., Ing. Ondřej Šik, Ph.D.

### **Ph.D. Students**

Ing. Adam Gajdoš, Ing. Michal Jurčík, Ing. Martin Kupařowitz, Ing. Jan Mucha, Ing. Nikola Papež, Ing. Josef Pokorný, Ing. Milan Spohner, Ing. L'ubomír Škvarenina, Mgr. Rashid Dallaev, Ing. Marek Vondra

### **Administrative and Technical Staff**

Mgr. Naděžda Bogatyreva, Ph.D., Ing. Pavel Kaspar, Ph.D., Ing. Alexandr Knápek, Ph.D., Miroslav Sadovský, Ing. Petr Sadovský, Ph.D., Ing. Milan Spohner, Ing. Jiří Šicner, Ph.D., Ing. L'ubomír Škvarenina, Ing. Tomáš Trčka, Ph.D., Ing. Alena Václavíková, Radimír Vrba

### **Main Interests**

The department provided tuition in Bachelor's courses Physics 1 and Physics 2 (full-time and part-time study), Physics for students of information technology, Physics 1 and 2 for the programme Biomedical Technology and Bioinformatics, Physics 1 for Audio Engineering, and Physics in Electrical Engineering H-AEI and a Physics seminar for FEEC and FIT. The courses offered in the Master programme included Nanotechnology, Modern Physics, Solid Phase Physics and Non-Destructive Diagnostics, Physics of Dielectrics for FEEC, Interfaces and Nanostructures and Spectroscopic Methods for Non-Destructive Diagnostics (for FEEC) and Optics (for FIT) for Ph.D. programme.

Assignments for Physical Practice and multimedia study materials were updated and innovated for instruction in the computer room and for self-study.

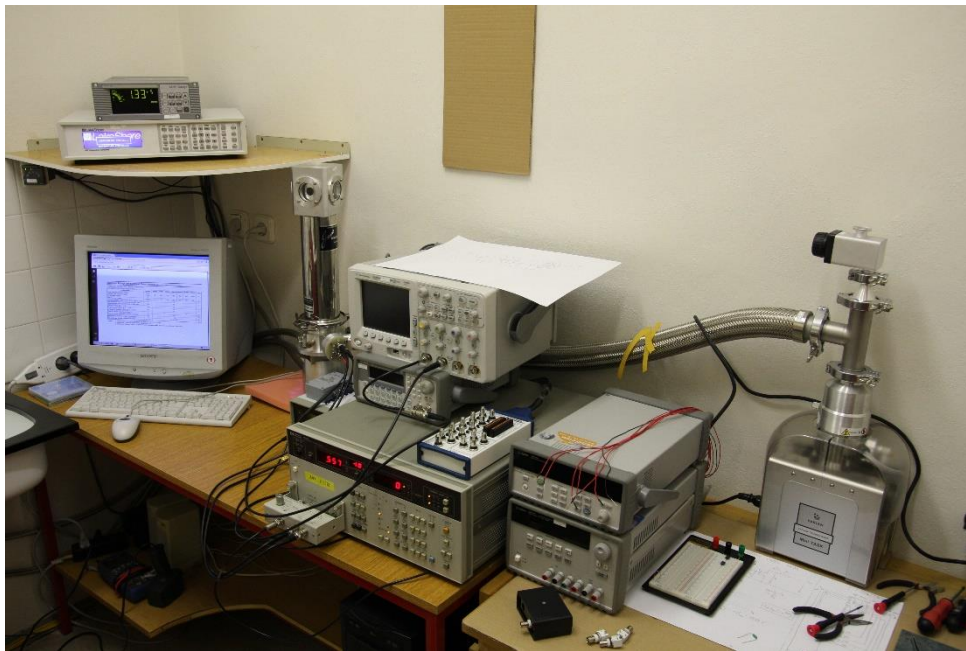
Research was centred on basic and applied research of the physical parameters of semiconductors and dielectric materials and components and nanosensors. The main areas of interest were noise spectroscopy, local characterisation with nanodistinction, measurement of nonlinearities, design of quality and reliability indicators and dielectric spectroscopy. Outstanding results were achieved in research on the characteristics of acoustic and electromagnetic emission sensors.

The department cooperated with European and Japanese laboratories in the field of noise spectroscopy and nanotechnology, and in research on dielectrics, with American universities in Orlando and Rapid City in nanometrology,

and with leading Czech laboratories in the development and enhancement of the parameters of CdTe radiation detectors.

Contract research has been expanding. Our major partners have been the world leading companies On Semiconductor, AVX, Kyocera, Smurfit Kappa and Konštrukta Industry, a.s.

Our top laboratory equipment includes electron microscope LYRA with 1 nm distinction, analyser Alfa Novocontrol for measurement of dielectric spectra over 12 frequency orders, infrared spectrometer-Nicolet, workstation for experimental study of semiconductor and dielectric samples at low temperatures (up to 10K), optical spectroscopy by SNOM, spectral analysers of signals for the entire technical frequency band, the automatic meter of characteristics and non-linearities Keithley 4200 and a vacuum system for research on autoemission cathodes in electron microscopy.



Laboratory of noise diagnostics

## Major Achievements

The department participated in the Regional Centre for Research and Development CZ.1.05/2.1.00/03.0072 'Centre for Sensor, Information and Communication Systems' (SIX). Two research laboratories were included in the project 'Laboratory of Electron Microscopy and Laboratory of Nanometrology'. The department's staff cooperated in the project CEITEC 2020 (LQ1601) in the frame of the 'National Sustainability Programme II'.

In 2018, work was under way on: a GAČR project, a TAČR project, an INWITE project, a specific research project of BUT and 13 economic contracts with industries. The GAČR project was focused on the research of electrochemical gas sensors, the TAČR project dealt with automatized removal of undesirable particles. The INWITE project dealt with wireless technologies research. The BUT grant researched the methodology of enhancing the quality of optoelectronic materials and components.

Commercial contracts dealt with measuring and analysis of FET transistor parameters, automotive industry coils diagnostics, optimisation of curing process in powder coating, development and realisation of multifunctional transportation device, device for aluminium alloy process analysis, development of control system in telecommunication switchboard and diagnostics system for monitoring and distant management of heat exchangers.

In 2018, department staff members published 9 papers in impact journals, 6 publications in the database SCOPUS, 17 papers in international conferences, 3 publications in peer-reviewed journals and 8 research reports.

## Major Research Projects

**Effect of Polymer Electrolyte Crystallinity and Carbon Electrode Morphology on Charge Transport and its Fluctuations in Electrochemical Gas Sensors – GAČR 18-19104S,**

Investigator: Petr Sedlák

**Automatized Removal System of Undesirable Particles - TJ01000332,**

Investigator: Vladimír Holcman

**Interdisciplinary Research on Wireless Technology – LO1401 (INWITE)**

Investigators: Lubomír Grmela, Vladimír Holcman

### Selected Publications

DALLAEV, R.; STACH, S.; TALU, S.; SOBOLA, D.; MÉNDEZ-ALBORES, A.; TREJO, G.; GRMELA, L. Stereometric Analysis of Effects of Heat Stressing on Micromorphology of Si Single Crystals. *Silicon*, 2019, vol. 11, no. 1, p. 1-15. ISSN: 1876-990X.

BARTLOVÁ, M.; KLOC, P.; AUBRECHT, V.; BOGATYREVA, N. Influence of metal vapours on radiation characteristics of air arc plasmas. *Plasma Physics and Technology*, 2018, vol. 6, no. 1, ISSN: 2336-2626.

POKORNÝ, J. Silicon in spectroscopic data of world databases. *Plasma Physics and Technology*, 2018, vol. 5, no. 3, p. 117-121. ISSN: 2336-2626.

GAJDOŠ, A.; ŠKARVADA, P.; MACKŮ, R.; PAPEŽ, N.; ŠKVARENINA, L.; SOBOLA, D. Isolation and optoelectronic characterization of Si solar cells microstructure defects. *Journal of Physics: Conference Series*, 2018, vol. 1124, no. 4, p. 1-6. ISSN: 1742-6596.

PAPEŽ, N.; SOBOLA, D.; GAJDOŠ, A.; ŠKVARENINA, L.; MACKŮ, R.; ELIÁŠ, M.; NEBOJSA, A.; MOTÚZ, R. Surface morphology after reactive ion etching of silicon and gallium arsenide based solar cells. *Journal of Physics: Conference Series*, 2018, vol. 1124, no. 4, p. 165-171. ISSN: 1742-6596.

BIJALWAN, V.; TOFEL, P.; HOLCMAN, V. Grain size dependence of the microstructures and functional properties of (Ba<sub>0.85</sub>Ca<sub>0.15-x</sub>Cex) (Zr<sub>0.1</sub>Ti<sub>0.9</sub>) O<sub>3</sub> lead-free piezoelectric ceramics. *Journal of Asian Ceramic Societies*, 2018, vol. 6, no. 4, p. 384-393. ISSN: 2187-0764.

KNÁPEK, A.; HORÁČEK, M.; CHLUMSKÁ, J.; KUPAROWITZ, T.; SOBOLA, D.; ŠIKULA, J. PREPARATION AND NOISE ANALYSIS OF POLYMER GRAPHITE CATHODE. *METROL MEAS SYST*, 2018, vol. 25, no. 3, p. 451-458. ISSN: 0860-8229.

TALU, S.; MOROZOV, I.; SOBOLA, D.; ŠKARVADA, P. Multifractal Characterization of Butterfly Wings Scales. *BULLETIN OF MATHEMATICAL BIOLOGY*, 2018, vol. 80, no. 11, p. 2856-2870. ISSN: 0092-8240.

PAPEŽ, N.; HOLCMAN, V. Efektivní zpracování dat z mikroskopie skenující sondou. *Jemná mechanika a optika*, 2018, č. 63, s. 180-182. ISSN: 0447-6441.

ŠKVARENINA, L.; MACKŮ, R. Noise and optical spectroscopy of single junction silicon solar cell. *METROL MEAS SYST*, 2018, vol. 25, no. 2, p. 303-316. ISSN: 0860-8229.

ŠIK, O.; ŠKVARENINA, L.; CAHA, O.; MORAVEC, P.; ŠKARVADA, P.; BELAS, E.; GRMELA, L. Determining the sub-surface damage of CdTe single crystals after lapping. *JOURNAL OF MATERIALS SCIENCE-MATERIALS IN ELECTRONICS*, 2018, vol. 29, no. 11, p. 9652-9662. ISSN: 0957-4522.

BAI, Y.; TOFEL, P.; HADAŠ, Z.; SMILEK, J.; LOŠÁK, P.; ŠKARVADA, P.; MACKŮ, R. Investigation of a cantilever structured piezoelectric energy harvester used for wearable devices with random vibration input. *MECHANICAL SYSTEMS AND SIGNAL PROCESSING*, 2018, vol. 106, no. 106, p. 303-318. ISSN: 0888-3270.

TALU, S.; YADAV, R.; ŠIK, O.; SOBOLA, D.; DALLAEV, R.; SOLAYMANI, S.; MAN, O. How topographical surface parameters are correlated with CdTe monocrystal surface oxidation. *MATERIALS SCIENCE IN SEMICONDUCTOR PROCESSING*, 2018, no. 85, p. 15-23. ISSN: 1369-8001.

PAPEŽ, N.; SOBOLA, D.; ŠKVARENINA, L.; ŠKARVADA, P.; HEMZAL, D.; TOFEL, P.; GRMELA, L. Degradation analysis of GaAs solar cells at thermal stress. *Applied Surface Science*, 2018, no. 461, p. 212-220. ISSN: 0169-4332.

ABDULAGATOVA, I., RAMAZANOV Sh.M., DALLAEV, R.S., MURLIEV E.K., PALCHAEV D.K., RABADANOV M.Kh., ABDULAGATOV I.M. Atomic Layer Deposition of AlN Using Tris(diethylamido)aluminum with Ammonia or Hydrazine. *Russian Microelectronics*, 2018, vol. 47, no. 2, p. 118-130. ISSN: 1063-7397.

ŠIK, O.; BÁBOR, P.; POLČÁK, J.; BELAS, E.; MORAVEC, P.; GRMELA, L.; STANĚK, J. Low Energy Ion Scattering as a depth profiling tool for thin layers - Case of bromine Methanol etched CdTe. *Vacuum*, 2018, no. 152, p. 138-144. ISSN: 0042-207X.

GAJDOŠ, A.; ŠKARVADA, P.; ŠKVARENINA, L. Charakterizace a izolace defektů monokrystalických křemíkových solárních článků na mikroskopické úrovni. *Elektrorevue - Internetový časopis (<http://www.elektrorevue.cz>)*, 2018, roč. 20, č. 1, s. 14-18. ISSN: 1213-1539.

DAMKOVÁ, J.; CHVÁTAL, L.; JEŽEK, J.; OULEHLA, J.; BRZOBOHATÝ, O.; ZEMÁNEK, P. Enhancement of the 'tractor-beam' pulling force on an optically bound structure. *Light: Science and Applications*, 2018, no. 7, p. 1-6. ISSN: 2047-7538.

### Bachelor's Courses

Physics 1

(RNDr. Pavel Dobis, CSc.)

Physics 2

(doc. RNDr. Milada Bartlová, Ph.D.)

Physics in Electrical Engineering (H-AEI)

(doc. Ing. Karel Liedermann, CSc.)

Physics for Audio Engineering (J-AUD)

(prof. Ing. Pavel Koktavý, CSc., Ph.D.)

Physics 1 (T-IBP)

(prof. Ing. Lubomír Grmela, CSc.)

Seminar of Physics BFYS

(Ing. Jitka Brüstlová, CSc.)

Seminar of Physics IFS

(doc. RNDr. Milada Bartlová, Ph.D.)

### Master's Courses

Solid State Physics

(prof. Ing. Pavel Koktavý, CSc., Ph.D.)

Modern Physics

(doc. Ing. Karel Liedermann, CSc.)

Physical Optics for IT Students

(doc. Ing. Petr Sedlák, Ph.D.)

Nanotechnology

(Ing. Pavel Škarvada, Ph.D., Ing. Robert Macků, Ph.D.)

Non-Destructive Diagnostics and Physics of Dielectrics

(Ing. Vladimír Holcman, Ph.D.)

### Ph.D. Courses

Junctions and Nanostructures

(Ing. Robert Macků, Ph.D.)

Spectroscopic Methods for Non-destructive Diagnostics

(doc. Ing. Karel Liedermann, CSc.)

Optics

(doc. Ing. Petr Sedlák, Ph.D.)



Laboratory of Physics

### Laboratories

**Czech Electronic Noise Research Laboratory - CNRL** (low-frequency noise, noise spectroscopy, development of non-destructive diagnostic methods and indicators of the reliability of materials and microelectronic components, research of sensors and acoustic and electromagnetic emission methods, Josef Šikula)

**Laboratory of Dielectric Relaxation Spectroscopy** (dielectric relaxation spectroscopy, monitoring of molecular dynamics of dielectric materials, Karel Liedermann)

**Laboratory of Physics** (instruction in Physics 1, Physics 2 and Physics for Information Technology, Physics for Audio Engineering, laboratory exercises for Physics of Solids and Non-Destructive Diagnostics of Materials, Semiconductors and Physics of Dielectrics, Pavel Dobis)

**Laboratory of Optical Nanometrology – SIX** (contactless investigation of local optical and electrical characteristics of optoelectronic and photonic structures with horizontal superresolution by scanning optical near field microscopy, Vladimír Holcman)

**Laboratory of Noise Diagnostics** (research of fluctuation processes in solids, mainly electronic components, electroinsulation and construction materials, diagnostics of semiconductor components and electroinsulation materials by partial charges using electromagnetic and acoustic emissions for diagnostics of fissures, Pavel Koktavý)

**Laboratory of Electron Microscopy** (equipped with the latest electron microscope LYRA with 1nm resolution, Lubomír Grmela)

**Laboratory of Noise Dielectric Spectroscopy and Electromagnetic Emission – SIX** (experimental and theoretical research of stochastic processes and carrier transport as a basis for novel advanced technologies, nanosensorics, development of non-destructive diagnostics and modern methods of electronic components and structures service time estimation, Lubomír Grmela).



## 7.6 Department of Languages

### Ing. Martin Jílek

Head

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### Associate Professor

doc. PhDr. Milena Krhutová, Ph.D.

### Lecturers

PaedDr. Alena Baumgartnerová, PhDr. Petra Fílová, Ph.D., PhDr. Marcela Borecká, Mgr. et Ing. Eva Ellederová, Kenneth Froehling, M.A., Mgr. Jaromír Haupt, Ph.D., Mgr. Jana Jašková, Ph.D., Ing. Martin Jílek, Mgr. Miroslav Kotásek, Ph.D., Mgr. Petra Langerová, Mgr. et Mgr. Hana Mihai, Mgr. Šárka Rujbrová, Mgr. Pavel Sedláček, PhDr. Milan Smutný, Ph.D., Mgr. Magdalena Šedrllová, Mgr. et Bc. Dagmar Šťastná, Mgr. Agata Walek, Mgr. Petra Zmrzlá, Ph.D., Mgr. Marie Žouželková Bartošová

### Administrative and Technical Staff

Miroslava Purová

### Main Interests

In 2018 the department provided tuition for three faculties – Faculty of Electrical Engineering and Communication, Faculty of Business and Management and Faculty of Information Technology. Another group of graduates in the philological study area ‘English in Electrical Engineering and Informatics’ completed their studies. The department is responsible for language education in Bachelor, Master and Ph.D. study programmes at all three faculties.

The programme ‘English in Electrical Engineering and Informatics’ provides education in the theory of linguistics and specific language skills for professionals in various disciplines of electrical engineering and information technology. The programme, unique in the Czech Republic, educates graduates with specific interdisciplinary knowledge and skills required in the current job market. The subjects Introduction in Linguistics, Professional Style in Czech and English, Practical English 1 – 5, Grammar Structures, Discourse Analysis, Linguistics Pragmatics, Translation Exercises were launched and instruction materials produced. The department provides instruction in professional English for all specialisations in the Bachelor and Master programmes EECR, the Ph.D. programme and the interdisciplinary programmes BT-BIO and AUDIO. The courses are focused on professional English in electrical engineering and information technology, social skills and competences in technical as well as commercial language.

A new topic dealt with in research and often in Bachelor theses is the influence of English on the Czech language and on the methods of communication in general, the impact of IT on various areas of everyday life, professional as well as free time activities. Research of English as a language of profession continued and its results have been gradually implemented in the teaching materials. Professional discourse analysis considered not only the pragmatic approach, but also the sociolinguistic approach taking into account the environment where English is spoken as a first or a second language.

In 2018, the department also offered optional courses on practical economy, psychology and pedagogy. Apart from daily studies it also gives an opportunity to get the Certificate of Educational Competence in the "Complementary Study Programme in Education for University Graduates and Vocational Education Teachers" which entitles graduates to teach at any secondary school in the Czech Republic. The Complementary Study Programme in Education for University Graduates and Vocational Education Teachers is successfully reaccredited by the MŠMT within the Further Pedagogical Staff Education Framework.





Courses of foreign languages and professional English are incorporated in all study programmes

### Major Achievements

The department coordinated successfully instruction at three faculties – Faculty of Electrical Engineering and Communication, Faculty of Information Technology and Faculty of Business and Management. Each semester the department provides instruction for 3,500 students. This requires effective testing and posting of study materials in the system Moodle.

Supported by the BUT project „Development of Study Environment“ the department could buy tablets and notebooks for electronic testing. Electronic tests were made and used in all Faculty of Business and Management courses (Business English).

The chief objective of the department in 2018 was the continuation of the Bachelor study programme ‘English in Electrical Engineering and Informatics’, mainly preparation of final examinations and defence of Bachelor theses in the 3rd year of study and related instruction materials, examination regulations and topics. Language courses offered in this programme are based on our long-term research on the specific discourse in English in electrical engineering and communication technologies. Research results have been incorporated in the courses and in specific methods that this type of instruction requires. A new line of research is forming of compound technical terms and the producer’s strategy in transmission of professional information and reality structuring in forming the terms.

Staff members visited universities in Great Britain (University of Nottingham) and Croatia (University of Zagreb) where they focused on interdisciplinary programmes connecting technical specialisations and professional English.

### Selected Publications

KOTÁSEK, M. Český literární kyberpunk a otázka žánru. *Ceska Literatura*, 2018, roč. 66, č. 3, s. 395-422. ISSN: 0009-0468.

SMUTNÝ, M. Terminology as a Specific Carrier of Information. *Prague Journal of English Studies*, 2018, vol. 7, no. 1, p. 143-160. ISSN: 1804-8722.

ELLEDEROVÁ, E. Design-based Research of a Coursebook for ESP: The Concept and Research Methodology. In *Research in Foreign Language Teaching and Learning / Fremdsprachenlehr- und Fremdsprachenlernforschung*. Janíková, V.; Hanušová, S. Brno: Masarykova univerzita, 2018. p. 69-81. ISBN: 978-80-210-8869-6.

ELLEDEROVÁ, E. English for Specific Purposes Materials Development: Design-Based Research Methodology. *Folio - Journal of the Materials Development Association*, 2018, vol. 18, no. 2, p. 8-13. ISSN: 1357-406X.

ELLEDEROVÁ, E. Design-Based Research of an ESP Coursebook: Results of a Questionnaire Survey. *GRANT Journal*, 2018, vol. 7, no. 1, p. 27-31. ISSN: 1805-0638.

MIHAL, H. Lexis creating a human dimension of a destination: Comparative discourse analysis of English and French parallel texts. In 14th ESSE Conference Abstracts for 14th Conference of the European Society for the Study of English (ESSE), 29 Aug – 2 Sep 2018, edited by Jiří Rambousek, Ivona Schöfrová and Jana Chamonikolasová, Masaryk University, Brno, pp 33-34. ISBN 978-80-210-9015-6 (brož. vaz.), ISBN 978-80-210-9016-3 (online: pdf)

FROEHLING, K. Review of "Canada as a Selective Power: Canada's Role and International Position after 1989" by Marcin Gabrys and Tomasz Soroka in Central European Journal of Canadian Studies, Masaryk University, vol. 12/13, 2018, pp. 195-196. ISBN 978-80-210-9023-1

FROEHLING, K. "The Ogilvie Cook Book, Canadian Cuisine And a Trip Down Memory Lane," in 14th ESSE Conference Abstracts for 14th Conference of the European Society for the Study of English (ESSE), 29 Aug – 2 Sep 2018, edited by Jiří Rambousek, Ivona Schöfrová and Jana Chamonikolasová, Masaryk University, Brno, p. 106. ISBN 978-80-210-9015-6(brož. vaz.), ISBN 978-80-210-9016-3 (online: pdf).

## Bachelor's Courses

Practical English  
(Mgr. Pavel Sedláček, Mgr. et Ing. Eva Ellederová,  
Mgr. Petra Langerová, PhDr. Milan Smutný, Ph.D.)

Introduction to Linguistics  
(PhDr. Milan Smutný, Ph.D.)

Grammar Structures  
(PaedDr. Alena Baumgartnerová)

Professional Styles in Czech and English  
(Mgr. Miroslav Kotásek, Ph.D.)

Language as Discourse in Science and Technology  
(doc. PhDr. Milena Krhutová, Ph.D.)

Pragmatics  
(Mgr. Jaromír Haupt, Ph.D.)

Discourse Analysis  
(Mgr. Petra Zmrzlá, Ph.D.)

Methodology  
(Mgr. Radek Vogel, Ph. D.)

Translation Seminar  
(Mgr. Radek Vogel, Ph. D.)

English for IT  
(Mgr. Magdalena Šedrllová)

English for Engineering  
(Mgr. Jaromír Haupt, Ph.D.)

Cultural Studies I  
(Mgr. Pavel Sedláček)

Cultural Studies II  
(Kenneth A. Froehling, M.A.)

English for Bachelors – Pre-Intermediate 1  
(PaedDr. Alena Baumgartnerová)

English for Bachelors – Pre-Intermediate 2  
(PaedDr. Alena Baumgartnerová)

English for Bachelors – Intermediate 1  
(Mgr. Agata Walek)

English for Bachelors – Intermediate 2  
(Mgr. Pavel Sedláček)

English for Europe  
(PhDr. Milan Smutný, Ph.D.)

English for Business Communication  
(Mgr. Marie Žouželková Bartošová)

Professional Ethics  
(Ing. Martin Jílek)

Engineering Pedagogy and Didactics  
(Ing. Martin Jílek)

Culture of Speech and the Generation of Texts  
(Ing. Martin Jílek)

Professional English for Electr. Engineering and Comp.  
Science (PhDr. Milan Smutný, Ph.D.)

Laboratory Didactics  
(Ing. Martin Jílek)

Bookkeeping for Managers  
(Ing. Martin Jílek)

German for Lower Intermediate  
(Mgr. Pavel Sedláček)

German for Intermediate  
(Mgr. Pavel Sedláček)

German for Beginners  
(Mgr. Pavel Sedláček)

Pedagogical psychology  
(Ing. Martin Jílek)

Double-Entry Bookkeeping  
(Ing. Martin Jílek)

Russian for Lower Intermediate  
(PaedDr. Alena Baumgartnerová)

Russian for Beginners  
(PaedDr. Alena Baumgartnerová)

Spanish for Lower Intermediate  
(PhDr. Marcela Borecká)

Spanish for Beginners  
(PhDr. Marcela Borecká)

## Master's Courses

English for Europe  
(PhDr. Milan Smutný, Ph.D.)

English for Life  
(Mgr. Pavel Sedláček, Kenneth Froehling, M.A.)

Professional Ethics  
(Ing. Martin Jílek)

Culture of Speech and the Generation of Texts  
(Ing. Martin Jílek)

Professional English for Electr. Engineering and Comp.  
Science (PhDr. Milan Smutný, Ph.D.)

Business English  
(Mgr. et Bc. Dagmar Šťastná)

Professional English  
(Mgr. Jaromír Haupt, Ph. D.)

Bookkeeping for Managers  
(Ing. Martin Jílek)

German for Lower Intermediate  
(Mgr. Pavel Sedláček)

German for Intermediate Students  
(Mgr. Pavel Sedláček)

German for Beginners  
(Mgr. Pavel Sedláček)

Double-Entry Bookkeeping  
(Ing. Martin Jílek)

Russian for Beginners  
(PaedDr. Alena Baumgartnerová)

Spanish for Beginners  
(PhDr. Marcela Borecká)

**Ph.D. Courses**

English for FIT post-graduates  
(Mgr. Petra Zmrzlá, Ph.D.)

English for FEEC post-graduates  
(doc. PhDr. Milena Krhutová, Ph.D.)

## 7.7 Department of Mathematics

### doc. RNDr. Zdeněk Šmarda, CSc.

Head

Technická 2848/8  
61600 Brno 16  
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fax: 541 143 392  
e-mail: umat@feec.vutbr.cz



### Professor Emeritus

prof. RNDr. Václav Havel, DrSc.

### Professors

prof. RNDr. Josef Diblík, DrSc.  
prof. RNDr. Jan Chvalina, DrSc.  
prof. Alexandra Rodkina, DrSc.

### Associate Professors

doc. RNDr. Jaromír Baštinec, CSc.  
doc. RNDr. Dana Hliněná, Ph.D.  
doc. RNDr. Edita Kolářová, Ph.D.  
doc. RNDr. Martin Kovár, Ph.D.  
doc. RNDr. Zdeněk Šmarda, CSc.

### Lecturers

RNDr. Petr Fuchs, Ph.D., Ing. Michal Fusek, Ph.D., Mgr. Irena Hlavičková, Ph.D., RNDr. Vlasta Krupková, CSc., Mgr. Michal Novák, Ph.D., Mgr. Josef Rebenda, Ph.D., RNDr. Zdeněk Svoboda, CSc., Mgr. Jiří Vítovec, Ph.D.

### Ph.D. Students

Ing. Marie Klimešová, Hanna Demchenko, Mgr. Jan Šafařík, Mgr. Kristýna Mencáková, Ing. Zuzana Piskořová, Mgr. David Staněk, RNDr. Bedřich Smetana, Mgr. Gabriela Vanžurová

### Administrative and Technical Staff

Eva Šimečková

### Main Interests

The department provided instruction in mathematical subjects in Bachelor and Master degree programmes in both the attended and combined form of study. The department also provided instruction in two Doctoral degree programmes and tuition in Bachelor degree study programme at the Faculty of Information Technology. Research was conducted on the basis of contracts with international partners - the team of Professor D. Khusainov, Institute of Dynamical System Modelling, Faculty of Cybernetics, Kiev State University, the team of Professor I. Dzalladova, Institute of Mathematics, Faculty of Information Systems and Technologies, Kiev National Economic University.

The department cooperated with leading world experts – Professor Leonid Berezansky, Beer-Sheva University, Israel, Professor S. Stevic, Serbian Academy of Sciences, Belgrade, Professor I. Cristea, School of Applied Sciences, University of Nova Gorica, Slovenia.

Research in the area of dynamical systems focused on the study of stability of linear differential and difference equations with feedback, relative controllability of higher order discrete systems with one delay and optimal stabilisation of delayed differential equations. Furthermore, the research workers of the department studied numerical algorithms for finding solutions of fractional differential equations in the sense of Caputo fractional derivative. Also, variance approach to the theory of stochastic partial differential equations (SPDR) describing the transmission process with random parameters, modelling cylindrical Wiener process including numerical solutions of SPDR and description of statistical properties of SPDR solutions.

In the area of statistical methods the research workers of the department focused on censored probability distributions with censorship of type I, especially on Weibull distribution and its special cases. Potential to use censored distributions for modelling hydrological data was also studied.

The research of algebraic hyperstructures covered several areas: generalisation of some topics of ideal theory for Krasner hyperrings, study of EL-hyperstructures in contexts when the relation is not antisymmetric, and the effort to reduce assumptions needed to construct specialised hyperstructures (especially of EL-type). Also, the issue of cyclicity in hypergroups and the issue of ideals in lower BCK semilattices and several problems of hypermodules in Krasner hyperrings were studied. Finally, EL-hyperstructures whose carrier set is fragmented, were studied.



Girls can also be interested in mathematics.

### Major Achievements

The research team dealing with continuous and discrete dynamics participates in the project 'European Centre of Excellence OP VAVpl CEITEC', group 'Cybernetics for Material Sciences focused on dynamic systems analysis'. The team was involved in two GAČR projects and one specific research project.

With the help of Ljapunov functions new results concerning exponential stability of linear differential systems have been proved. In the area of relative controllability of linear discrete equations with one delay a criterion of Kalman-type controllability was found. Also, the research team was able to establish the moment starting from which the system is controllable. In the area of global solutions the research showed existence of such solutions on the whole real axis. The results were proved exactly with the help of monotonic sequences and Schauder principle. In the area of optimal stabilisation of delayed differential equations a Malkin-type criterion was found. This criterion was applied on nonlinear differential equations with constant coefficients and specific criteria were derived. Furthermore, characteristics of variability of stochastic responses in hybrid circuits consisting of parts with cogested and sparsed parameters were given, and a numerical model of the cyllindric Wiener proces, necessary for stating statistic properties of SPDR solutions was derived. In the area of fractional differential equations a numerical algorithm was proposed and it was applied on solvability of fractional Lane-Emden equations and stiff systems. In the area of statistical methods, methods for censored observations were successfully applied on analysis of elementary (EC) and organic (OC) carbon in atmosphere.

In the area of algebraic hyperstructure theory several results concerning EL-hyperstructures, were given. These primarily focused on increasing applicational potential of the theory (reduction of assumptions, newly also application on fragmented sets). A mathematical model of underwater wireless sensor networks data aggregation was constructed; this model is based on algebraic hyperstructures which make use of binary relations. The rather complicated issue of cyclicity in hypergroups was described in a detailed way. This result clarified the so far inconsistent terminology and makes further explorations of this area, based on solid foundations, possible.

In 2018 the department staff published 13 papers in impact journals and 17 papers in international conference proceedings.



## Major Research Projects

### Dynamic Systems Identification on Time Scales

Investigator: Josef Diblík

### Representation of Dynamic Systems with Focus on Algebraic and Topological Structure

Investigator: Zdeněk Šmarda

## Selected Publications

KOLÁŘOVÁ, E.; BRANČÍK, L. Stochastic differential equations describing systems with coloured noise. Tatra Mountains Mathematical Publications, 2018, vol. 1, no. 71, p. 99-107. ISSN: 1210-3195.

STEVÍČ, S.; IRIČANIN, B.; KOSMALA, W.; ŠMARDA, Z. Representation of solutions of a solvable nonlinear difference equation of second order. Electronic Journal of Qualitative Theory of Differential Equations, 2018, vol. 2018, no. 95, p. 1-18. ISSN: 1417-3875.

STEVÍČ, S.; IRIČANIN, B.; KOSMALA, W.; ŠMARDA, Z. Note on the bilinear difference equation with a delay. Mathematical Methods in the Applied Sciences, 2018, vol. 41, no. 18, p. 9349-9360. ISSN: 1099-1476.

NOVÁK, M.; KŘEHLÍK, Š.; CRISTEA, I. Cyclicity in EL-hypergroups. Symmetry, 2018, vol. 10, no. 11, p. 1-13. ISSN: 2073-8994.

NOVÁK, M.; KŘEHLÍK, Š. EL-hyperstructures revisited. SOFT COMPUTING, 2018, vol. 2018, no. 21, p. 7269-7680. ISSN: 1432-7643.

DIBLÍK, J.; MEDINA, R. Dominant and subdominant positive solutions to generalized Dickman equation, Applied Mathematics and Computations. APPLIED MATHEMATICS AND COMPUTATION, 2018, vol. 2018, no. 320, p. 169-186. ISSN: 0096-3003.

MOURALOVÁ, K.; BENEŠ, L.; ZAHRADNÍČEK, R.; BEDNÁŘ, J.; HRABEC, P.; PROKEŠ, T.; HRDÝ, R. Analysis of cut orientation through half-finished product using WEDM. Materials and Manufacturing Processes, 2018, vol. 33, no. 16, p. 1-11. ISSN: 1532-2475.

DIBLÍK, J.; GALEWSKI, M.; KONIORCZYK, M.; SCHMEIDEL, E. An application of a diffeomorphism theorem to Volterra integral operator. Differential and Integral Equations, 2018, vol. 31, no. 7-8, p. 621-642. ISSN: 0893-4983.

DIBLÍK, J.; DEMCHENKO, H.; BAŠTINEC, J.; KHUSAINOV, D. Exponential Stability of Linear Discrete Systems with Multiple Delays. Discrete Dynamics in Nature and Society, 2018, vol. 2018, no. 2018, p. 1-7. ISSN: 1607-887X.

SMETANA, B.; CHVALINA, J. Algebraic Spaces and Set Decompositions. Ratio Mathematica, 2018, no. 34, p. 67-76. ISSN: 1592-7415.

MBENGUE, S.; FUSEK, M.; SCHWARZ, J.; VODIČKA, P.; HOLUBOVÁ ŠMEJKALOVÁ, A.; HOLOUBEK, I. Four years of highly time resolved measurements of elemental and organic carbon at a rural background site in Central Europe. ATMOSPHERIC ENVIRONMENT, 2018, no. 182, p. 335-346. ISSN: 1352-2310.

FUSEK, M.; MICHÁLEK, J. Left-censored samples from skewed distributions: Statistical inference and applications. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 2018, vol. 66, no. 1, p. 245-252. ISSN: 1211-8516.

KHUSAINOV, D.; FEDOROVA, K.; DIBLÍK, J.; BAŠTINEC, J. About one mathematical model of dynamics of free competition market. Visnik Kiiivskogo nacionalnogo universitetu imeni Tarasa Shevchenko, Kibernetika, 2018, vol. 17, no. 1, p. 44-53. ISSN: 1728-3817.

BEREZANSKY, L.; DIBLÍK, J.; SVOBODA, Z.; ŠMARDA, Z. Exponential stability of linear delayed differential systems. APPLIED MATHEMATICS AND COMPUTATION, 2018, vol. 2018, no. 320, p. 474-484. ISSN: 0096-3003.

LABOUNEK, R.; BRIDWELL, D.; MAREČEK, R.; LAMOŠ, M.; MIKL, M.; SLAVÍČEK, T.; BEDNÁŘÍK, P.; BAŠTINEC, J.; HLUŠTÍK, P.; BRÁZDIL, M.; JAN, J. Stable Scalp EEG Spatiospectral Patterns Across Paradigms Estimated by Group ICA. BRAIN TOPOGRAPHY, 2018, vol. 31, no. 1, p. 76-89. ISSN: 0896-0267.

DIBLÍK, J.; SVOBODA, Z. Asymptotic properties of delayed matrix exponential function via Lambert function. DISCRETE AND CONTINUOUS DYNAMICAL SYSTEMS-SERIES B, 2018, vol. 72, no. 10, p. 123-144. ISSN: 1553-524X.

STEVÍČ, S.; IRIČANIN, B.; ŠMARDA, Z. Product-type System of Difference Equations with Multiplicative Coefficients Solvable in Closed Form. Journal of Computational Analysis and Applications, 2018, vol. 24, no. 6, p. 1088-1101. ISSN: 1572-9206.

## Bachelor's Courses

Discrete Mathematics  
(doc. RNDr. Martin Kovár, Ph.D.)

Mathematical Seminar  
(RNDr. Petr Fuchs, Ph.D.)

Mathematics 1  
(doc. RNDr. Edita Kolářová, CSc.)

Mathematics 2  
(prof. RNDr. Jan Chvalina, DrSc.)

Mathematics 3  
(Mgr. Irena Hlavičková, Ph.D.)

Probability and Statistics  
(doc. RNDr. Jaromír Baštinec, CSc.)

Mathematics 2 for Audio Engineering



(RNDr. Zdeněk Svoboda, CSc.)  
Selected Parts from Mathematics I.  
(doc. RNDr. Zdeněk Šmarda, CSc.)  
Selected Parts from Mathematics II.  
(doc. RNDr. Zdeněk Šmarda, CSc.)  
Mathematics in Electrical Engineering  
(RNDr. Petr Fuchs, Ph.D.)

Vector and Matrix Algebra  
(RNDr. Zdeněk Svoboda, CSc.)  
Discrete Mathematics  
(doc. RNDr. Martin Kovár, Ph.D.)  
Mathematical Foundations of Fuzzy Logic  
(doc. RNDr. Dana Hliněná, Ph.D.)  
Numerical Methods and Probability  
(RNDr. Michal Novák, Ph.D.)

### Master's Courses

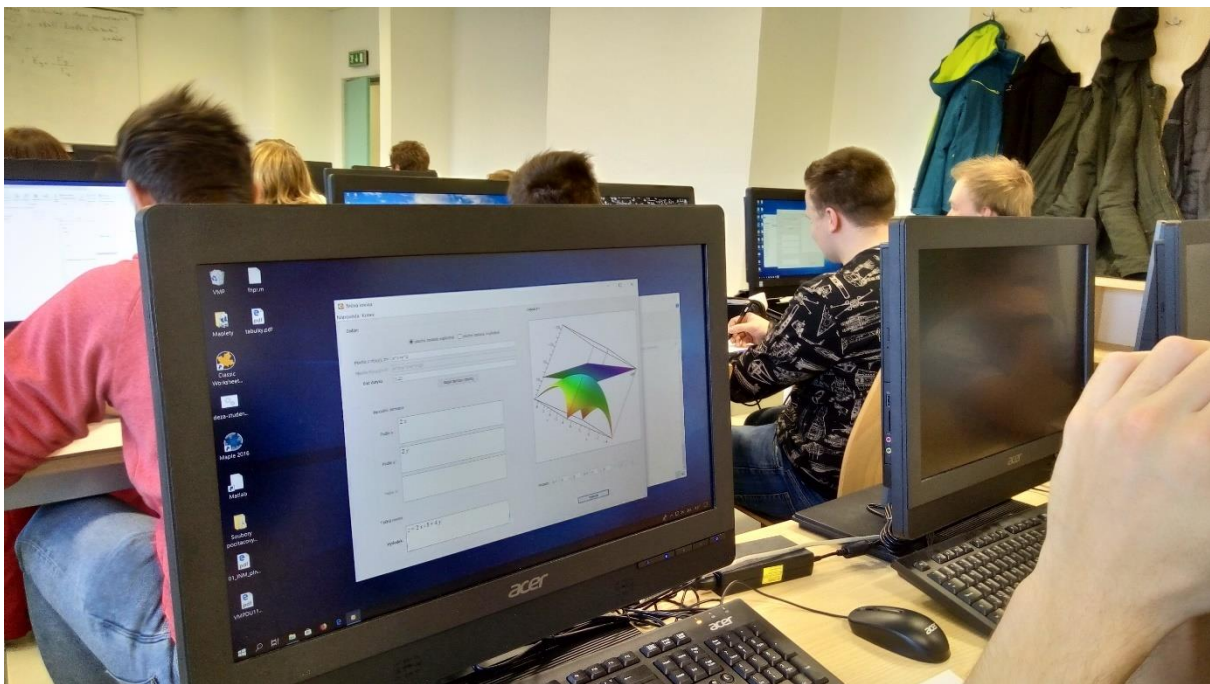
Differential Equations in Electrical Engineering  
(prof. RNDr. Josef Diblík, DrSc.)  
Matrices and Tensors Calculus  
(doc. RNDr. Martin Kovár, Ph.D.)  
Modern Numerical Methods  
(doc. RNDr. Jaromír Baštinec, CSc.)  
Mathematics  
(Ing. Michal Fusek, Ph.D.)

Probability, Statistics and Operation Research  
(doc. RNDr. Jaromír Baštinec, CSc.)  
Stochastic Processes  
(doc. RNDr. Jaromír Baštinec, CSc.)  
Coding in Informatics  
(RNDr. Petr Fuchs, Ph.D.)

### Ph.D. Courses

Discrete Processes in Electrical Engineering  
(prof. RNDr. Josef Diblík, DrSc.)

Probability, Statistics and Operations Research  
(doc. RNDr. Jaromír Baštinec, CSc.)



Mathematics is also instructed using modern mathematical programmes in the department's computer laboratory.

### Laboratories

**Computer Laboratories (2)** (simulation of application mathematical thematic wholes using Matlab, Maple, Mathematica, Petr Fuchs)

**Computer Laboratory for Mathematical Modelling** (data simulation and processing using StatSoft and Maple-Sim, Michal Novák)

## 7.8 Department of Microelectronics

### doc. Ing. Jiří Háze, Ph.D.

Head

Technická 3058/10

616 00 Brno

tel.: 541 146 159

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### Professors

prof. Ing. Dalibor Biolek, CSc.  
prof. Ing. Jaroslav Boušek, CSc.  
prof. Ing. Vladislav Musil, CSc.  
prof. Ing. Radimír Vrba, CSc.

### Associate Professors

doc. Ing. Jana Drbohlavová, Ph.D.  
doc. Ing. Lukáš Fucík, Ph.D.  
doc. Ing. Jiří Háze, Ph.D.  
doc. Ing. Jaromír Hubálek, Ph.D.  
doc. Ing. Jaroslav Kadlec, Ph.D.  
doc. Ing. Fabian Khateb, Ph.D.  
doc. Ing. Radek Kuchta, Ph.D.  
doc. Ing. Pavel Legát, CSc.  
doc. Ing. Radovan Novotný, Ph.D.  
doc. Ing. Josef Šandera, Ph.D.  
doc. Ing. Pavel Šteffan, Ph.D.  
doc. Ing. Ivan Szendiuch, CSc.  
doc. Ing. František Urban, CSc.

### Lecturers

Ing. Martin Adámek, Ph.D., Ing. Edita Hejátková, Ing. Vilém Kledrowetz, Ph.D., Ing. Michal Pavlík, Ph.D., Ing. Jan Pekárek, Ph.D., Ing. Jana Pekárková, Ph.D., Ing. Jan Prášek, Ph.D., Ing. Roman Prokop, Ph.D., Ing. Michal Řezníček, Ph.D., Ing. Ondřej Sajdl, Ph.D., Ing. Martin Štáva, Ph.D., Ing. Jaromír Žák, Ph.D.

### Research Workers

Dr. Alon Ascoli, Mgr. Zdenka Fohlerová, Ph.D., doc. RNDr. Pavel Kopel, Ph.D., doc. Ing. Pavel Neužil, Ph.D., DrSc., Ing. Lukáš Nejd, Ph.D., RNDr. Lukáš Richtera, Ph.D., prof. Dr. Ulrich Schmid, Dr. Michael Schneider, prof. Ronald Tetzlaff, doc. Mgr. Markéta Vaculovičová, Ph.D., doc. RNDr. Ondřej Zítka, Ph.D.

### Ph.D. Students

Ing. Vojtěch Dvořák, Ing. Jiří Hofman, Ing. Milan Holík, Ing. Lukáš Hrubý, Ing. Milan Hurban, Ing. Ondřej Chmela, Ing. Tomáš Janůš, Ing. Michal Jelínek, Ing. Milan Jílek, Ing. Michal Kerndl, Ing. Stanislav Krátký, Mgr. Zdeňka Kuchtová, Ing. Vladimír Levek, Ing. Michal Macek, Ing. Barbora Mojrová, Ing. Tomáš Musil, Ing. Lukáš Novák, Ing. Václav Novotný, Ing. Alexandr Otáhal, Ing. Karel Ptáček, Ing. Bc. Pavel Řihák, Ing. Josef Skácel, Ing. Jakub Somer, Ing. Kateřina Urbánková, Ing. Radek Vala, Ing. Martin Vala, Ing. Jan Valíček, Ing. David Veverka, Ing. Radim Zahradníček

### Administrative and Technical Staff

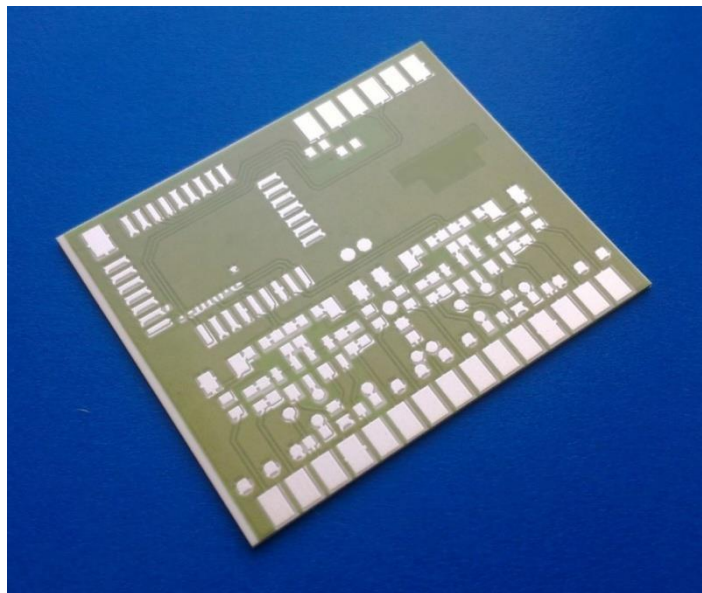
Mgr. Jana Baná, Ing. Marek Bohrn, Ph.D., Ing. Martin Buršík, Ph.D., Mgr. Jana Helena Církvová, Ing. Evelína Gablech, Ing. Imrich Gablech, Ing. Martina Gaňová, Ph.D., Ing. Ondřej Hégr, Ph.D., Ing. Radim Hrdý, Ph.D., Ing. Jaroslav Jankovský, PhDr. Jarmila Jurášová, Ph.D., Ing. Jiří Kudr, Ph.D., RNDr. Michal Masařík, Ph.D., Ing. Břetislav Mikel, Ph.D., Bc. David Nejezchleb, Ph.D., Petra Procházková DiS, Ing. Vojtěch Svatoš, Ing. Jiří Šubarda, Ing. Miroslav Zemánek, Ph.D.

## Main Interests

The department is responsible for instruction in basic subjects, mainly electronic components and circuits, and subjects specialised in the design of integrated circuits and microelectronic technology in Bachelor and follow-up Master degree programmes.

Basic and applied research was focused on integrated circuits, sensors and microelectronic technologies. The main areas of interest were:

- design of voltage, current and mixed-mode circuits
- design of circuits with switched capacitors and switched currents
- cosmic applications
- basic research of memristors, memcapacitors and meminductors
- MEMS structures design and simulation through COMSOL a ANSYS
- methods of signal evaluation from chemo-sensors, optosensors and biosensors, mainly gases and toxic materials
- advanced technologies for components, surfaces and sensors
- formation of nanostructures (nanodots, nanotubes, nanocolumns) using advanced nanotechnologies
- simulation and evaluation of the reliability of 3D linking systems
- novel methods of thixotropic material nonvacuum deposition in 3D circuits
- reliability of lead-free solders
- advanced methods of semiconductor chips interconnection and packaging
- simulation of electronic kits and packages in ANSYS
- non-conventional application of thick films (sensors, attenuators, shielding, antennas etc)



The department also designs and tests hybrid intergrated circuits.

The department closely cooperated (student placements) with Technical University in Sofia (Bulgaria), TU Ilmenau and IMMS Erfurt, Germany, and maintained research cooperation with Autoflug, Hamburg, Catalonia University Rovira i Virgili in Tarragona, microelectronic centre CNM in Barcelona, research laboratory IMEC-KHBO in Belgium, UC Berkeley, UC San Diego, NIST Gaithersburg (USA), Tampere University of Technology, Politecnico Di Torino, and TU Dresden.

With Fill Factory, Rožnov pod Radhoštěm (former Solartec) and research centre ISC Konstanz, we started research on the effect of the surface structure of crystalline quartz cells on their properties. The department closely cooperates with the 'Centre of Excellence CEITEC'.

## Major Achievements

The department's staff was involved in 3 projects of the 7th EU Framework in programmes ARTEMIS JU and ENIAC JU, 3 GAČR projects, 3 MPO projects and 1 TAČR project. In October 2018 the department coorganised the „international IMAPS flash Conference 2018“ with participation of Czech and international experts. There were 50 participants and 30 papers on microelectronics and technology were presented there.

The group involved in microelectronic technology and casting headed by Mr. Otáhal provided instruction in subjects BMTS, MMTE, MVSK, BMEP and BMP2 for full-time students and instruction in other three subjects for part-time students. The group focused on several research and development topics. An important part of its focus was creating a new method for rebalancing electronic BGA packages. Based on this research a new method of doing so directly into the heated template was performed and patented. The uniqueness of the method was awarded with TAČR GAMA project which is aimed at developing a soldering device with a heated template for the process of rebalancing, followed by its subsequent commercialisation. In this area the group also dealt with the research on the impact of heat current created by soldering on the inner structure and mechanical properties of the ball-shaped soldering seam in BGA packages. Another research was performed on hard soldering used at conducting cermet thick layers testing the possibility of using a manual soldering device without the need of using inert shielding atmosphere. An interdisciplinary research was conducted on measuring the amount of heavy metals in edible insect. The most significant achievement in the cooperation with the industry was the selling of the licence for production of glass substrates with chip components designed for detecting the washing medium activity when cleaning the PCB after soldering. Among other successes can be listed several economic contracts with electrical engineering companies focusing on optimisation of soldering, electronic chip components failures analysis and hybrid intergrated circuit construction. The research and development results were published at ISSE conferences in Serbia, IMAPS flash Conference in Brno and Student EEICT. Scientific papers were also published in Journal of Electrical Engineering and Potravinárstvo Journal.

The group LabSensNano (Laboratory of microsensors and nanotechnology) led by J. Hubálek continued their involvement in the centre SIX and Central European Technology Institute. The team was engaged in research and development of physical and chemical sensors and biosensors for medical, environmental and specific applications using micro- and nanotechnologies. An IR camera with novel characteristics for scanning in a broader spectrum than usual in thermovision cameras was designed, using MEMS technologies. Development of the Lab on a chip technology for ultra-fast analysis in mobile devices continued. It further deals with the study of the nanowires sensitive properties. Research outcomes were published in impact journals and presented at Web of Science (ISI) conferences.

The team working on custom integrated circuits led by L. Fucik focused on the development of intelligent submicron structures and systems for modern microsensors and low-input and low-voltage applications. An integrated circuit for basic evaluation circuit (future building block of a line evaluation system) was designed for measurement of temperature changes in resistivity of a bolometer sensor working as an integrator based on the principle of  $\Delta\Sigma$  modulation. The integrated circuit has been designed to evaluate the change in bolometer resistivity due to heating by incident infrared radiation. This structure was patented and then published in impact journals. Over the last years the group for design of custom integrated circuits has become involved in the development of devices for use in the space, mainly smaller devices able to affect significantly certain key functions of space satellites. We are currently involved in the project 'METOP SG 3MI' where we are developing all electronics, from power components to signal processing, control and automation of engine. It is an optical experiment for monitoring of the surface area of earth, climate, atmospheric temperature and moisture. A new generation of meteo satellites is being developed to provide high quality data on climate development. These are projects of the 'European space agency' (ESA). They are very complex and require high technical competence, therefore many European topteam are involved, and we closely cooperate with them.

A joint team of the department and companies IMA s. r. o. continued development of system for monitoring processes using modern tools for their optimisation, supported by the Ministry of Industry and Trade. A successful cooperation with the BD Sensors, s.r.o. company continued, focusing on the developmenet of novel sensors for low pressure and their intergration into distant management.

A joint team of the department and companies CROSS Zlín and NETWORK GROUP, s.r.o. continued development of a novel sensor for the system of dynamic weighing of vehicles. Successful cooperation with the BD Sensors, s.r.o company continued on the research focused on low pressure and vacuum pressure sensor. With other partners we worked on wireless network and communication protocols. The key objective of this cooperation was the development of reliable identification systems based on wireless technology from MICRORISC s.r.o.

In 2018 the research team led by Professor Bielek got a project GAČR 18-21608S 'Memristors and Other Non-Conventional Elements' together with other team collaborators from TU Dresden. The research was conducted in cooperation with other excellent European workplaces under the European platform COST IC 1401 "Memristors - Devices, Models, Circuits, Systems and Applications (MemoCiS)". Among other successes can be listed a new methodology of predictive modelling of complex various nature dynamic systems applied on nanosystems. The main advantage of these models is magnitudal growth in speed of computer simulations and the possibility of automatic synthesis of complex systems made of fundamental building blocks comprising memristors as well. The synthesis uses newly discovered general principle of duality for higher order elements from Chua table. In cooperation with TU Dresden, Forshungszentrum Juelich (Germany), Democritus University of Thrace (Greece), Politecnico di Milano (Italy), UC Berkeley (USA) and Politecnico di Torino (Italy) other current problems in memristive systems were dealt with, such as "fading memory" phenomenon, observed at Hewlett-Packard and „Hafnium-Oxide RRAMs“ memristors and their application in CNN and "bio-inspired" electronics. Results were published in prestigious impact journals.

## Major Research Projects

**System for Process Monitoring with Utilisation of Modern Tools for Their Optimisation (SYMONPRO) – FV10562**

Investigator: Radimír Vrba

**Memristors and Other Non-Conventional Elements - GAČR 18-21608S,**

Investigator: Dalibor Bielek

**Development of Intelligent Tunable White Universal Connectivity Lights – TH03010472**

Investigator: Pavel Šteffan

**Microfluidics-Based Ultrafast Differential Fluometry for Pharmaceutical Research ( $\mu$ DSF) – GAČR 16-11140S**

Investigator: Jaromír Hubálek

**Unique Versatile Security Camera Based on Nanotechnologies – VI20152019043,**

Investigator: Jaromír Hubálek

**Chip for Autonomous Sensor Field Power Conservation (CAPoC) – GAČR 17-27340S,**

Investigator: Ulrich Schmid

## Selected Publications

KHATEB, F.; KULEJ, T.; KUMNGERN, M.; PSYCHALINOS, C. Multiple-input bulk-driven MOS transistor for low-voltage low-frequency applications. *CIRCUITS SYSTEMS AND SIGNAL PROCESSING*, 2018, no. , IF: 1.998, p. 1-10. ISSN: 0278-081X.

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KUMNGERN, M.; NONTHAPUTHA, T.; KHATEB, F. Arbitrary waveform generators using current-controlled current conveyor transconductance amplifier and current conveyor analog switches. *JOURNAL OF CIRCUITS SYSTEMS AND COMPUTERS*, 2018, no. , IF: 0.595, p. 1-10. ISSN: 0218-1266.

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KUMNGERN, M.; KHATEB, F.; KULEJ, T. 0.5 V bulk-driven CMOS fully differential current feedback operational amplifier. *IET Circuits, Devices and Systems*, 2018, no. , IF: 1.395, p. 1-10. ISSN: 1751-858X.

KHATEB, F.; KULEJ, T.; AKBARI, M.; ŠTEFFAN, P. 0.3-V bulk-driven nanopower OTA-C integrator in 0.18  $\mu$ m CMOS. *CIRCUITS SYSTEMS AND SIGNAL PROCESSING*, 2018, no. , IF: 1.998, p. 1-10. ISSN: 0278-081X.

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KUMNGERN, M.; KHATEB, F. Current-mode universal filter and quadrature oscillator using current controlled current follower transconductance amplifiers. *Analog Integrated Circuits and Signal Processing*, 2018, no. , IF: 0.623, p. 1-10. ISSN: 1573-1979.

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### Bachelor's Courses

Analogue Electronic Circuits

(prof. Ing. Dalibor Bielek, CSc.)

Diagnostics and Testing of Electronic Systems

(Ing. Michal Pavlík, Ph.D.)

Digital Circuits

(doc. Ing. Lukáš Fucik, Ph.D.)

Digital Circuits and Microprocessors - HDOM

(doc. Ing. Pavel Šteffan, Ph.D.)

Analog Technology – HANA

(Ing. Vilém Kledrowetz, Ph.D.)

Electronic Devices - BESO, HESO

(prof. Ing. Jaroslav Boušek, CSc.)

Design of Vacuum Systems for Technologies in

Microelectronics

(doc. Ing. Josef Šandera, Ph.D.)

Microelectronic Practice

(doc. Ing. Josef Šandera, Ph.D.)

Microelectronic Practice 2

(doc. Ing. Josef Šandera, Ph.D.)

Microelectronics and Assembly Technology

(Ing. Michal Řezníček, Ph.D.)

Microsensors and Micromechanical Systems

(doc. Ing. Jaromír Hubálek, Ph.D.)

Modelling and Computer Simulation

(prof. Ing. Dalibor Bielek, CSc.)

Design and Technology of Electronic Instruments

(prof. Ing. Vladislav Musil, CSc.)

Design of Analog Integrated Circuits

(doc. Ing. Jiří Háze, Ph.D.)

Optoelectronics and Optical Communications

(doc. Ing. František Urban, CSc.)

Management Minimum

(doc. Ing. Radovan Novotný, Ph.D.)

### Master's Courses

Analogue Integrated Circuits

(doc. Ing. Jiří Háze, Ph.D.)

Applied Computer Technology

(Ing. Radovan Novotný, Ph.D.)

Digital Integrated Circuits

(doc. Ing. Pavel Šteffan, Ph.D.)

Integrated Optoelectronics

(doc. Ing. František Urban, CSc.)

Design and Technology of Electronic Equipments

(prof. Ing. Vladislav Musil, CSc.)

Methods of Analog Integrated Circuits Design

(Ing. Roman Prokop, Ph.D.)

Methods of Digital Integrated Circuits Design

(doc. Ing. Lukáš Fucik, Ph.D.)

Microelectronics in English

(doc. Ing. Jiří Háze, Ph.D.)

Microelectronic Devices and Structures

(prof. Ing. Vladislav Musil, CSc.)

Modelling and Simulation in Microelectronics

(doc. Ing. Jaroslav Kadlec, Ph.D.)

New Technology for Microelectronic Circuits

(doc. Ing. Ivan Szendiuch, CSc.)

Design of Electronic Instruments

(doc. Ing. Radek Kuchta, CSc.)

New Circuit Principles for Integrated System Design

(doc. Ing. Fabian Khateb, Ph.D.)

Management Minimum

(doc. Ing. Radovan Novotný, Ph.D.)

Theory of AD and DA Signal Conversion

(doc. Ing. Jiří Háze, Ph.D.)

Vacuum Technology

(prof. Ing. Jaroslav Boušek, CSc.)

Electronic Components Production

(doc. Ing. Ivan Szendiuch, CSc.)

### Ph.D. Courses

Microelectronic Systems

(prof. Ing. Vladislav Musil, CSc.)

Microelectronic Technologies

(doc. Ing. Jaromír Hubálek, Ph.D.)



REM TESCAN microscope in the department laboratory

## Laboratories

**Laboratory of Electronic Components** (instruction in Electronic Components, Martin Adámek, Jaroslav Boušek). New measuring devices were provided by ON Semiconductor.

**Laboratory of Analog Circuits and Microelectronic Practice** (instruction in Analog Integrated Circuits and Microelectronic Practice, Jiří Háze, Josef Šandera)

**Laboratory of Microsensors and Nanotechnologies** (research laboratory of chemistry, chemical sensors and biosensors, development of electronic devices, electron microscopy and lithography, dispersive X-ray spectroscopy, Jaromír Hubálek)

**Laboratory of Microelectronic Mount Technology and Casing** (thick films, solder surface mounting, lead-free soldering and casing, instruction in Microelectronics and Component Technology, Manufacturing of Components and Construction Elements, Modern Technology of Electronic Circuits and Systems, student projects, Ivan Szendiuch)

**Laboratory of Vacuum Technology** (research and development laboratory, Jaroslav Boušek, Josef Šandera)

**Laboratory of Microsensors** (instruction in Microsensors and Micromechanical Systems, Biosensors, Jaromír Hubálek)

**Design Laboratory of Electronic Devices and Systems** (instruction in Digital Circuits and Microprocessors, Electronic Systems, student projects, Pavel Šteffan)

**Design Laboratory of Integrated Circuits** (instruction in Design of Analog Integrated Circuits and Design of Digital Integrated Circuits, student projects, Roman Prokop)

**Laboratory of Optoelectronics and Laser Technology** (instruction in Optoelectronics, student projects, František Urban)

**Computer Laboratory** (computer exercises for various subjects, student self-study, internet, David Nejezchleb)

**Laboratory for Characterisation of Semiconductor Components – testing of chips** (instruction in Manufacturing of Components and Construction elements, student projects, Jaromír Hubálek)

## 7.9 Department of Radioelectronics

### prof. Ing. Tomáš Kratochvíl, Ph.D.

Head

Technická 3082/12  
616 00, Brno  
tel.: 541 146 538  
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### Professors Emeriti

prof. Ing. Tomáš Dostál, DrSc.  
prof. Ing. Václav Říčný, CSc.  
prof. Ing. Vladimír Šebesta, CSc.

### Professors

prof. Ing. Lubomír Brančík, CSc.  
prof. Ing. Stanislav Hanus, CSc.  
prof. Ing. Miroslav Kasal, CSc.  
prof. Dr. Ing. Zdeněk Kolka  
prof. Ing. Tomáš Kratochvíl, Ph.D.  
prof. Ing. Roman Maršálek, Ph.D.  
prof. Ing. Aleš Prokeš, Ph.D.  
prof. Dr. Ing. Zbyněk Raida  
prof. Ing. Milan Sigmund, CSc.  
prof. Ing. Otakar Wilfert, CSc.

### Lecturers

Ing. Viera Biolková, Ing. Jiří Dřínovský, Ph.D., Ing. Ivana Jakubová, Ing. Michal Kubíček, Ph.D., Ing. Tomáš Urbanec, Ph.D.

### Research Workers

Ing. Peter Barčík, Ph.D., Ing. Jiří Blumenstein, Ph.D., Ing. Dr. Techn. Vojtěch Derbek, Ing. Aleš Dobesch, Ph.D., Ing. Petr Kadlec, Ph.D., Ing. Jan Kufa, Ph.D., Ing. Lukáš Langhammer, Ph.D., prof. Dr. Ing. Christoph Mecklenbräuker, Ing. Tomáš Mikulášek, Ph.D., Ing. Jiří Miloš, Ph.D., Ing. Aleš Povalač, Ph.D., prof. Dr. Ing. Markus Rupp, Ing. Vladimír Šeděnka, Ph.D., Ing. Filip Záplata, Ph.D., prof. Daniel Krzysztof Wójcik

### Ph.D. Students

Ing. Nawfal Al-Zubaidi R-Smith, Ing. Miroslav Cupal, Ing. Ondřej Domanský, Ing. Ondřej Fišer, Ing. Michal Harvánek, Ing. Erik Herceg, Ing. Martin Hrabina, Ing. Aslihan Kartci, Ing. Eva Klejmová, Ing. Martin Kokolia, Ing. Jan Král, Ing. David Kuřátko, Ing. Martin Marek, Ing. Marek Novák, Ing. Martin Pospíšil, Ing. Stanislav Rozum, Ing. Petr Skryja, Ing. Jan Špůrek, Ing. Josef Vychodil, Ing. Jaroslav Zechmeister, Ing. Miroslav Waldecker, Ing. Dominika Warmowska

### Administrative and Technical Staff

Ing. Josef Báňa, Ing. Philip Bělohávek, Bohuslava Raidová, Petra Šípová, Aleš Vanžura, Jaroslav Voráč

### Associate Professors

doc. Ing. Tomáš Frýza, Ph.D.  
doc. Ing. Tomáš Götthans, Ph.D.  
doc. Ing. Lucie Hudcová, Ph.D.  
doc. Ing. Jaroslav Láčík, Ph.D.  
doc. Ing. Jiří Petržela, Ph.D.  
doc. Ing. Ladislav Polák, Ph.D.  
doc. RNDr. Jitka Poměnková, Ph.D.  
doc. Ing. Martin Slanina, Ph.D.  
doc. Ing. Jiří Šebesta, Ph.D.  
doc. Ing. Roman Šotner, Ph.D.  
doc. Ing. Martin Štumpf, Ph.D.



## Main Interests

Research is focused on modern electronic circuits, novel signal processing methods, microwave circuits, antennas and wireless communication. Our areas of interest are mobile, satellite and optical communications, analog and digital systems, microprocessor technology, low-frequency and audio electronics, digital radio and television technology and electromagnetic compatibility (EMC).

Research was financed from 5 projects of Czech Science Foundation (GA ČR) and 5 projects of the Technology Agency of the Czech Republic (TA ČR). The department was involved in 2 projects of Ministry of Industry and Trade (MPO ČR) and 3 internal specific research grants of Brno University of Technology.

The department participated in 2 European projects H2020, 1 bilateral project CZ - AT, 1 project of international cooperation COST, and it cooperated in contracts for leading international partners (Volkswagen, Rohde & Schwarz, ON Semiconductors) and nearly 20 direct contracts for Czech companies (Škoda Auto, Barco, CSRS, PBS, OZM, IMA, etc.)

We cooperate with many professional organisations and societies. Staff members are engaged in the committee of the Czech and Slovak section of IEEE and Radioengineering Society. There has been active cooperation with the Czech Electrotechnical Society. The department supports activities of Radioclub OK2KOJ and the Student Section of IEEE at Brno University of Technology and is a collective member of the international organisation AMSAT (Radio Amateur Satellite Corporation) and URSI (International Union of Radio Science).



Laboratory of Communication Systems

## Major Achievements

The department participates, in cooperation with departments of telecommunications, microelectronics, theoretical and experimental electrical engineering and physics, in the regional 'Centre of Applied Research SIX' (Centre of Sensor, Information and Communication Systems). The centre receives institutional support, it is involved in a number of national and European projects and employs research workers and Ph.D. students.

Research is centred on radiofrequency systems for transport vehicles (team leader Aleš Prokeš), future generations of mobile communication systems (Roman Maršálek) and applied electromagnetism (Jaroslav Láčík). The teams are involved in several national applied research projects of TAČR and MPO.

In 2018 the department joined the international activities COST, namely CA15104 The Inclusive Radio Communications (IRACON), defining future communication beyond the 5G net development horizon.

The department was also involved in national basic and applied research projects, in the European project H2020 'European Integrated Research and Training Network on Convergence of Electronics and Photonics Technologies for Enabling Terahertz Applications' (CELTA) and Smart City Lighthouse Project (RUGGEDISED). A bilateral cooperation CZ - At was contracted by the initial project Interoperability of Heterogeneous Radio Systems.

Research results are immediately incorporated in the curricula of the Bachelor, Master and Ph.D. study area Electronics and Communications.

For secondary school students, the department prepared the 'Radio Engineering Workshop' and the second finals of the competition 'Golden Transistor 2018' where student teams compete for the best technical project presentation and prizes from sponsors.

### Major Research projects

#### **Convergence of Electronics and Photonics Technologies for Enabling Terahertz Applications (CELTA) –**

European project H2020-MSCA-ITN-2015 no. 675683

Investigator: Zbyněk Raida

#### **Future tranceiver techniques for the society in motion – GA ČR č. GA17-18675S,**

Investigators: Markus Rupp (TU Vienna) and. Roman Maršálek.

#### **Mobile channel analysis and modelling in millimeter wave band – GA ČR č. 17-27068S,**

Investigators: Christoph Mecklenbräuer (TU Vienna) and Aleš Prokeš

#### **Interoperability of Heterogeneous Radio Systems (InterOP) – bilateral project INTERREG č. ATCZ175,**

Investigator: Vojtěch Derbek

#### **Future Wireless Radio Communication Networks in Real Scenarios (FEWERCON) – COST LTC č. 18021,**

Investigator: Ladislav Polák, Ph.D.

#### **Development of an Efficient Climatisation System for Training Jet Aircraft – TA ČR no. TH02010981**

Investigator: Zdeněk Kolka

#### **Tools for Synthesis of Aerials and Sensors – TA ČR no. TA04010457**

Investigator: Petr Kadlec

#### **Digital Spectrometer of Mixed Fields of Photons and Neutrons– MPO ČR no. FV20453**

Investigator: Michal Kubíček

### Selected Publications

KOLÁŘOVÁ, E.; BRANČÍK, L. Stochastic differential equations describing systems with coloured noise. Tatra Mountains Mathematical Publications, 2018, vol. 1, no. 71, p. 99-107. ISSN: 1210-3195.

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PETRŽELA, J. Strange attractors generated by multiple-valued static memory cell with polynomial approximation of resonant tunneling diodes. ENTROPY, 2018, vol. 20, no. 9, p. 1-23. ISSN: 1099-4300.

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ŠTUMPF, M. Evaluating the Ground Impedance -- A New Methodology Based on EM Reciprocity. *IEEE Transaction on Electromagnetic Compatibility*, 2018, vol. 61, no. 3, p. 1-7. ISSN: 0018-9375.

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KADLČÍK, L.; HORSKÝ, P. A CMOS Follower-Type Voltage Regulator With a Distributed-Element Fractional-Order Control. *IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS I-REGULAR PAPERS*, 2018, vol. 65, no. 9, p. 2753-2763. ISSN: 1549-8328.

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- KARTCI, A.; AGAMBAYEV, A.; HERENCŠÁR, N.; SALAMA, K. N. Series-, Parallel-, and Inter-Connection of Solid-State Arbitrary Fractional-Order Capacitors: Theoretical Study and Experimental Verification. IEEE Access, 2018, vol. 6, no. 1, p. 10933-10943. ISSN: 2169-3536.
- LANGHAMMER, L.; DVOŘÁK, J.; JEŘÁBEK, J.; KOTON, J.; ŠOTNER, R. Fractional-Order Low-Pass Filter with Electronic Tunability of Its Order and Pole Frequency. Journal of Electrical Engineering, 2018, vol. 69, no. 1, p. 3-13. ISSN: 1335-3632.
- ŠOTNER, R.; JEŘÁBEK, J.; HERENCŠÁR, N.; PETRŽELA, J. Methods for Extended Tunability in Quadrature Oscillators Based on Enhanced Electronic Control of Time Constants. IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, 2018, vol. 67, no. 6, p. 1495-1505. ISSN: 0018-9456.
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- TSIRIMOKOU, G.; KARTCI, A.; KOTON, J.; HERENCŠÁR, N.; PSYCHALINOS, C. Comparative Study of Discrete Component Realizations of Fractional-Order Capacitor and Inductor Active Emulators. JOURNAL OF CIRCUITS SYSTEMS AND COMPUTERS, 2018, vol. 27, no. 11, p. 1850170-1 (1850170-26 p.)ISSN: 0218-1266.
- DVOŘÁK, J.; LANGHAMMER, L.; JEŘÁBEK, J.; KOTON, J.; ŠOTNER, R.; POLÁK, J. Synthesis and Analysis of Electronically Adjustable Fractional-Order Low-Pass Filter. JOURNAL OF CIRCUITS SYSTEMS AND COMPUTERS, 2018, vol. 27, no. 2, p. 1850032-1 (1850032-18 p.)ISSN: 0218-1266.
- ŠTUMPF, M. Controlling Pulsed EM Scattering of a One-Port Receiving Antenna. RADIO SCIENCE, 2018, vol. 52, no. 12, p. 1596-1603. ISSN: 1944-799X.
- AL-ZUBAIDI R-SMITH, N.; KARTCI, A.; BRANČÍK, L. Application of Numerical Inverse Laplace Transform Methods for Simulation of Distributed Systems with Fractional-Order Elements. JOURNAL OF CIRCUITS SYSTEMS AND COMPUTERS, 2018, vol. 27, no. 11, p. 1-25. ISSN: 0218-1266.
- MRNKA, M.; RAIDA, Z. An effective permittivity tensor of cylindrically perforated dielectrics. IEEE Antennas and Wireless Propagation Letters, 2018, vol. 17, no. 1, p. 66-69. ISSN: 1536-1225.
- ŠTUMPF, M. The Time-Domain Compensation Theorem and Its Application to Pulsed EM Scattering of Multiport Receiving Antennas. IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, 2018, vol. 66, no. 1, p. 226-232. ISSN: 0018-926X.

## Bachelor's Courses

- |  |  |
|--|--|
| Analog Electronic Circuits<br>(prof. Ing. Lubomír Brančík, CSc.)                 |  |
| Electromagnetic Compatibility<br>(Ing. Jiří Dřínovský, Ph.D.)                    | Computers and Programming 1<br>(doc. Ing. Jiří Šebesta, Ph.D.)                           |
| EM Waves, Antennas and Lines<br>(prof. Dr. Ing. Zbyněk Raida)                    | Computers and Programming 2<br>(doc. Ing. Jiří Šebesta, Ph.D.)                           |
| Electronic Practice<br>(Ing. Ivana Jakubová)                                     | CAD of Electronic Circuits<br>(prof. Dr. Ing. Zdeněk Kolka)                              |
| Pulse and Digital Techniques<br>(doc. Ing. Tomáš Frýza, Ph.D.)                   | CAD in Communication Subsystems<br>(Ing. Petr Kadlec, Ph.D.)                             |
| Communication Systems<br>(prof. Ing. Aleš Prokeš, Ph.D.)                         | Radio and Mobile Communication<br>(prof. Ing. Stanislav Hanus, CSc.)                     |
| Microprocessor Techniques and Embedded Systems<br>(doc. Ing. Tomáš Frýza, Ph.D.) | Radio Receivers and Transmitters<br>(prof. Ing. Aleš Prokeš, Ph.D.)                      |
| Microwave Techniques<br>(doc. Ing. Jaroslav Láččík, Ph.D.)                       | Signals and Systems<br>(prof. Ing. Milan Sigmund, CSc.)                                  |
| Modern Wireless Communication<br>(doc. RNDr. Jitka Poměnková, Ph.D.)             | High Frequency Techniques<br>(Ing. Tomáš Urbanec, Ph.D.)                                 |
| Power Supply Systems<br>(Ing. Michal Kubíček, Ph.D.)                             | Optical Communication Fundamentals and<br>Optoelectronics<br>(Ing. Lucie Hudcová, Ph.D.) |
| Analog Filter Design<br>(doc. Ing. Jiří Petržela, Ph.D.)                         | Fundamentals of TV Technology<br>(prof. Ing. Stanislav Hanus, CSc.)                      |
| Low-frequency and Audio Electronics<br>(prof. Ing. Tomáš Kratochvíl, Ph.D.)      |  |

## Master's Courses



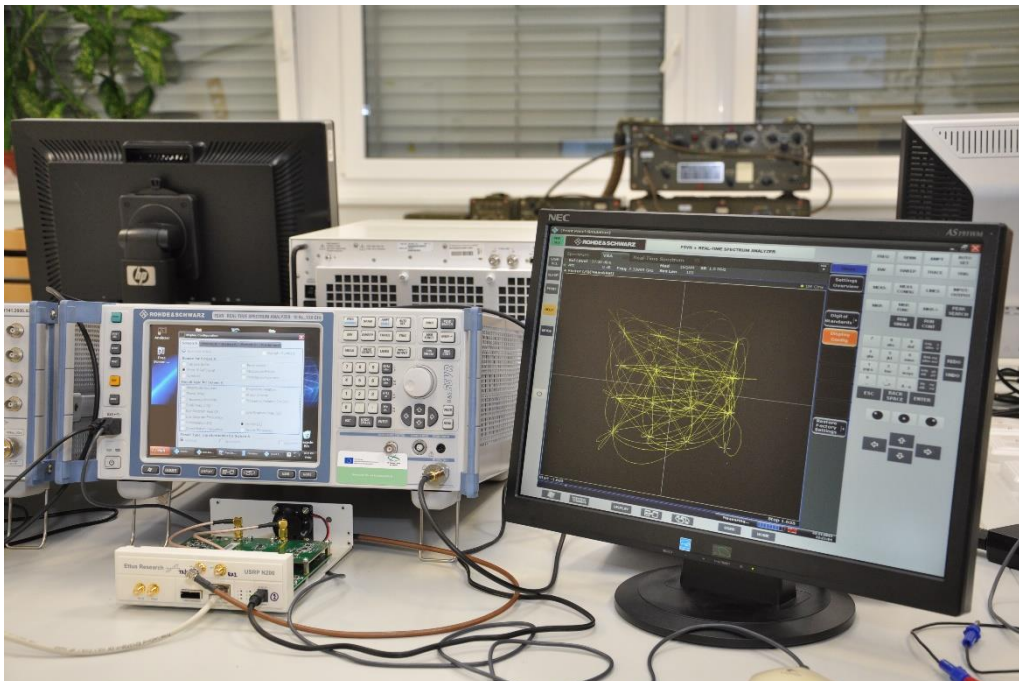
Advanced radio communication systems  
(doc. RNDr. Jitka Poměnková, Ph.D.)  
Analysis of Radiocommunication Signals  
(doc. RNDr. Jitka Poměnková, Ph.D.)  
CAD in Microwaves  
(prof. Dr. Ing. Zbyněk Raida)  
Digital Television and Radio Systems  
(prof. Ing. Tomáš Kratochvíl, Ph.D.)  
Quantum and Laser Electronics  
(Ing. Lucie Hudcová, Ph.D.)  
Microcontrollers for Advanced Applications  
(Ing. Aleš Povalač, Ph.D.)  
Design of Antennas and Radio Links  
(doc. Ing. Jaroslav Láččík, Ph.D.)  
Computer and Communication Networks  
(prof. Dr. Ing. Zdeněk Kolka)  
Microprocessors with ARM Architecture  
(Ing. Aleš Povalač, Ph.D.)  
Programmable Logic Devices  
(Ing. Michal Kubíček, Ph.D.)

Radiofrequency Identification  
(Dr. Techn. Vojtěch Derbek)  
Radioelectronic Measurement  
(Ing. Jiří Dřínovský, Ph.D.)  
Radars and Navigation Systems  
(doc. Ing. Jiří Šebesta, Ph.D.)  
Radio Relay and Satellite Communication  
(Ing. Filip Záplata, Ph.D.)  
Implementation of Software Communication Systems  
(prof. Ing. Roman Maršálek, Ph.D.)  
Mobile Communication Systems  
(doc. Ing. Martin Slanina, Ph.D.)  
Theory of Electronic Circuits  
(doc. Ing. Jiří Petřžela, Ph.D.)  
Wireless Communication Theory  
(prof. Ing. Roman Maršálek, Ph.D.)  
Video and Multimedia Technology  
(doc Ing. Martin Slanina, Ph.D.)

### Ph.D.Courses

Modern Digital Wireless Communication  
(prof. Ing. Milan Sigmund, CSc.)

Modern Electronic Circuit Design  
(prof. Dr. Ing. Zdeněk Kolka)



Digital Communication Systems

### Laboratories

**Laboratory of Analog Electronic Circuits** (instruction in analog electronics, Ivana Jakubová, Lubomír Brančík, Jiří Petřžela, Roman Šotner)

**Laboratory of Electromagnetic Compatibility EMC** (research and instruction in EMC and pre-certifying tests of interference and resistance according to European norms, Jiří Dřínovský)



**Laboratory of Low-Frequency Applications** (research and instruction in audio technology, low-frequency electronics and power supply systems for electronic devices, Tomáš Kratochvíl, Michal Kubíček)

**Laboratory of Signals and Digital Technology** (research and instruction in signals and digital technology, Viera Biolková, Milan Sigmund, Tomáš Frýza)

**Laboratory of Microprocessor Technology** (instruction in microprocessor and microcomputer technology, Tomáš Frýza, Aleš Povalač)

**Laboratory of Communication Systems** (research and instruction in communication systems, data transmission, Aleš Prokeš)

**Laboratory of Optoelectronics and Photonics** (research and instruction in optoelectronics, photonics and optical communications, Otakar Wilfert, Lucie Hudcová, Peter Barčík)

**Laboratory of TV and Video Technology** (research and instruction in digital TV and video technology, Martin Slanina, Ladislav Polák)

**Laboratory of Microwave Technology** (research and instruction in microwave technology and special electronic-components, Tomáš Urbanec, Jiří Dřínovský)

**Laboratory of Mobile Communications** (research and instruction in mobile wireless communication, Stanislav Hanus, Martin Slanina, Jiří Miloš)

**Laboratory of Antennas and Electromagnetic Field** (research and instruction in EM fields, antennas and design of radio links, Jaroslav Láčík, Tomáš Mikulášek)

**Laboratory of Radio Relay and Satellite Communication** (research and instruction in radio and satellite communication, radiolocation and navigation, Miroslav Kasal, Filip Záplata)

**Laboratory for Student Research** (student projects, theses, self-study, Jiří Šebesta)

**Electronic Technology Laboratory** (dry and wet techniques for printed circuit boards, photographic production of patterns, Aleš Vančura, Jaroslav Voráč)

**Computer Laboratories** (two laboratories for computer-aided exercises in circuits, signals and systems, special areas of radioelectronics and communication technology, Josef Báňa)

**Research Laboratory of Experimental Satellite Communication** (research and development of subsystems for satellite communication and navigation, telemetric and command stations of experimental AMSAT satellites, Miroslav Kasal)

**Research Laboratory of Numerical Methods** (applied electromagnetism and electromagnetic field modelling, Zbyněk Raida, Petr Kadlec)

**Research Laboratory of Optical Communications** (research in measurement, testing and design of lighttransmitting and atmospheric optical connectors, Otakar Wilfert, Lucie Hudcová, Peter Barčík)

**Research Laboratory of Signal Processing** (digital radio communication and methods for digital signal processing, Roman Maršálek)

## 7.10 Department of Telecommunications

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prof. Ing. Zdeněk Smékal, CSc.  
prof. Ing. Kamil Vrba, CSc.

### Associate Professors

doc. Ing. Karel Burda, CSc.  
doc. Ing. Radim Burget, Ph.D.  
doc. Ing. Petr Číka, Ph.D.  
doc. Ing. Jan Hajný, Ph.D.  
doc. Ing. Norbert Herencsar, Ph.D.  
doc. Ing. Jiří Hošek, Ph.D.  
doc. Ing. Jan Jeřábek, Ph.D.  
doc. Ing. Dan Komosný, Ph.D.  
doc. Ing. Jaroslav Koton, Ph.D.  
doc. Ing. Ivo Lattenberg, Ph.D.  
doc. Ing. Petr Mlýnek, Ph.D.  
doc. Ing. Vít Novotný, Ph.D.  
doc. Ing. Miloš Orgoň, Ph.D.  
doc. Mgr. Pavel Rajmic, Ph.D.  
doc. Ing. Kamil Říha, Ph.D.  
doc. Ing. Jiří Schimmel, Ph.D.  
doc. Ing. Jaroslav Sklenář, CSc.  
doc. Ing. Petr Sysel, Ph.D.  
doc. Ing. Vladislav Škorpil, CSc.  
doc. Ing. Václav Zeman, Ph.D.

### Lecturers

Ing. Miroslav Balík, Ph.D., Ing. Radim Číž, Ph.D., Mgr. Radka Koton, Ing. Pavel Hanák, Ph.D., Ing. Ondřej Krajsa, Ph.D., Ing. David Kubánek, Ph.D., Ing. Anna Kubánková, Ph.D., Ing. Lukáš Langhammer, Ph.D., Ing. Lukáš Malina, Ph.D., Ing. Zdeněk Martinásek, Ph.D., Ing. Jiří Mekyska, Ph.D., Ing. Jiří Přinosil, Ph.D., Ing. Pavel Šilhavý, Ph.D., Mgr. Karel Slavíček, Ph.D.

### Research Workres, Technical and Administrative Staff

Ing. Vlastimil Člupek, Ing. Jakub Frolka, Ing. Tomáš Horváth, Magda Lounková, Hana Lukešová, Ing. Lukáš Malina, Ph.D., Ing. Jan Mašek, Ing. Pavel Mašek, Ing. Jiří Mekyska, Ph.D., Ing. Petr Münster, Ph.D., Lukáš Pazdera, Robert Pernica, Jitka Šichová, Ing. Václav Uher, Ph.D., Ing. Kateřina Zehlová

### Ph.D. Students

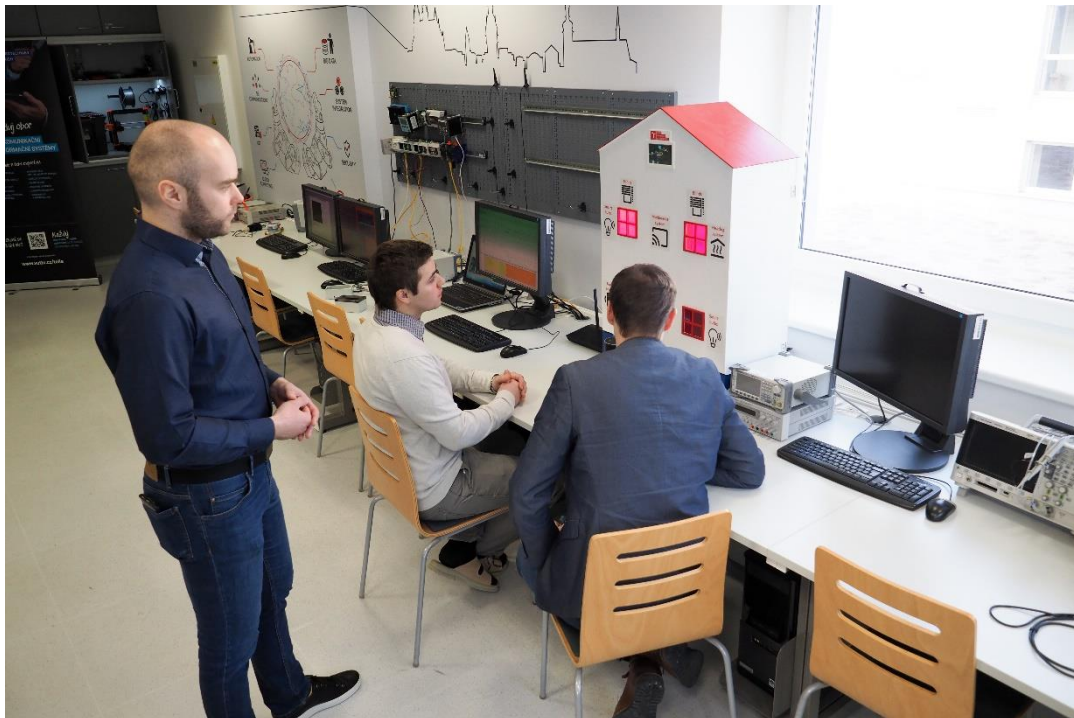
Ing. Petr Blažek, Ing. Josef Brychta, Ing. Rastislav Červeňák, Ing. Milan Čučka, Ing. Petr Dejdar, Ing. Marie Mangová, Ing. Jan Dorazil, Ing. Petr Dzurenda, Ing. Jakub Frolka, Ing. Radek Fujdiak, Ing. Zoltán Galáž, Ing. Tomáš Gerlich, Ing. Juraj Gierl, Ing. Pavol Harár, Ing. Tomáš Horváth, Ing. Petr Ilgner, Ing. Tomáš Kiska, Ing. Lukáš Kočí, Ing. Martin Kenyeres, Ing. Martin Kolařík, Ing. Jan Krejčí, Ing. Petr Ležák, Ing. Tomáš Lieskovan, Ing. Zdeněk Mžourek, Ing. Pavel Mašek, Ing. Jan Mašek, Ing. Václav Mecerod, Ing. Petr Musil, Ing. Vojtěch Myška, Ing. Michaela Novosadová, Ing. Adam Olejář, Ing. Václav Oujezský, Ing. Lukáš Povoda, Ing. Josef Polák, Ing. Marek Sikora, Ing. Pavel Sikora, Ing. David Smékal, Ing. Pavel Šeda, Ing. Pavel Závíška, Ing. František Urban, Ing. Lukáš Vlček, Ing.

Kryštof Zeman, Ing. Vojtěch Burian, Ing. Jan Dvořák, Ing. David Grenar, Ing. Pavol Ilko, Ing. Petr Kříž, Ing. Ján Mucha, Ing. Jiří Pokorný, Ing. Zuzana Polešáková, Ing. Martin Rajnoha, Ing. Ján Sláčík, Ing. Ondřej Sládok, Ing. Vojtěch Zvončák, Ing. Martin Štůsek

### Main Interests

The department has been developing the Bachelor study programme 'Teleinformatics' and Master programme 'Telecommunications and Information Technology'. We seek balance in education in all areas of communications, students are trained in all computing systems, computer networks, learn to develop network applications in various programming languages. They are instructed in the design of analog and digital circuits, microprocessors and signal processors and their applications. The students can specialise in multimedia informatics i.e. digital speech, music and image processing. There is a follow-up Ph.D. programme 'Teleinformatics'.

Another Bachelor study programme is 'Audio Engineering'. The programme has been provided in cooperation with Janáček Academy of Music and Performing Arts, Faculty of Music. The programme provides interdisciplinary Bachelor education in audio engineering and is focused on training of audio engineers with technical and artistic approach to the latest audio technology, audio signal processing, musical production and studio practice. The Master programme was accredited in 2015 when instruction in the study programme 'Information Safety' (IBEP) was launched. This interdisciplinary programme is focused on internet and network protection information and communication safety (ICT). The students learn how to configure and maintain extensive computer infrastructure and test computer security by ethical hacking. The study programme offers interesting and attractive subjects in cryptography of programming or network operating systems, and also software law and economic aspects connected with safety issues. This interdisciplinary programme is provided in cooperation with Faculty of Law, Masaryk University in Brno and Faculty of Business and Management, Brno University of Technology. The scope of training prepares students not only for technical positions, but also commercial or management positions and consultancy.



Prototype of a voice-controlled smart household operated by sensors and IoT devices

The department has been successful in obtaining funds from various education and research projects. In 2018 research and development teams conducted basic and applied research projects of nearly 50 million CZK. A research team has been engaged in providing up-to-date multimedia services via mobile and wireless networks. The department was involved in research and development for industry in the frame of MPO, TAČR, GAČR and Ministry of the Interior projects. We continued cooperation with GiTy a.s., Webnode s.r.o., 2N Telekomunikace, MegA, a.s.-Měřící Energetické aparáty, TTC telekomunikace and 3S s.r.o. We dealt with commercial projects for T-Mobile,

Honeywell, Telekom Austria, E.ON Česká republika and AT&T. The department's staff members are involved in operation of the regional centre SIX – 'Centre of Sensor, Information and Communication Systems'.

### Major Achievements

The main research interests of the department are converged information and communication systems focused on multimedia informatics, electronic systems for medical technology. In 2018 the department achieved very good results in:

Solution of cryptographic protection of communication and information systems of data networks, security of electronic archives.

Design and implementation of algorithms for digital processing of speech and music signals for telecommunication and multimedia applications, embedded systems for acoustic signal processing, and software for these systems.

Development of electronic devices for medical data transmission and processing, design and implementation of algorithms for processing and analysis of biomedical signals (NMR and CT tomography and ultrasound) and 3D modelling of parts of human body for diagnostics and surgery.

Research and development of telemetric systems, remote data collection systems, systems for wireless sensor networks, networks for industrial data collection and control (smart grids of power plants, waterworks, transportation, etc.).

Design and optimisation of algorithms for digital signal processing (digital filters, signal detection, spectral analysis, etc.), implementation of algorithms in signal processors and microcontrollers.

Research and design of systems of speech and image processing, security of multimedia systems archives, evaluation of emotions in speech and mimics via genetic programming.

Research and development of an intelligent system for power grid control and identification of threats in power grid infrastructure.

### Major Research Projects

#### **Research of Cryptographic Primitives for Secure Authentication and Protection of Digital Identity – GAČR GP14-25298P**

Investigator: Jan Hajný

#### **Research and Development of a Technology for Detection of Emotions in Unstructured Data – MPO FRT14/151**

Investigator: Zdeněk Smékal

#### **Stress Tester ICT – MV ČR VI20152018002,**

Investigator: Václav Zeman

#### **Smart Solution for Increase in Efficiency and Working Process Automatization Implementing Industry 4.0 – MPO FV20487,**

Investigator: Petr Mlýnek

#### **Detection of Safety Threats on Active Elements of Critical Infrastructures– VI2VS/428**

Investigator: Petr Münster

#### **Systems Synthesis and Analysis – GA16-06175S**

Investigator: Jaroslav Koton

#### **Active Elements with Differential Gates for Design of Original Non-Differential and Pseudo-Differential Function Blocks – GJ16-11460Y**

Investigator: Norbert Herencsár

#### **Perfusion MR Imaging by Scan Compression – GA16-13830S**

Investigator: Pavel Rajmic

### Selected Publications

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### Bachelor's Courses in Teleinformatics

Analog Technology

(prof. Ing. Kamil Vrba, CSc.)

Signals and Systems Analysis

(prof. Ing. Zdeněk Smékal, CSc.)

Network Architecture

(doc. Ing. Vít Novotný, Ph.D.)

CISCO Academy I

(doc. Ing. Dan Komosný, Ph.D.)

CISCO Academy II, V

(Ing. Anna Kubánková, Ph.D.)

CISCO Academy III

(doc. Ing. Jan Jeřábek, Ph.D.)

CISCO Academy IV

(doc. Ing. Radim Burget, Ph.D.)

Digital Filters

(doc. Ing. Petr Sysel, Ph.D.)

Digital Signal Processing

(prof. Ing. Jiří Mišurec, CSc.)

Data Communication

(Ing. Pavel Šilhavý, Ph.D.)

Electroacoustics

(doc. Ing. Jiří Schimmel, Ph.D.)

Hardware of Computer Networks

(doc. Ing. Jaroslav Koton, Ph.D.)

Communication Technology

(doc. Ing. Jan Jeřábek, Ph.D.)

Design of Electronic Devices

(prof. Ing. Kamil Vrba, CSc.)

Object Oriented Programming

(doc. Ing. Ivo Lattenberg, Ph.D.)

Multimedia Services

(doc. Ing. Petr Číka, Ph.D.)

Computers and Programming 1

(doc. Ing. Ivo Lattenberg, Ph.D.)

Computers and Programming 2

(Ing. Jiří Přinosil, Ph.D.)

Practical Exercises in Information Networks

(doc. Ing. Petr Číka, Ph.D.)

Transmission Media

(prof. Ing. Miloslav Filka, CSc.)

Accesses and Transports Networks  
(doc. Ing. Vladislav Škorpil, CSc.)  
Network Operating Systems  
(doc. Ing. Dan Komosný, Ph.D.)  
Studio and Music Electronics  
(doc. Ing. Jiří Schimmel, Ph.D.)  
Security Systems

### **Bachelor's Courses in Audio Engineering**

Analog Technology  
(prof. Ing. Kamil Vrba, CSc.)  
Signals and Systems Analysis  
(prof. Ing. Zdeněk Smékal, CSc.)  
Audiotechnology in English  
(prof. Ing. Zdeněk Smékal, CSc.)  
Digital Signal Processing  
(prof. Ing. Jiří Mišurec, CSc.)  
Electroacoustics  
(doc. Ing. Jiří Schimmel, Ph.D.)  
Music Theory in English  
(prof. Ing. Zdeněk Smékal, CSc.)  
Design of Electronic Devices  
(prof. Ing. Kamil Vrba, CSc.)

### **Bachelor's Courses in Information Safety**

Foundations of Cryptography  
(doc. Ing. Jan Hajný, Ph.D.)  
Computers and Programming 1  
(doc. Ing. Ivo Lattenberg, Ph.D.)  
Computers and Programming 2  
(Ing. Jiří Přinosil, Ph.D.)  
Applied Cryptography  
(doc. Ing. Václav Zeman, Ph.D.)  
Communication Technology  
(doc. Ing. Jan Jeřábek, Ph.D.)  
Data Communication  
(doc. Ing. Pavel Šilhavý, Ph.D.)  
Network Operating Systems  
(doc. Ing. Dan Komosný, Ph.D.)  
Theoretical Informatics  
(doc. Ing. Radim Burget, Ph.D.)  
Semester project  
(doc. Ing. Petr Číka, Ph.D.)  
  
ICT Security 1  
(doc. Ing. Jan Hajný, Ph.D.)  
Multimedia Services  
(doc. Ing. Petr Číka, Ph.D.)  
ICT Security 2  
(prof. Ing. Jiří Mišurec, CSc.)  
Professional Practice  
(doc. Ing. Vladislav Škorpil, CSc.)

(doc. Ing. Karel Burda, CSc.)  
High-speed Communications Systems  
(doc. Ing. Vladislav Škorpil, CSc.)  
Foundations of Cryptography  
(doc. Ing. Jan Hajný, Ph.D.)  
Introduction to Computer Typography and Graphics  
(doc. Mgr. Pavel Rajmic, Ph.D.)

Design and Technology of Audio-electronic Devices  
(prof. Ing. Jiří Mišurec, CSc.)  
Computers and Programming 1  
(doc. Ing. Ivo Lattenberg, Ph.D.)  
Computers and Programming 2  
(Ing. Jiří Přinosil, Ph.D.)  
Object Oriented Programming  
(doc. Ing. Ivo Lattenberg, Ph.D.)  
Practical Exercises in Information Networks  
(doc. Ing. Petr Číka, Ph.D.)  
Studio and Music Electronics  
(doc. Ing. Jiří Schimmel, Ph.D.)  
Introduction to Computer Typography and Graphics  
(doc. Mgr. Pavel Rajmic, Ph.D.)

Bachelor Thesis  
(doc. Ing. Petr Číka, Ph.D.)  
Cryptologic Protocol Theory  
(doc. Ing. Jan Hajný, Ph.D.)  
Introduction to Computer Typography and Graphics  
(doc. Mgr. Pavel Rajmic, Ph.D.)  
Security Systems  
(doc. Ing. Karel Burda, CSc.)  
Accesses and Transports Networks  
(doc. Ing. Vladislav Škorpil, CSc.)  
Network Architecture  
(doc. Ing. Vít Novotný, Ph.D.)  
Object Oriented Programming  
(doc. Ing. Ivo Lattenberg, Ph.D.)  
Transmission Media  
(prof. Ing. Miloslav Filka, CSc.)  
Hardware of Computer Networks  
(doc. Ing. Jaroslav Koton, Ph.D.)  
High-speed Communications Systems  
(doc. Ing. Vladislav Škorpil, CSc.)  
Practical Exercises in Information Networks  
(doc. Ing. Petr Číka, Ph.D.)

CISCO academy 1 – CCNA  
(doc. Ing. Dan Komosný, Ph.D.)

CISCO akademý 5 – CCNP  
(Ing. Anna Kubánková, Ph.D.)

CISCO akademý 3 – CCNP  
(doc. Ing. Jan Jeřábek, Ph.D.)

CISCO akademý 4 – CCNP  
(doc. Ing. Radim Burget, Ph.D.)

CISCO akademý 2 – CCNA  
(Ing. Anna Kubánková, Ph.D.)

### Master's Courses in Telecommunications and Information Technology

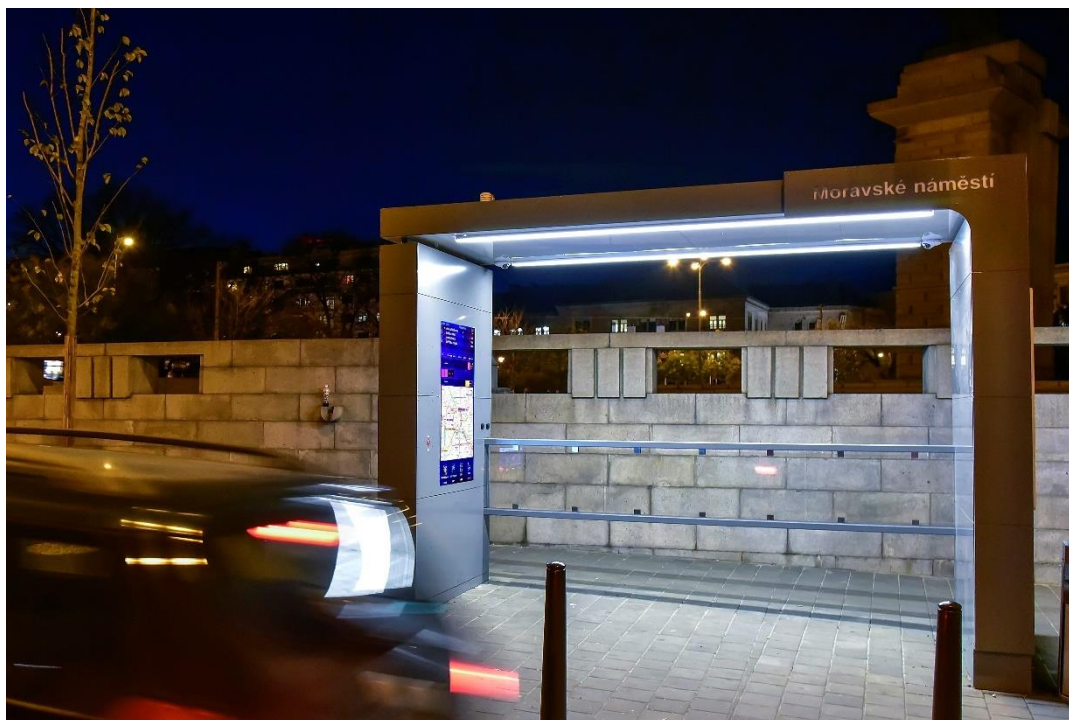
Information System Security  
(doc. Ing. Karel Burda, CSc.)  
CISCO Academy I  
(doc. Ing. Dan Komosný, Ph.D.)  
CISCO Academy II, V  
(Ing. Anna Kubánková, Ph.D.)  
CISCO Academy III  
(doc. Ing. Jan Jeřábek, Ph.D.)  
CISCO Academy IV  
(doc. Ing. Radim Burget, Ph.D.)  
Digital Audio Signal Processing  
(Ing. Miroslav Balík, Ph.D.)  
Digital Signal Processing  
(prof. Ing. Zdeněk Smékal, CSc.)  
Modern Computer Graphics  
(doc. Mgr. Pavel Rajmic, Ph.D.)  
Mobile Network Communication Systems  
(doc. Ing. Miloš Orgoň, Ph.D.)  
Cryptography  
(doc. Ing. Václav Zeman, Ph.D.)  
Modern Network Technologies  
(doc. Ing. Jaroslav Koton, Ph.D.)  
Multimedia  
(doc. Ing. Petr Číka, Ph.D.)  
Projecting, Administration and Security of Computer  
Networks  
(doc. Ing. Karel Burda, CSc.)  
Optical Networks  
(prof. Ing. Miloslav Filka, CSc.)

Computers and Peripheral Devices  
(Ing. Miroslav Balík, Ph.D.)  
Computer-Supported Solution of Engineering  
Problems  
(prof. Ing. Jiří Mišurec, CSc.)  
Modern Communication Techniques  
(doc. Ing. Jan Jeřábek, Ph.D.)  
Advanced Techniques of Image Processing  
(doc. Ing. Kamil Říha, Ph.D.)  
Wireless Sensor Networks  
(Ing. Ondřej Krajsa, Ph.D.)  
Digital Signal Processors  
(doc. Ing. Petr Sysel, Ph.D.)  
Services of Telecommunication Networks  
(doc. Ing. Vladislav Škorpil, CSc.)  
Theoretical Informatics  
(doc. Ing. Radim Burget, Ph.D.)  
Theory of Communication  
(Ing. Radim Číž, Ph.D.)  
Advanced Data Transmission Technology  
(doc. Ing. Václav Zeman, Ph.D.)  
A/D and D/A Converters  
(prof. Ing. Kamil Vrba, CSc.)  
Security Systems  
(doc. Ing. Karel Burda, CSc.)  
Speech Processing  
(prof. Ing. Zdeněk Smékal, CSc.)  
Telecommunication and Information Systems  
(Ing. Pavel Šilhavý, Ph.D.)

### Ph.D. Courses

Applied Cryptography  
(doc. Ing. Karel Burda, CSc.)

Modern Network Technologies  
(doc. Ing. Jaroslav Sklenář, CSc.)



The department participated in Research and Development project by designing smart cities. In 2018 it became a commercial company partner at supplying smart street furniture. Together with the partner two prototypes of smart public transport stop were constructed for the Dopravní podnik města Brna, a.s., placed at Moravské náměstí in Brno. The department provided the software design for smart panel, the weather station development and its connectivity to the internet.

## Laboratories

**Laboratory of Circuit Technology** (research of analog current-mode circuits, Kamil Vrba)

**Laboratory of Converged Networks** (research and instruction in modern data communication networks and services, 2G - 4G mobile telecommunication networks and systems for data network provision of voice and multimedia services, Vít Novotný, Pavel Šilhavý)

**Laboratory of Digital Music Studio** (instruction and research in real-time multichannel audio signal processing on PCs and embedded systems, Jiří Schimmel)

**Laboratory of Electroacoustics and Studio Technology** (anechoic chamber, instruction and research in measurement of electroacoustic converters, identification and analysis of sound sources, space acoustics, analysis and synthesis of sound fields, Jiří Schimmel)

**Acoustic Laboratory** (research in sound effects, multichannel sound systems, 3D audio, conference audio systems, Jiří Schimmel)

**Laboratory of Grid Technology** (instruction in network technologies, research of switch and indicator management, analysis of stationary and wireless local computer networks operation, modelling of algorithms used in modern data networks, Jaroslav Koton)

**Laboratory of Multimedia Services** (research in design and multimedia communication services including multimedia data digital processing, Petr Číka)

**Laboratory of Data Transmission** (instruction in data communication and research in data transmission, modulation methods and error-protection codes, esp. for xDSL and PLC systems, modelling of access network and end device characteristics, Pavel Šilhavý)

**Laboratory of Design Systems** (instruction in programming languages, modelling of communication systems, telecommunication networks and electronic circuits, research on modern communication technologies, design of electronic devices, Radim Číž)

**Laboratory of Sensor Systems and Signals** (instruction and research in sensor networks based on the IEEE 802.15.4 standard, analysis of Zigbee and 6lowPAN protocols, sensor units configuration, data transmission and wireless network management, microcontrollers Atmel AVR, Ondřej Krajsa)

**Laboratory of Telecommunication Systems** (instruction in Telecommunication Systems, research of error-free transmission of messages, modelling of anti-error code systems, Václav Zeman)

**Laboratory of Analog Circuits and Analog-Digital Conversion** (instruction and research of analog circuits and mutual analog-digital converters, David Kubánek)

**Laboratory of Communication Systems** (instruction and research in access and transportation networks, transportation and connection systems, converged telecommunication and computer networks, high-speed systems and telecommunication network services, Vladislav Škorpil)



**Laboratory of Transmission Networks** (research in FPGA and high-rate multimedia data transmission up to 100 Gb/s, Vladislav Škorpil)

**Laboratory of Acoustic Signal Processing** (design, optimisation and implementation of algorithms for speech and acoustic signal processing, optimisation of algorithms for multi-core computing systems, instruction in Digital Acoustic Signal Processing, computers and their peripherals, Miroslav Balík)

**Laboratory of Multimedia Signals** (research and development of multimedia embedded devices with ARM, Harvard architecture and VLIW architecture digital signal processors, optimization of algorithms for real-time digital signal processing, instruction in Signal Processors, Digital Filters and Digital Signal Processing, Petr Sysel)

**Research and Instruction Laboratory of Safety Systems** (research and development of cryptographic methods for communication and information systems, research and development of electronic protection systems, Karel Burda)

**Telepresence Studio** (research and development in videoconferencing and telepresenting services, Petr Číka)

## 7.11 Department of Theoretical and Experimental Electrical Engineering

**prof. Ing. Pavel Fiala, Ph.D.**

Head

Technická 3082/12

61600 Brno

tel.: 541 146 281

e-mail: utee@feec.vutbr.cz

### Professor Emeritus

prof. Ing. Libor Dědek, CSc.

### Professors

prof. Ing. Karel Bartušek, DrSc.

prof. Ing. Jarmila Dědková, CSc.

prof. Ing. Pavel Fiala, Ph.D.

prof. Ing. Eva Gescheidtová, CSc.

### Associate Professors

doc. Ing. Petr Drexler, Ph.D.

doc. Ing. Jan Mikulka, Ph.D.

doc. Ing. Jiří Sedláček, CSc.

doc. Ing. Miloslav Steinbauer, Ph.D.

doc. Mgr. Lenka Zajíčková, Ph.D.

### Lecturers

Ing. Tibor Bachorec, Ph.D., Ing. Martin Čáp, Ph.D., Mgr. Přemysl Dohnal, Ing. Martin Friedl, Ph.D., Ing. Radim Kadlec, Ph.D., Ing. Tomáš Kříž, Ph.D., Ing. Petr Marcoň, Ph.D., Ing. Dušan Nešpor, Ph.D., Ing. Zdeněk Roubal, Ph.D., Ing. Zoltán Szabó, Ph.D.

### Ph.D. Students

Ing. Jan Dušek, Ing. Tomáš Hejtmánek, Ing. Daniel Chalupa, Ing. Jiří Janoušek, Ing. Pavel Křepelka, Ing. Pavel Londák, Ing. Rastislav Motúz, Ing. Josef Pokorný, Ing. Jiří Sliž, Ing. Eliška Vlachová Hutová

### Administrative and Technical Staff

Eva Cupáková, Alena Javůrková, Otáhalová Veronika

### Main Interests

The department provides instruction in Bachelor, Master and Ph.D. programmes targeted at education in the key areas of electrical engineering through understanding of the basic principles of electrical engineering, safety issues, measurement of electrical and non-electrical characteristics with focus on special applications and numerical modelling of electromagnetic fields. Bachelor, Master and Ph.D. theses deal with topics of current and long-term research interests of the department, focusing mainly on nanoelectrotechnology (since 2007), photonics, biophotonics, modern mathematical and numerical analysis tools in electromagnetic field nanostructures and material engineering. Instruction is provided in up-to-date equipped laboratories, computer laboratories and a research laboratory for students' work on their diploma theses.

Research is conducted in laboratories fully equipped for research projects. The department focuses on research in numerical modelling of subatomic structures, periodical systems, photonics systems, deterministic macro-, micro- and nano-scopic models, wide-band signals, quadrupole resonance spectroscopy and specific designs of metamaterial and resonance structures for nuclear magnetic resonance and electron microscopy, optoelectronic and photonic measurements and metrology (GAČR). The research follows in the long term the analysis of numerical models of organic and anorganic systems associated with production technologies and design tests in the centre SIX, CVVOZE, and CEITEC following the IET methodology. The research is supported by GAČR.

In cooperation with IMI International, s. r. o. - Norgren CZ, research on graphene-based nanostructures is being conducted for applications in nanosensors (GAČR). Nanostructure plasma and its formation by electromagnetic field under cryogenic temperatures is researched as well. Another research issue is processing of images of magnetic resonance and electric impedance tomography. Research is also centred on MR and electric impedance tomography image processing, on the design of specific measuring methods, low-level and pulse signal processing and evaluation, and is supported by grant projects and contract cooperation with external partners and the industrial sector. Long-term safety research on the impact of electromagnetic fields on inanimate materials and living substance, pulse processes and wide-band detection methods has been pursued (GAČR projects, student theses).

Since 2007, basic research has been focused on the electromagnetic field design and analysis described by progressive numerical methods, design of atomic and subatomic substance structures, modelling and analysis of EMG characteristics of nanostructures and periodical structures of organic and anorganic nature, wideband signal processing, NMR, NQR, noise spectroscopy, specific metamaterial structures for NMR and electron microscopy, optical and optoelectronic measuring methods in EMG spectrum.

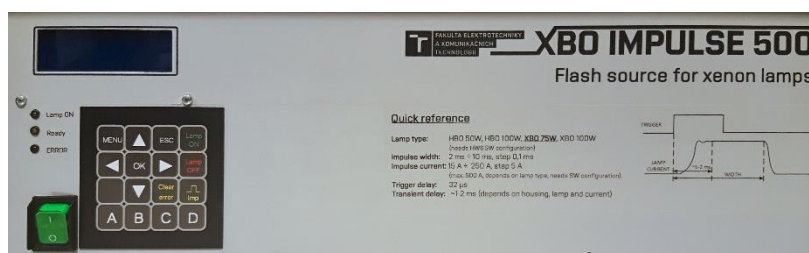
## Major Achievements

In 2018 a successful research cooperation with the TES s.r.o. company continued in design and development of partial discharge detection and localisation sensors in UHF power transformers. A new sensor prototype was developed and tested, being more compact, lighter and enabling connection with the central unit by a single transmission channel, securing sensor signal gains in power supply, control and high frequency signal transmission. Another success was a new compact and light prototype of a sub-nanosecond calibration signal generator with embedded control and power supply. These prototypes will be implemented in the MOSAD-PD-UHF diagnostics system, which will make the operation easier and shorten the transformation diagnostics.



Partial discharge UHF signal sensor and calibration impulses source

Based on the Masaryk University demand a novel impulse current source was designed and constructed, enabling xenon lamp power supply with the possibility of short-term power overload. The power source serves to flash spectrometry, enables a continuous Xe lamp operation and its current impulse overload up to 500 A. The source is protected against excessive overload and it has its control functions including the lamp wear expiration. The impulse source makes part of the modernised laser flash spectrometer at the Masaryk University.



Special impulse current source for xenon lamps

Research in image processing methods focused on processing and evaluation of NMR images and tests of novel imaging methods. Ph.D. study researched the influence of changes in geomagnetic field on the characteristics of an individual with predictable impact in the society (GAČR).

In 2018 the department was awarded with several patents. Further research is conducted in cooperation with contractual partners, such as the design and analysis of rail vehicle models for Škoda transportation a.s., models and analysis of innovative turnout lock, etc. Tests were performed on a functional sample of non-destructive evaluation of the distribution of composite material fibres. Research on generation and detection of isolated EMG pulses continued as well as the long-term research of periodical systems and structures in infrared EMG waves and their utilisation as an information element. Further research was focused on low-frequency harvesting as well as a study of vibrations of mini- and microgenerators. Properties of electromagnetically adjusted H<sub>2</sub>O were experimentally measured within the UV, X-ray and gamma (Am, St isotopes) range and the results were published under GAČR.

Work on the design of an operating sample of induction flow meter with measurement of average velocity up to

1 mm/s continued.

Long-term cooperation with PROTOTYPA, a. s. in research on special measuring methods for single processes continued, and preparatory exterior work is going on for location of a passive optical radar at Brno airport and monitoring to secure the external perimeter. Joint research on microtechnology and design of structures with Technische Universität Wien continued as well as the cooperation with Lublin University of Technology, Institute of Electronics and Information Technology, Poland, NETRIX, Lublin.

The department is involved in centres SIX a CVVOZE. In 2018 we participated in the international project 'Interdisciplinary Research of Wireless Technologies' (INWITE).

## Major Research Projects

### Interdisciplinary Research of Wireless Technologies – LO1401 (INWITE),

Investigators: Pavel Fiala, Petr Drexler

### Complex Artificial Electromagnetic Structures and Nanostructures – GAČR 17-00607S

Investigator: Pavel Fiala

### Spatial Analysis of the Force Load on a Deformed Developing Spine, and Corrective Force Modelling Applied to Minimize the Scope of a Scoliosis Surgery – Ministry of Health of the Czech Republic, NV18-08-00459,

Investigator: Jan Mikulka

### On-Chip Energy Storage for Autonomous Sensor Fields (CAPoC)- GAČR 17-27340S

Cooperation with Department of Microelectronics

### Development of a Wireless Data Transmission and Processing Device for Measuring Water, Heat and other Energies Flow Rate, Using LPWAN Network – project OP PIK, CZ.01.1.02/0.0/0.0/17\_107/0012319,

Investigator: Pavel Fiala

## Selected Publications

PAŘÍLKOVÁ, J.; MÜNSTEROVÁ, Z.; MIKULKA, J.; DUŠEK, J.; NOVOTNÁ, J.; JUŘIČKA, D.; GJUNSBURGS, B.; NEDEV, M.; YANEV, Y.; GOMBOŠ, M.; PAVELKOVÁ, D.; ZYDROŇ, T.; GRUCHOT, A. Utilization of earth electric impedance mapping in water engineering. ACTA HYDROLOGICA SLOVACA, 2018, vol. 19, no. 2, p. 287-295. ISSN: 1335-6291.

MACÍČEK, O.; JIŘÍK, R.; MIKULKA, J.; BARTOŠ, M.; ŠPRLÁKOVÁ, A.; KEŘKOVSKÝ, M.; STARČUK, Z.; BARTUŠEK, K.; TAXT, T. Time-Efficient Perfusion Imaging Using DCE- and DSC-MRI. Measurement Science Review, 2018, vol. 18, no. 6, p. 262-271. ISSN: 1335-8871.

CHALUPA, D.; MIKULKA, J. A Novel Tool for Supervised Segmentation Using 3D Slicer. Symmetry, 2018, vol. 10, no. 11, p. 1-9. ISSN: 2073-8994.

BACHOREC, T.; FIALA, P.; STEINBAUER, M.; ROUBAL, Z. A Non-Destructive Impedance Method Using Resonance to Evaluate the Concentration of Steel Fibers in Concrete. Measurement Science Review, 2018, vol. 18, no. 5, p. 218-226. ISSN: 1335-8871.

MARCOŇ, P.; ZEŽULKA, F.; BRADÁČ, Z. Terminology of Industry 4.0. Journal of the Technical University at Plovdiv. Fundamental Sciences and Applications, 2018, vol. 24, no. 1, p. 7-12. ISSN: 1310-8271.

KOMÁRKOVÁ, T.; FIALA, P.; STEINBAUER, M.; ROUBAL, Z. Testing an Impedance Non-destructive Method to Evaluate Steel-Fiber Concrete Samples. Measurement Science Review, 2018, vol. 18, no. 1, p. 35-40. ISSN: 1335-8871.

HANZELKA, M. Mediální archeologie v kontextu ekonomického růstu a uchování hodnoty. 2018, roč. JOINME, č. 2/2018, s. 1-11.

SZABÓ, Z.; FIALA, P.; DOHNAL, P. Magnetic circuit modifications in resonant vibration harvesters. MECHANICAL SYSTEMS AND SIGNAL PROCESSING, 2018, vol. 1, no. 99, p. 832-845. ISSN: 0888-3270.

## Bachelor's Courses

Safety in Electrical Engineering

(Ing. Radim Kadlec, Ph.D.)

Electrical Engineering Tutorial

(doc. Ing. Miloslav Steinbauer, Ph.D.)

Electrical Engineering

(Ing. Petr Marcoň, Ph.D.)

Electrical Engineering 1

(doc. Ing. Petr Drexler, Ph.D., prof. Ing. Jarmila

Dědková, CSc.)

Electrical Engineering 2

(doc. Ing. Jiří Sedláček, CSc., doc. Ing. Miloslav Steinbauer, Ph.D.)

Electrical Engineering for Audio Engineering

(doc. Ing. Petr Drexler, Ph.D.)

Measurement in Electrical Engineering

(prof. Ing. Karel Bartušek, DrSc., doc. Ing. Jan

Mikulka, Ph.D., prof. Ing. Eva Gescheidtová, CSc.)

Electrical Measurement for Audio Engineering

(prof. Ing. Karel Bartušek, DrSc.)

The C++ Programming Language

(prof. Ing. Pavel Fiala, Ph.D.)  
Computer Modeling of Electrical Devices and  
Components

(prof. Ing. Pavel Fiala, Ph.D.)  
Selected Topics of Electrical Engineering in English  
(Ing. Petr Marcoň, Ph.D.)

### Master's Courses

Safety in Electrical Engineering  
(Ing. Radim Kadlec, Ph.D.)  
Safety of Electrical Devices  
(doc. Ing. Miloslav Steinbauer, Ph.D.)

Electrical Installations  
(Ing. Radim Kadlec, Ph.D.)  
Electromagnetic Field Modeling  
(Ing. Tibor Bachorec, Ph.D.)

### Ph.D. Courses

Numerical Computations with Partial Differential  
Equations (prof. Ing. Pavel Fiala, Ph.D.)

Special Measurement Methods  
(prof. Ing. Karel Bartušek, DrSc.)

### Laboratories

**Laboratory of Electrical Measurements** (instruction in Measurements in Electrical Engineering and Measurements in Electrical Engineering for Audio Engineering, Zoltán Szabó)

**Laboratory of Electrical Engineering** (instruction in Electrical Engineering 1,2 and Electrical Engineering for Audio Engineering, Martin Friedl)

**Laboratory of Electrical Engineering and Electrical Installations** (instruction laboratory for Electrical Installations, Electrotechnical Seminar and Electrical Engineering, Radim Kadlec)

**IET Laboratory** (instruction laboratory, Miloslav Steinbauer)

**Computer Laboratory of Electrical Engineering** (instruction in Electrical Engineering 1 and 2, Electrical Engineering for Audio Engineering, Miloslav Steinbauer)

**Computer Laboratory** (instruction in Electrotechnical Seminar, Modelling of Electromagnetic Fields Computer Modelling of Electrical Devices and Components and Seminar C++, Miloslav Steinbauer)

**Seminar Laboratory** (Miloslav Steinbauer)

**Research Laboratory of Magnetic Measurement** (research laboratory of magnetic measurement, Zdeněk Roubal)

**Research Laboratory of Light Technology** (measurement of the parameters of light sources, Zdeněk Roubal)

**Restricted Access Laboratory** (basic and applied research of numerical methods, Pavel Fiala)

**Low-Level Measurement Laboratory** (Zdeněk Roubal)

**Research Laboratory for Student Theses** (research laboratory for students, Martin Friedl)

**Laboratory of Printed Circuit Boards** (development of printed circuit boards, Zoltán Szabó)

**Research Laboratory for Prototype Development** (research laboratory for Ph.D. students, Martin Friedl)

**Research Laboratory of Pulse Sources and Microwave Devices** (basic research of pulse sources, low-noise measurements, shielded laboratory, semi-anechoic laboratory, Pavel Fiala)

**Laboratory of Modelling and Optimisation in Electromechanical Systems FEEC BUT** (basic research of numerical modelling, EMG fields analysis, Pavel Fiala)

**Research Laboratory of Electro-Optics and Laser Technology** (optoelectronic measuring methods, Petr Drexler)



## 7.12 Department of Power Electrical and Electronic Engineering

### doc. Ing. Ondřej Vítek, Ph.D.

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### Professors

prof. RNDr. Vladimír Aubrecht, CSc.

prof. Ing. Vítězslav Hájek, CSc.

### Associate Professors

doc. Ing. Bohuslav Bušov, CSc.

doc. Ing. Radoslav Cipín, Ph.D.

doc. Ing. Čestmír Ondrůšek, CSc.

doc. Dr. Ing. Miroslav Patočka,

doc. Ing. František Veselka, CSc.

doc. Ing. Ondřej Vítek, Ph.D.

doc. Ing. Pavel Vorel, Ph.D.

### Lecturers

Ing. Jan Bárta, Ph.D., Ing. Dalibor Červinka, Ph.D., Ing. Petr Huták, Ph.D., Ing. Marcel Janda, Ph.D., Mgr. Petr Kloc, Ph.D., Ing. Martin Mach, Ph.D., Ing. Ivo Pazdera, Ph.D., Ing. Petr Procházka, Ph.D., Ing. Jiří Valenta, Ph.D.

### Ph.D. Students

Ing. Dušan Benda, Ing. Jan Bulín, Ing. Jiří Ctibor, Ing. Lukáš Dostál, Ing. Martin Folprecht, Ing. Jaroslav Chlup, lelyzaveta Ishkova, Ing. Jiří Klíma, Ing. Jan Martiš, Ing. Jan Mikláš, Ing. Lukáš Mišinger, Ing. Veronika Novotná, Ing. Jan Pígl, Ing. Matřin Prudík, Ing. Ondřej Rubeš, Ing. Josef Samek, Ing. David Šimek, Ing. Michal Šír, Ing. Petr Španěl, Ing. Marek Toman, Ing. Adam Vašíček

### Administrative and Technical Staff

Ing. Zdeněk Feiler, Ph.D., Zdeněk Liška, Josef Němec, Bc. Lucie Sobolová

### Main Interests

The department provides instruction in the study area 'Power Electrical and Electronic Engineering' in the Bachelor and Ph.D. programmes and in the study areas 'Power Electrical Engineering and Power Electronics' in the Master degree programme. Instruction is focused on the theory and construction of electrical machines and devices, CAD systems including solutions for electromagnetic and thermal fields and optimisation methods for construction designs. The design, size, control and dynamics of electromechanical systems are the subject of instruction in electrical drives. Another area of interest is power electronics including DC/DC pulse converters (switching sources), DC/AC alternators, rectifiers etc. Attention is paid to the theory of regulation and digital control.

In basic research, the department deals with theoretical modelling of radiation energy transport in thermal plasma. Currently we are involved in basic research for medical purposes, in the development of a special high voltage pulse source for electroporation of cancer cells.

In applied research, electric machines, power electronics and electric drives and devices are in the focus of interest. Research is centered on low-voltage machines used in automotive industry, synchronous machines with permanent magnets, asynchronous and DC machines, and recently high-revolution asynchronous motors. The department's staff is experienced in the development of special machines such as starter generators, controlled magnetic bearings and magnetic levitation systems. They focused on power exploitation for electric arc extinction in low- and high-voltage devices, power converters of extreme parameters. Research on electric drives deals with

optimal regulation of electrical drives, especially loss minimisation in traction drives, implementation of ultracapacitors, accumulators and fuel cells in the system of traction drives.

The department cooperates with a number of universities, e.g. SPGU in Petersburg, TU Pskov, TU Omsk, TU Delft, TU Žilina, LUT Lappeenranta, MU Brno, Mendel University in Brno and industrial companies and institutions, such as JSC Electrocontact (Kineshma-RF), Siemens Elektromotory Mohelnice, Siemens Electric Machines s.r.o. Drásov, OEZ Letohrad, ATAS Náchod, EMP Slavkov u Brna, VUES Brno a.s., IVEP Brno, ŠLP Křtiny a.s., Tesla Blatná, AGAMA a. s., BAUMÜLLER BRNO, s.r.o., První brněnská strojirna Velká Bíteš, a.s., TES VSETÍN s.r.o. and other.



Testing of electroperforational UVEE device for cardio arrhythmia removal

## Major Achievements

In switching devices laboratory 32 contractual orders for electric devices and switchboards were completed for both Czech and foreign industrial partners, such as shooting and analysis of high-speed video recording with arc light suppression by special filters and laser lightning when studying high voltage switchboard components. Another achievement was the evaluation of electric arc influence on protective gear for short circuit, including the plasma temperature evaluation by optical emission spectrometry.

In electric devices a sample of an asynchronous machine with the output of 50 kW at the revolution 50000 min<sup>-1</sup> was realised and a machine sample with the output of 12 kW at the revolution 45000 min<sup>-1</sup>. Furthermore, an electromagnetic, thermal and mechanical synchronous motor design was made with permanent magnets and the sample performed output of 1.5 kW at the revolution 1500 min<sup>-1</sup>. Together with the Baumüller company the department worked on the optimisation of an assisted reluctance motor with 55 kW output and a revolution 100 min<sup>-1</sup>. In cooperation with PBS the department focused on the optimisation of eddy-current break with the output of 2, 3 and 5 kW at the revolution ranging from 150 000 -230 000 min<sup>-1</sup>, which is also used in cryogenics. The department also cooperated with Atas company on the research of resolvers with better properties and of highly efficient small asynchronous motors. In cooperation with the Faculty of Mechanical Engineering the research on hybrid pump system power was carried out. With the TES Vsetín company an electromagnetic design of a pilot driver was made with 3.2 kW at the revolution 750, 1000, 1500 min<sup>-1</sup>.

In the field of electric drive a prototype of a three-phase switch with the output of 50 kW at the revolution 50 000 min<sup>-1</sup> for high-revolution asynchronous motor was tested. In cooperation with AGAMA a fully functional prototype of a tractor unit with an additional electric drive accumulator was constructed, as well as the concept of an electric drive harvester.

In power electronics a device for wireless transmission of high output of 2.5 kW was developed. This output is transmitted by coils with the diameter of 30 cm at the distance of 25 cm. The device is easily constructed, yet with good performance parameters, which is enabled by PDM. The total efficiency is up to 91% and its working frequency is 320 kHz.

The department researches the development of cell electroporation devices in the long run. In 2018 the AC high frequency electroporation generator was complemented by system synchronisation with patient's heart beat, which enabled its usage at the myocard surgeries. The Ahythmology clinics ICRC FNUSA Brno researchers performed unique experiments at the University of Veterinary and Pharmaceutical Sciences in Brno when they tested successfully the electroporation for cardio arhythmia removal. The cooperation with the Clinic of Radiology and Nuclear Medicine of the University Hospital Brno is successfully carried out in which the novel AC generator is tested for the bile stenosis and in the future it should replace the direct electroporation one.

In terms of foreign cooperation an internship at the University of Padua was realised and another one was at the Lappeenranta University of Technology in Finland.

## Major Research Projects

### **Energy in Conditions of Sustainable Development (EN-PUR) – LO1210**

Investigator: Vladimír Aubrecht

### **Resolvers - Modern Position Sensors – FV10195**

Investigator: Vítězslav Hájek.

### **Special Rotary Machine Engineering Centre - TE02000232,**

Investigator: Čestmír Ondrůšek

### **Harvester Prototype with a Multifunctional Carriage and a Hybrid Drive**

Investigator: Petr Procházka

### **High-efficiency Machines Controlled by Net**

Investigator: Jan Bárta, Ph.D.

### **Transport Tractor Set with Hybrid Drive –TH02010115.**

Investigator: Ondřej Vítek

### **Research and development of assisted reluctance synchronous motors series up to 55kW**

Investigator: Čestmír Ondrůšek

## Selected Publications

PROCHÁZKA, P.; PAZDERA, I.; CIPÍN, R.; VOREL, P.; KNOBLOCH, J. Battery Powered Mini-Excavator. ECS Transactions, 2018, vol. 87, no. 1, p. 343-347. ISSN: 1938-5862.

CIPÍN, R.; TOMAN, M.; PROCHÁZKA, P.; PAZDERA, I. High-Frequency Model of Battery in Form of Transfer Function. ECS Transactions, 2018, vol. 87, no. 1, p. 269-274. ISSN: 1938-5862.

TOMAN, M.; CIPÍN, R.; VOREL, P. Thermal Network for Battery Cell Temperature Modeling. ECS Transactions, 2018, vol. 87, no. 1, p. 285-290. ISSN: 1938-5862.

MARTIŠ, J.; VOREL, P.; ČERVINKA, D. Battery-powered Soldering Gun. ECS Transactions, 2018, vol. 87, no. 1, p. 1-6. ISSN: 1938-5862.

JANDOVÁ, K.; JANDA, M. Wind Effect Simulation on Photovoltaic Modules. ECS Transactions, 2018, no. 87, p. 411-413. ISSN: 1938-5862.

VESELKA, F. Aplikace kluzného kontaktu v elektrických strojích. 7. Část – 2. díl – Kluzný kontakt ve válcovenských strojích. Electro, 2018, roč. 28, č. 11, s. 64-65. ISSN: 1210-0889.

VESELKA, F. Nová koncepce sběracího ústrojí elektrického stroje. Electro, 2018, roč. 28, č. 12, s. 64-65. ISSN: 1210-0889.

VESELKA, F. Aplikace kluzného kontaktu v elektrických strojích. 8. Část – Speciální elektrické stroje. Electro, 2018, roč. 28, č. 12, s. 64-65. ISSN: 1210-0889.

ZÁHEJSKÝ, P.; VESELKA, F.; SHESTAKOV, I. Problematika diagnostiky izolačních systémů a praktické využití prachových částic. Elektrotechnika v praxi, 2018, roč. 28, č. 9-10, s. 48-51. ISSN: 0862-9730.

VESELKA, F. Aplikace kluzného kontaktu v elektrických strojích. 6. Část - Turbogenerátory. Electro, 2018, roč. 28, č. 7, s. 64-65. ISSN: 1210-0889.

VESELKA, F. Aplikace kluzného kontaktu v elektrických strojích. 5. Část - Hydrogenerátory. Electro, 2018, roč. 28, č. 6, s. 64-65. ISSN: 1210-0889.

DOSTÁL, L.; VALENTA, J.; ŠIMEK, D. Low-Voltage Circuit-Breaker Behavior under Overload Conditions. Plasma Physics and Technology, 2018, vol. 5, no. 1, p. 1-4. ISSN: 2336-2626.

VESELKA, F. Aplikace kluzného kontaktu v elektrických strojích, 4. Část – Kloubové tramvaje. Electro, 2018, roč. 28, č. 5, s. 63-64. ISSN: 1210-0889.

KLÍMA, J.; NERG, J.; BÁRTA, J.; VÍTEK, O. The impact of the rotor slit number on the behavior of high-speed induction motor. Przegląd Elektrotechniczny, 2018, vol. 2018, no. 5, p. 7-13. ISSN: 0033-2097.

VESELKA, F. Inovace komponent kluzného kontaktu - 9. část. Electro, 2018, roč. 28, č. 1, s. 62-64. ISSN: 1210-0889.

JENIŠTA, J.; TAKANA, H.; UEHARA, S.; NISHIYAMA, H.; BARTLOVÁ, M.; AUBRECHT, V.; MURPHY, A. Modeling of inhomogeneous mixing of plasma species in argon–steam arc discharge. *Journal of Physics D - Applied Physics*, 2018, vol. 51, no. 4, p. 1-22. ISSN: 1361-6463.

### Bachelor's Courses

Computers and Programming 1

(prof. RNDr. Vladimír Aubrecht, CSc.)

Computer Science in High Power Engineering

(Ing. Marcel Janda, Ph.D.)

Power Electronics

(doc. Dr. Ing. Miroslav Patočka)

Electrical Apparatus

(doc. Ing. Bohuslav Bušov, CSc.)

Electrical Machines

(doc. Ing. Čestmír Ondrůšek, CSc.)

Control Theory

(Ing. Petr Huták, Ph.D.)

Electrical Drives

Ing. Dalibor Červinka, Ph.D.)

Automobile Electric and Electronic Systems

(prof. Ing. Vítězslav Hájek, CSc.)

Control Electronics

(doc. Dr. Ing. Miroslav Patočka)

Electrical Machines 2

(doc. Ing. Ondřej Vítek, Ph.D.)

Electrotechnical Inspection and Supervision

(doc. Ing. František Veselka, CSc.)

Microprocessor Technics for Drives

(Ing. Ivo Pazdera, Ph.D.)

Computer Aided Design

(Ing. Marcel Janda, Ph.D.)

### Master's Courses

Electromechanical System Dynamics

(doc. Ing. Čestmír Ondrůšek, CSc.)

Technika výkonových měničů

(doc. Dr. Ing. Miroslav Patočka)

Computer Modelling in Power Electrical Engineering

(Ing. Marcel Janda, Ph.D.)

Control of Dynamic Systems

(Ing. Petr Huták, Ph.D.)

Laboratory of Electrical Machines and Apparatus

(Ing. Marcel Janda, Ph.D.)

Industrial Electronics

(doc. Ing. Pavel Vorel, Ph.D.)

AC Drives

(Ing. Ivo Pazdera, Ph.D.)

Electrical Microdrives

(doc. Ing. Ondřej Vítek, Ph.D.)

Electrical Controlled Drives

(Ing. Dalibor Červinka, Ph.D.)

Power Converter Design

(doc. Dr. Ing. Miroslav Patočka)

Adaptive and Optimal Control of Drives

(Ing. Petr Huták, Ph.D.)

Diagnostics and Electrical Equipments Protections

(Ing. Jiří Valenta, Ph.D.)

Project Management of Innovation

(doc. Ing. Bohuslav Bušov, CSc.)

Control Elements in Electrical Drives

(doc. Ing. Pavel Vorel, Ph.D.)

Construction and Production of Electrical Equipments

(doc. Ing. Bohuslav Bušov, CSc.)

Microcomputer Control of Electrical Drives

(Ing. Ivo Pazdera, Ph.D.)

### Ph.D. Courses

Topical Issues of Electrical Machines and Apparatus

(doc. Ing. Čestmír Ondrůšek, CSc.)

Selected Problems from Power Electronics and Electrical Drives

(prof. Ing. Jiří Skalický, CSc.)

### Laboratories

**Laboratory of Electrical Machines** (research on commutation of electrical machines, measurement of medium-power output, magnetic bearings, automated measurements, Ondřej Vítek)

**Laboratory of Mechatronics** (Ondřej Vítek)

**Laboratory of Electrical Devices** (switching devices, Bohuslav Bušov)

**Laboratory of Holographic Interferometry** (optical stand for holographic interferometry, e.g. diagnostics of rotating machine vibrations, Marcel Janda)

**Laboratory of Electrical Drives** (electrical drives with focus on independent traction, Dalibor Červinka)

**Laboratory of Power Electronics** (research in pulse converters of different outputs, Petr Procházka)



**Laboratory of High-Current Electronics** (research on DC/DC converters, alternators and low-voltage brushless drives, Dalibor Červinka)

**Laboratory of Dynamic Properties of Electrical Machines** (experimental analysis of transient performances in electrical machines, Ondřej Vítek)

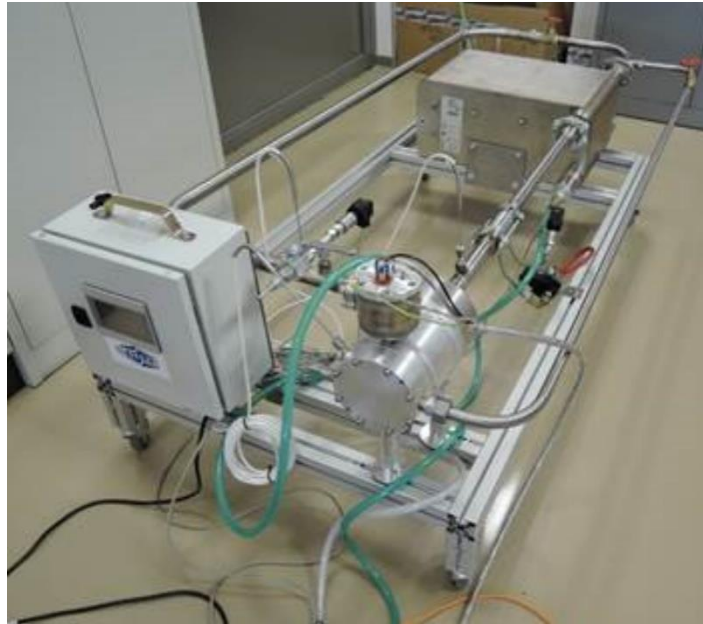
**Laboratory of Control Electronics** (Pavel Vorel)

**Laboratory of Microprocessor Technology** (Bohumil Klíma)

**Laboratory of Microelectromechanical Systems** (Radoslav Cipín)

**Laboratory of Power Electronics 2** (Pavel Vorel)

**Research and Development Laboratory** (Petr Procházka)



Helium turbocirculator with asynchronous motor 6 kW, 120 000 min<sup>-1</sup> being tested



## 8 Final Evaluation of Faculty Activities

In the education field we can consider a major faculty achievement a successful accreditation of all Bachelor study programmes in Audioengineering, Automation and Measurement, Electronics and Communication Technologies, Microelectronics and Technology, Power Electrical and Electronic Engineering, Telecommunication and Information Systems, Information Security and follow-up Master study programmes Audioengineering, Biomedical Engineering and Bioinformatics. Subsequently, accreditation applications for follow-up Master and Ph.D. study programmes were prepared.

The faculty actively participated in application preparation for institutional accreditation in instruction fields of Electrical Engineering, Power Electrical Engineering and Informatics, which significantly contributed to the fact that the National Accreditation Bureau awarded the Brno University of Technology with the institutional accreditation as the first technical college in the Czech Republic.

The faculty reached satisfactory economic results in 2018. Income from the instruction activities rose by 10% compared to 2017. The amount of financial means from funding bodies increased significantly in comparison to the previous year. The overall project activities profit reached almost 300 mil. CZK, which ensured substantial faculty income for the successful grant investigators, namely from the Czech Science Foundation (GAČR), Technology Agency of the Czech Republic (TAČR), Ministry of Industry and Trade (MPO), Ministry of the Interior (MV), NPU ENPUR and INWITE. The Operational Programme Research, Development and Education also brought a significant rise in income. The faculty followed the increasing trend in economic activities income. The income from contractual research orders increased interannually by 10 mil CZK and in total it exceeded 40 mil. CZK.

Congratulations and highest appraisal to all faculty staff and Ph.D. students.

*prof. RNDr. Vladimír Aubrecht, CSc.*

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