
**DEPARTMENT OF ELECTRONICS AND
MULTIMEDIA TELECOMMUNICATIONS**



Annual Report
2018

Technical University of Košice
Faculty of Electrical Engineering and Informatics

TECHNICAL UNIVERSITY OF KOŠICE
Faculty of Electrical Engineering and Informatics
(Slovak Republic)

DEPARTMENT OF ELECTRONICS AND
MULTIMEDIA TELECOMMUNICATIONS

ANNUAL REPORT 2018

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1 DEPARTMENT PROFILE

1.1 Brief overview

The Department of Electronics and Multimedia Communications was founded in 1969. The original name of department was Department of Electronics. The Department offers three types of full-time courses:

Bachelor's Degree course lasts in normal way 3 years and is leading to degree Bc. The graduates get more-or-less practical skills in mastering

- ◆ Computer Networks,
- ◆ Intelligent Electronics,
- ◆ Multimedia Communication Technologies.

Master's Degree course lasts in normal way 2 years and is leading to degree Ing. The graduates get theoretical and practical skills in specialization

- ◆ Computer Networks,
- ◆ Smart Electronics,
- ◆ Multimedia Communication Technologies.

Doctoral Study course lasts in normal way 4 years and is leading to degree PhD. The graduates get erudition in scientific areas

- ◆ Computer Networks,
- ◆ Electronic Systems and Signal Processing,
- ◆ Multimedia Communication Technologies.

Teaching and research activities of the department are focused on advanced technologies of computer networks, electronics, telecommunications and smart measuring systems. In addition to the theoretical and practical basics, the teaching is more concentrated on basics of computer and software engineering, operating and database systems, computer networks, transmission media, computer systems architecture, mobile and satellite technologies and services, automotive electronics, digital processing and transmission of multimedia signals (image, video, speech), cryptography and security in computer and telecommunication networks, optoelectronics and optical communication, sensor systems, interactive telecommunications systems and services.

1.2 Department staff and structure

Total number of staff members is 28 (26).

- ◆ Professors: Anton Čižmár, Miloš Drutarovský, Pavol Galajda, Jozef Juhár, Dušan Kocur, Dušan Levický, Stanislav Marcheviský, Ján Mihalík, Linus Michaeli, Ján Šaliga, Ján Turán
- ◆ Associate Professors: Ľubomír Doboš, Ján Gamec, Ľuboš Ovseník, Ján Papaj
- ◆ Assistant Professors: Gabriel Bugár, Mária Gamcová, Iveta Gladišová, Daniel Hládek, Ľudmila Maceková, Stanislav Ondáš, Matúš Pleva, Ján Staš
- ◆ Research Assistant: Martin Lojka, Mária Švecová (until April 30, 2018), Peter Vizslay (until November 30, 2018)
- ◆ Support staff: Zuzana Bugárová, Viera Šumáková

2 DIVISIONS OF THE DEPARTMENT

2.1 Teaching and research laboratories

Laboratory of Multimedia Communications

Head: Professor: prof. Ing. Dušan Levický, CSc., Member of the IEEE

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Research Assistant: Ing. Peter Vizslay, PhD.

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Laboratory of Digital Signal Processing and Satellite Communications

Head: Professor: prof. Ing. Stanislav Marchevský, CSc.

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Professor: prof. Ing. Dušan Kocur, CSc.

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Assistant professor: Ing. Ľudmila Maceková, PhD.

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Laboratory of Digital Image Processing and Videocommunication

<http://www.tuke.sk/fei-ldipv/>

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Laboratory of Optoelectronic Communications

<http://los.fei.tuke.sk/>

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Laboratory of Electronic Circuits & Measurement

Head: Professor: prof. Ing. Linus Michaeli, DrSc., Member of the IEEE

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2.2 Special laboratories and equipment

Laboratory of measurement is equipped by various analog and digital electronic instrumentations, data acquisition cards, computers and software as follows:

- Agilent 81150A-002 2-channel 120 MHz Pulse-Function-Arbitrary Generator,
- Fast precise digitizer NI PXI-1033, NI PXI-5922, NI PXI-6552 100 MHz, 24 bits,
- 3 GHz spectrum analyser N9320B-TG3 3GHz with Tracking Generator,
- RF vector signal generator and analyser based on PXI by National Instruments,
- Sound and vibration analyser based on PXI - NI PXI-1033, NI PXI-4461, (24 Bit, 204.8 kS/s), NI PXI-6251,
- Reconfigurable PXI system based on FlexRIO by NI,
- Precise multimeter Agilent 3458,
- 500MHz oscilloscope with logic analyser Agilent MSO7054,
- EMC chamber,
- RLCG meter 3532-50 LCR HiTester,
- NI ELVIS II + Emona DATEx Telecommunication Board for ELVIS; Emona ETT-211 FOTEX-Fiber Optic Comm Trainer, FPGA development boards,
- Agilent N9310A RF Signal generator 9KHz to 3.0GHz,
- Logic analyser Tektronix TLA5201B,
- Arbitrary generators Agilent 33220A, Rigol, etc.,
- Digital oscilloscopes (Agilent, Tektronix, Rigol, etc.),
- Function signal generators (Agilent, Panasonic, Metex),
- Handheld multimeter (Metex, Unitest),
- Calibrator Stanford Research,
- Multimeters (Agilent 34405A, Unitrend),
- Programmable power supplies Agilent,
- Measurement systems based on PXI by National Instruments,
- Multifunction DAQ cards up to 2MHz and 18 bits by National Instruments,
- Communication cards and modules by National Instruments, e.g., GPIB, CAN, RS488, etc.,
- Remotely accessible (across the Internet) demonstration and educational stand with DAQ cards and electronic boards,
- Department multilicense for all software by NI (LabVIEW, CVI, ...).

Laboratory of communication technologies and advanced digital signal processing

- Equipment for interactive multiview video streaming for supporting education:
 - ◆ Server HP ML350pT08 E5-2609v2; HDD HP 3TB 6G SATA 7.2k
 - ◆ 3 x camera system (Bosh NBN-932V-IP DinionHD; Objektiv BoshLVF-5003N-,1/2", Cmount, 3.8-13mm, SR-IRIS; Stativ Velbon EX-630)
 - ◆ Cisco WS-C2960C-8PC-L (PoE switch)
- Advanced measurement equipment:
 - ◆ M-sequence UWB radar (frequency band: 0.2-6.5 GHz),
 - ◆ M-sequence UWB radar (frequency band: DC-2.25 GHz),
 - ◆ impulse UWB radar (frequency band: 0.1-6 GHz),
 - ◆ Anritsu MG3700A vector signal generator,
 - ◆ Tektronix digital storage oscilloscopes,
 - ◆ Agilent logic analyzer,
 - ◆ WiFi 802.11a/b/g link.

- Video and audio processing equipment:
 - ◆ Handycam SONY DCR SR 290,
 - ◆ 3CCD HDD camera Everio for HDD recording,
 - ◆ computer INTEL Pentium IV with satellite card STAR for reception and recording of packet oriented services and transmission of video-streams into IP networks,
 - ◆ satellite Dreambox receiver supported by computer with Linux operating system,
 - ◆ satellite receiver with 125cm parabola antenna and DISEC motor, combined DVB-S and DVB-T receiver,
 - ◆ GPS receivers ASUS, large plasma SAMSUNG display with 108 cm diagonal,
 - ◆ Pioneer sound laboratory system with recording and reproducing capabilities.
- Computers:
 - ◆ 4-core application DELL server,
 - ◆ 11 PC Pentium IV computers (2,8 GHz, HDD 200GB) and 10x 17''-LCD monitors.
- Software tools and development boards:
 - ◆ SystemView and IT ++ simulation software,
 - ◆ CAD-CAE development tools for FPGA Mentor Graphics (26 licenses) and Altera; FPGAs (16 licenses), Nanometer IC Design- HEP (Higher Educational Program) Mentor Graphics (30 licenses)
 - ◆ development tools for Analog Devices Blackfin DSPs (16 licenses),
 - ◆ Altera FPGA development boards:
 - 1x UP-1 basic development board for Altera FLEX10K FPGA family,
 - 2x UP-3 basic development board for Altera Cyclone FPAG family,
 - 1x NIOS II development board for synthetic 32-bit soft processors in Altera Cyclone FPGAs,
 - 1x Stratix DSP development kit for testing and development DSP algorithms in Stratix FPGA, support for analog signal processing up to 100 MHz , integrated AD and DA converter; 1xCyclone II DSP development kit with video input daughtercard for testing and development of video signals in Cyclone II FPGA.
 - ◆ Analog Devices Blackfin DSP development boards:
 - 8x development board EZ-KIT 533 600 MHz with Analog Devices signal processor Blackfin ADSP21533,
 - 2x development board EZ-KIT 561 600 MHz with Analog Devices signal processor Blackfin ADSP21561,
 - 5x development board EZ-KIT 535 350 MHz signal processor Analog Devices Blackfin ADSP21535,
 - 2x extender for video signal processing with Blackfin DSPs; 1x HS-USB Emulator for Blackfin DSPs.
 - ◆ Development boards for 32-bit Freescale microcontrollers:
 - 10 x development board of 32-bit microcontroller Freescale M52233DEMO with ColdFire V2 core and integrated Ethernet communication interface,
 - 2 x development board Freescale M5329EVB with ColdFire V3 core and cryptographic coprocessor.
 - ◆ Freescale development tools for RadioFerequency (RF) ZigBee networks:
 - 1x 1321xNSK: Freescale Network Starter Kit with highly integrated chips (CPU + RF), external emulation interface,
 - 8x ZigBee RF interface with integrated 2.4 GHz antenna and SPI interface.
 - ◆ Development tools for 8-bits microcontrollers:
 - 7x development boards based on Analog Devices ADuC83x microconverters with embedded 16 a 24-bits AD converters.

Laboratory of optoelectronics

- Fiber optic education system:
 - ◆ Optical bench with 2 x HeNe laser,
 - ◆ Fiber optic power meter,
 - ◆ Fibre optic transmitter (7 x transmit module with LED diode – 565, 583, 635, 660, 830, 850 and 900 nm),
 - ◆ Fibre optic receiver (2 x receive module with PIN diode),
 - ◆ Optical bench (the simulate attenuation: air gap, axial displacement and angle of approach),
 - ◆ Fiber optic (plastic fibre 0.5, 5, 10, 20 and 50 m; glass fibre 1 and 20 m),
 - ◆ Coaxial cable (100 m),
 - ◆ Storage case (add-on transformer),
 - ◆ Opto-couplers.
- Unique optoelectronic devices:
 - ◆ Optical Cambridge correlators,
 - ◆ Fiber optic refractometer,
 - ◆ Optically powered system,
 - ◆ Weather sensor (measured: temperature, relative humidity, density of floating particles in the air).
- Advanced optoelectronic equipment:
 - ◆ FSO system LightPointe Flight Strata 155E (Free-space wavelength 850 nm, full-duplex 155 Mbps, operational range 2000 m clear air and 1000 m extreme rain),
 - ◆ FSO system FSona SONAbeam™ 155-E (Free-space wavelength 1550 nm, full-duplex 125 Mbps, operational range 3500 m clear air and 1700 m extreme rain),
 - ◆ Near-Infrared Spectrometer NIRQuest256-2.1 (wavelength range: 900 to 2050 nm),
 - ◆ OTDR: EXFO FTB-200 (compact platform for multilayer, multimedium testing),
 - ◆ All-Fibre Handheld OTDR—AXS-110 (wavelengths: 1310/1490/1550/1625/850/1300 nm),
 - ◆ Fusion splicer Fitel S178 (applicable fibers: SM, MM, DSF, NZD, EDF, BIF/UBIF (Bend insensitive fiber)),
 - ◆ Fiber Power Meters KI 7600C Series (options for 600 - 1700 nm, +27 to -70 dBm, SMF, MMF and large core (0.2 - 3 mm) fiber).
- Computers:
 - ◆ Server (PC Pentium III),
 - ◆ 2 x PC Pentium IV computers (2,8 GHz, HDD 200GB),
 - ◆ 6 x Laptop,
 - ◆ Switches (16 ports and 8 ports)
 - ◆ Web cameras, printers, scanners,...
- Software tools:
 - ◆ System RSoft's simulation software of optical communication:
 - Software OptSim (simulate single mode optical communication systems at the signal propagation level),
 - Software ModeSYS (simulate multimode optical communication systems at the signal propagation level),
- Microwave measuring bench for cm waves with klystron power.

Laboratory of multimedia and network security

- Advanced equipment:
 - ◆ 6x VoIP phones,
 - ◆ 3x Wireless LAN controllers,

- ◆ Intrusion detection system,
- ◆ 3x Terminal server AUX,
- ◆ Exchange for DSL,
- ◆ Exchange for PSTN.
- Computers:
 - ◆ Server (Monitor, CD/DVD/Blue ray,...),
 - ◆ 6x Switch,
 - ◆ 9x L3 Switch distribution,
 - ◆ Wifi 802.11a/b/g Access Point (Asus WL 520g),
 - ◆ 6x Access point,
 - ◆ 6x Lightweight Access Point,
 - ◆ 12x PC Pentium IV (2,8 GHz, HDD 200GB, Windows/Linux),
 - ◆ 13x 17''-LCD monitors, LCD TV Samsung 40'' Full HD,
 - ◆ 6x Web cameras,
 - ◆ 10x Routers (3x with VoIP accessories),
 - ◆ 2x Firewall (for VoIP services).
- Videoconferencing system Eagle,
- Magio box.

Laboratory of speech and mobile technologies in telecommunications

- Telecommunication server, equipped with 12 port Dialogic D120JCT, three GSM gateways, Skype box, SIP Linksys Gateway, Cisco VoIP Gateway a PSTN link,
- Spoken language dialogue system, developed in the scope of national research project, enabling information retrieval using voice interaction between human and computer in Slovak language through telecommunication network and it finds information distributed in Internet (prototype). It serves as platform for development of speech and mobile technologies and human – computer interaction,
 - Application server for research and development in the domain of speech and language technologies (E3-1230 v5 @ 3.40GHz, 64GB RAM, 4TB HDD, OS Debian Linux),
- Computing server for speech analysis and synthesis (HP ProLiant DL380 G7, 2xCore2Quad 2.4GHz, 96GB RAM, 4x HP 900-GB 6G 10K 2.5" DP SAS HDD),
- CorpusServer (DVB-T, speech data recording, text data collecting),
- Collection of „opensource“ and own software tools for research and development of speech and language technologies,
- Speech and text corpuses, containing more than 500 hours of annotated speech recordings and 2 billion tokens of text in Slovak language
- PC workstations (6 pcs) and notebooks (15 pcs),
- IBM DS3300 + 2x x3650 M3 + x3850 X5 + x3650 M4 + 2x x3630 M4 computing and data (40TB integrated) storage centre. The DS3300 provides scalable storage array which is used for text and speech databases, consisting of 12 SATA disk bays (23TB installed) with iSCSI interface. The high performance 6x4CPU servers are used for acoustical and language modelling issues, which could be parallelized and needs also a huge storage and high performance access to the databases. One of them contain Tesla K40 GPGPU card for massive parallel computing tasks. These servers provides also totally 404GB of memory which is necessary for this type of tasks,
- The VoIP Traffic Generator and Analyzer consisting of the Abacus 50 GigE test system and ClearSight™ Analyzer & Network Time Machine,

- TIMS (Telecommunication Instructional Modelling System) - hardware and software based platform for modelling telecoms theory and techniques within the laboratory telecommunications and signal processing courses,
- OPNET Modeller Simulator is the world leading discrete event R&D network tools, providing research environment for design, modelling, simulation and analysis of many types of communications networks,
- Hand-held Bruel & Kjaer Analyzer Type 2270 for sound and vibration measurement, analysis and recording,
- Acoustic measurement system Audiomatica (Clio FW Standard 10, Clio Pre-01 Mk2, Clio QC Box Model 5, CLIO accelerometer ACH-01, mics, notebook.

3 TEACHING

3.1 Courses

Bachelor Degree Course (title Bc.) –Computer Networks

Bachelor study is aimed at achieving the theoretical basics and practical skills in computer systems and networks. The student achieve a good knowledge from basic computer and software engineering, programming, operating and database systems, computer networks, transmission media, computer system architecture and security in computer networks

Bachelor Degree Course (title Bc.) –Intelligent Electronics

Bachelor study is aimed at achieving the theoretical basics and practical skills of automotive, industrial and consumer electronics. Students achieve a good understanding of linear and nonlinear circuits, digital electronics and microprocessor technology, electronic measuring systems, optoelectronics and RF technology.

Bachelor Degree Course (title Bc.) –Multimedia Communication Technologies

Bachelor study is aimed at achieving the theoretical basics and practical skills in telecommunications systems and networks. Students achieve good knowledge of telecommunications services, telecommunications management and economics in telecommunications.

Master Degree Course (title Ing.) –Computer Networks

The Master degree engineering program is oriented to achieve advanced skills in progressive computer networks, security of information and computer systems, advanced technologies and data processing systems, computer networks management and economics in computer networks.

Master Degree Course (title Ing.) –Smart Electronics

The Master degree engineering program is oriented to achieve advanced skills in electronics for information and communications technology. The object of study is the methods of analysis and design of advanced systems based on signal processors, optoelectronics, smart measuring systems, digital signal processing and cryptography.

Master Degree Course (title Ing.) – Multimedia Communication Technologies

The Master degree engineering program is oriented to achieve advanced skills in digital communication and transmission systems, mobile and satellite communications, optoelectronics communication systems and multimedia communication.

Ph.D. Degree Courses (title Ph.D.) –Computer Networks

The Ph.D. degree program is orientated on achieving expert level knowledge in the field of computer networks as well as modern transmission technologies and networks, digital signal processing in computer networks.

Ph.D. Degree Courses (title Ph.D.) –Electronic Systems and Signal Processing

The Ph.D. degree program is orientated into the field of digital image and speech encoding and transmission, optoelectronics systems and digital filtering as well as design of electronic and optoelectronics systems, sensor systems and digital circuit's simulation.

Ph.D. Degree Courses (title Ph.D.) –Multimedia Communication Technologies

The Ph.D. degree program is orientated on achieving expert level knowledge in the field of multimedia communications, mobile and satellite communications as well as modern telecommunication technologies and networks, digital signal processing in telecommunications.

3.2 List of subjects taught

3.2.1 Study plan for Bc. degree

Undergraduate Study (Bc.) – Automotive Electronics

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of electronics	2 nd	3/2	Gamec, Gamcová
Electronics I.	3 rd	3/2	Gamec, Gamcová
Signals and systems	3 rd	3/2	Mihalík, Gladišová
Electronics II.	4 th	3/2	Kocur
Electronic measuring instruments and methods	4 th	2/3	Šaliga
Measuring systems	5 th	2/3	Šaliga
Electronic automotive control systems	5 th	3/2	Gamec
Electronics III.	6 th	3/2	Galajda

Undergraduate Study (Bc.) – Computer Networks

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of algorithms and programming	1 st	3/2	Hládek
Programming	2 nd	2/2	Hládek
Principles of computer engineering	2 nd	2/2	Čížmár
Basic of software engineering	2 nd	2/2	Ondáš
Computer system architectures	3 rd	2/2	Drutarovský, Maceková
Object oriented programming	3 rd	2/2	Juhár, Hládek, Ondáš
Operating systems	3 rd	3/2	Pleva
Basics of electronics and logic circuits	3 rd	2/2	Galajda
Introduction to digital communications	3 rd	2/2	Doboš
Computer networks	4 th	2/2	Čížmár, Bugár
Database systems	4 th	3/2	Juhár, Ondáš
Transmission media	4 th	2/2	Ovseník
Multimedia signals in communication networks	4 th	2/2	Štaš
Bachelor thesis	5 th	0/8	Čížmár, Galajda
Application of computer networks	5 th	2/2	Papaj, Bugár
Data structures and algorithms	5 th	2/2	Čížmár, Hládek
Mobile technology and services	5 th	2/2	Doboš
Programming audio applications	5 th	2/2	Juhár
Satellite technology and services	5 th	2/2	Marchevský
Web technologies	6 th	2/2	Papaj
Security of computer systems	6 th	2/2	Drutarovský
Programming of embedded systems	6 th	2/2	Drutarovský
Speech interactive communication systems	6 th	2/2	Juhár, Ondáš

Undergraduate Study (Bc.) – Intelligent Electronics

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of electronics	2 nd	3/2	Gamec, Gamcová
Electronics I.	3 rd	3/2	Gamec, Gamcová
Signals and systems	3 rd	3/2	Mihalík, Gladišová
Electronics II.	4 th	3/2	Kocur

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Measurement in electronics	4 th	2/3	Šaliga
High-frequency and microwave electronics	5 th	3/2	Gamec, Gamcová
Programming of measuring systems	5 th	2/3	Šaliga
Intelligent automotive control systems	5 th	3/2	Gamec
Optoelectronics	6 th	3/2	Turán
Active and passive safety systems	6 th	2/2	Gamec

Undergraduate Study (Bc.) – Multimedia Communication Technologies

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of electronics	2 nd	3/2	Gamec, Gamcová
Digital electronics	3 rd	2/2	Galajda
Multimedia technologies	4 th	3/2	Štaš

3.2.2 Study plan for MSc. degree

Graduate Study (Ing.) – Advanced Materials and Technologies in Automotive Electronics

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Digital signal processing	1 th	3/2	Mihalík, Gladišová
Smart measuring systems	1 th	2/3	Šaliga
Optoelectronics	1 th	3/2	Turán
Communication systems and networks in cars	2 nd	2/2	Kocur
Reconfigurable circuits	2 nd	2/2	Gamec
Photonics	3 rd	3/2	Turán
UWB sensor networks	3 rd	2/2	Kocur

Graduate Study (Ing.) – Automotive Electronics

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Digital signal processing	1 th	3/2	Mihalík, Gladišová
Optoelectronics	1 th	3/2	Turán
Circuit theory	1 th	3/2	Galajda
Signal and communication interfaces	1 th	3/2	Šaliga
Signal processors	1 th	3/2	Drutarovský
Smart antennas	1 th	3/2	Ovseník
Applied cryptography	1 th	3/2	Drutarovský
Processing and transmission of speech and audio signals	2 nd	3/2	Juhár
Smart measuring systems	2 nd	2/3	Šaliga
Digital image processing and coding	2 nd	3/2	Mihalík
Telecommunication systems theory	2 nd	3/2	Čížmár
Optical communication systems	2 nd	3/2	Turán
Design of integrated circuits for smart applications	2 nd	2/3	Galajda
High frequency and microwave technology	2 nd	3/2	Gamec, Gamcová
Photonics	3 rd	3/2	Turán
Digital television systems	3 rd	3/2	Marchevský
Smart security systems	3 rd	3/2	Marchevský
UWB sensor networks	3 rd	2/2	Kocur
Advanced speech applications for communication technology	3 rd	3/2	Juhár
Medical electronics	3 rd	3/2	Michaeli
Advanced communication systems	3 rd	3/2	Kocur

Graduate Study (Ing.) – Multimedia Communication Technologies

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Smart measuring systems	1 th	2/3	Šaliga
Applied cryptography	1 th	3/2	Drutarovský
Digital signal processing	1 th	3/2	Mihalík, Gladišová
Optoelectronics	1 th	3/2	Turán
Signal processors	1 th	3/2	Drutarovský
Smart antennas	1 th	3/2	Ovseník
Localization in wireless and mobile systems	1 th	3/2	Doboš
Optical communication systems	2 nd	3/2	Turán
Diploma project 1	2 nd	0/6	Juhár
Processing and transmission of speech and audio signals	2 nd	3/2	Juhár
Telecommunication systems theory	2 nd	3/2	Čižmár
Design of integrated circuits for smart applications	2 nd	2/3	Galajda
Digital image processing and coding	2 nd	3/2	Mihalík
High frequency and microwave technology	2 nd	3/2	Gamec, Gamcová
Signal and communication interfaces	2 nd	3/2	Šaliga
Diploma project 2	3 rd	0/6	Juhár
Mobile communications	3 rd	3/2	Doboš
Multimedia technologies	3 rd	3/2	Staš
Advanced speech applications for communication technology	3 rd	3/2	Juhár
Advanced communication systems	3 rd	3/2	Kocur
Digital television systems	3 rd	3/2	Marchevský
Photonics	3 rd	3/2	Turán
UWB sensor networks	3 rd	2/2	Kocur

Graduate Study (Ing.) – Smart Electronics

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Circuit theory	1 th	3/2	Galajda
Digital signal processing	1 th	3/2	Mihalík, Gladišová
Optoelectronics	1 th	3/2	Turán
Signal and communication interfaces	1 th	3/2	Šaliga
Applied cryptography	1 th	3/2	Drutarovský
Signal processors	1 th	3/2	Drutarovský
Smart antennas	1 th	3/2	Ovseník
Digital image processing and coding	2 nd	3/2	Mihalík
Diploma project 1	2 nd	0/6	Juhár
Processing and transmission of speech and audio signals	2 nd	3/2	Juhár
Smart measuring systems	2 nd	2/3	Šaliga
Design of integrated circuits for smart applications	2 nd	2/3	Galajda
Optical communication systems	2 nd	3/2	Turán
High frequency and microwave technology	2 nd	3/2	Gamec, Gamcová
Telecommunication systems theory	2 nd	3/2	Čižmár
Diploma project 2	3 rd	0/6	Juhár
Digital television systems	3 rd	3/2	Marchevský
Photonics	3 rd	3/2	Turán
Advanced speech applications for communication technology	3 rd	3/2	Juhár
Advanced communication systems	3 rd	3/2	Kocur
Medical electronics	3 rd	3/2	Michaeli
Smart security systems	3 rd	3/2	Marchevský
UWB sensor networks	3 rd	2/2	Kocur

3.2.3 Study plan for Ph.D. degree

Graduate Study (PhD.) – Computer networks

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Theory of computer engineering and computer networks	1 th	0/5	Čížmár
Foreign language 1	1 th	0/2	
Research activities 1	1 th	0/5	Levický
Foreign language 2	2 nd	0/2	
Modern communication systems	2 nd	0/5	Čížmár
Specialization subject	3 rd	0/5	Levický
Research activities 2	3 rd	0/5	Levický
Research activities 3	5 th	0/5	Levický
Research activities 4	6 th	0/5	Levický
Research activities 5	7 th	0/5	Levický

Graduate Study (PhD.) – Electronic Systems and Signal Processing

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Electronic circuits and signals and systems theory	1 th	0/5	Kocur
Foreign language 1	1 th	0/2	
Research activities 1	1 th	0/5	Turán
Foreign language 2	2 nd	0/2	
Complex electronic systems and advanced signal processing methods	2 nd	0/5	Kocur
Specialization subject	3 rd	0/5	Turán
Research activities 2	3 rd	0/5	Turán
Research activities 3	5 th	0/5	Turán
Research activities 4	6 th	0/5	Turán
Research activities 5	7 th	0/5	Turán

Graduate Study (PhD.) – Multimedia Communication Technologies

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Multimedia and communication systems theory	1 th	0/5	Juhár
Foreign language 1	1 th	0/2	
Research activities 1	1 th	0/5	Levický
Foreign language 2	2 nd	0/2	
Modern multimedia communication technologies	2 nd	0/5	Juhár
Specialization subject	3 rd	0/5	Levický
Research activities 2	3 rd	0/5	Levický
Research activities 3	5 th	0/5	Levický
Research activities 4	6 th	0/5	Levický
Research activities 5	7 th	0/5	Levický

4 RESEARCH AND PROJECTS

4.1 International scientific projects

Project title: **Inclusive Radio Communication Networks for 5G and Beyond**

Acronym: **IRACON**

Number: COST CA15104 Action

Program/agency: COST

Coordinator from TU: doc. Ing. Ľubomír Doboš, CSc.

Project partners: 142 registered institutions (Industry / University / Research / Small and Medium Enterprises), 311 registered participants

Start of project: 1/2016

End of project: 12/2020

Total funding: not defined

Annotation: Radio Communications have become one of the pillars on which our Society relies for performing many daily tasks. Today, the number of connected devices is increasing exponentially, reflecting not only enthusiastic smartphone adoption but also increasing connectivity of machines, sensors, vehicles and other devices for health and smart environments.

The Inclusive Radio Communications (IRACON) concept defines those technologies aimed to support wireless connectivity at any rates, for any communicating units, and in any type of scenarios. The Wireless Internet of Things beyond 2020 will require revolutionary approaches in Radio Access technologies, networks and systems. Some theoretical foundations have to be revisited and breaking technologies are to be discovered during the coming decade.

This COST Action aims at scientific breakthroughs by introducing novel design and analysis methods for the 5th-generation (5G) and beyond-5G radio communication networks. Challenges include i) modelling the variety of radio channels that can be envisioned for future inclusive radio, ii) capacity, energy, mobility, latency, scalability at the physical layer and iii) network automation, moving nodes, cloud and virtualisation architectures at the network layer, as well as iv) experimental research addressing Over-the-Air testing, Internet of Things, localization and tracking and new radio access technologies.

The group of experts supporting this proposal comes from both academia and industry, from a wide spread of countries all over Europe, with the support of some non-COST institutions and R&D associations and standardisation bodies worldwide. The proposers have also long experience on COST Actions in the Radiocommunications field.

Project title: **The ICT Engineer of 21st Century: Mastering Technical Competencies, Management Skills, and Societal Responsibilities**

Acronym: TeamSoc21

Number: 2017-1-HR01-KA203-035408

Program/agency: Erasmus+ Programme of the European Union

Coordinator from TU: Ing. Mária Gamcová, PhD.

Project partners: University of Zagreb, Universitat Politecnica de Valencia, Hochschule fur Telekommunikation Leipzig, Szechenyi Istvan University, University of Telecommunications and Post, Bulgaria, University of Žilina, Institut Mines Telecom Brest,

Start of project: 09/2017

End of project: 08/2019

Total funding: 224.137.000,00 €

Annotation: TeamSoc21 curricula, which will be available as an open educational resource (OER), consists of four main topic groups: entrepreneurship, intercultural topics with focus on multicultural

teams, ICT topics with focus on entrepreneurship based on ICT and student start-up projects with focus on entrepreneurial cases on how ICT can contribute to innovative societal development.

Project title: Resilient Communication Services Protecting End-user Applications from Disaster-based Failure

Acronym:

Number: COST CA15127 Action

Program/agency: COST

Coordinator from TU: doc. Ing. Ján Papaj, PhD., doc. Ing. Ľubomír Doboš, CSc.

Project partners: 118 partners from university, research and industrial institutions

Start of project: 1/2016

End of project: 12/2020

Total funding: not defined

Annotation: Disaster-based disruptions seriously degrading the performance of any communication network (following from natural disasters, technology-related disasters, or malicious attacks) are now gaining importance due to observed increase of their intensity and scale. The problem is of the utmost importance due to lack of appropriate mechanisms deployed in practice in Europe. Each time, unavailability of communication networks services, considered as an important part of critical infrastructure, in the presence of disasters implies evident societal problems for people desperately seeking for information, or trying to communicate with each other. The Action will fill this gap by offering the respective solutions to provide resilient communications in the presence of disaster-based disruptions of all types for existing communication networks (e.g., IPv4-based, current Internet), as well as emerging architectures of the global communications infrastructure (i.e., the Future Internet). Geographical diversity characteristics of disaster-based disruptions across Europe requires creation of an international and geographically diverse group of researchers to provide the proper solutions. Therefore, COST Action is viewed as the best way to address this issue. This output-oriented Action will be driven by researchers from academia and industry in strong cooperation with governmental bodies. The aim is to introduce the set of techniques of resilient communications, as well as recommendations on how to deploy/update topologies of communication networks to make them resistant to disruptions that can be applied in practice by network equipment operators and national/international network providers at the European level.

Project title: Wearable Robots for Augmentation, Assistance or Substitution of Human Motor Functions

Acronym: WearableRobots

Number: COST Action CA16116

Program/agency: COST

Coordinator from TU: Ing. Matúš Pleva, PhD.

Project partners: 101 partners from university, research and industrial institutions

Start of project: March 15/2017

End of project: March 14/2021

Total funding: not defined

Annotation: Wearable Robots (WRs) is an emerging field of personal devices that are integrated parts of human functioning, and that are constructed of typical robotic components such as actuators, sensors and control algorithms. Where conventional robots were typically intended for use in industrial environments to help in tedious and repetitive tasks and tasks requiring high precision, the situation is currently evolving to one where there is an increasing direct physical interaction between robot and human operator. The interaction with humans in WRs is not only physical, but also includes cognitive aspects, as in the interaction, control of functions is typically shared by human and machine. WRs can be used either to augment, train or supplement motor

functions or to replace them completely. Wearable Robots operate alongside human limbs, as is the case in orthotic robots, exoskeletons or robotic suits. WRs are expected to find applications in Medical, Industrial and Consumer Domains, such as neuro-rehabilitation, worker support, or general augmentation. As WRs continuously interact with humans in multiple situations, Human Robot Interaction, Ergonomics, and Ethical, Legal and Societal (ELS) considerations, as well as early involvement of stakeholders are of essential interest. This Action focuses on the European integration of different underlying disciplines in science and engineering, as well as on engaging of stakeholders to improve WR technology and its societal impact.

Project title: MULTI-modal Imaging of FOREnsic SciEnce Evidence

Acronym: MULTI-FORESEE

Number: COST Action CA16101

Program/agency: COST

Coordinator from TU: Ing. Matúš Pleva, PhD.

Project partners: 105 partners from university, research and industrial institutions

Start of project: March 2/2017

End of project: March 1/2021

Total funding: not defined

Annotation: The main objective of this Action, entitled ‘MULTI-modal Imaging of FOREnsic SciEnce Evidence (MULTI-FORESEE)- tools for Forensic Science’, is to promote innovative, multi-informative, operationally deployable and commercially exploitable imaging solutions/technology to analyse forensic evidence. Forensic evidence includes, but not limited to, fingerprints, hair, paint, biofluids, digital evidence, fibers, documents and living individuals. Imaging technologies include optical, mass spectrometric, spectroscopic, chemical, physical and digital forensic techniques complemented by expertise in IT solutions and computational modelling. Imaging technologies enable multiple physical and chemical information to be captured in one analysis, from one 'specimen', with information being more easily conveyed and understood for a more rapid exploitation. The ‘enhanced’ value of the evidence gathered will be conducive to much more informed investigations and judicial decisions thus contributing to both savings to the public purse and to a speedier and stronger criminal justice system. Lack of knowledge sharing, standardised protocols and communication between Academia, End Users and industry has been a barrier to translational science in this field; the Action will use the unique networking and capacity-building capabilities provided by the COST framework to bring together their knowledge and expertise; this is paramount to engage in a synergistic approach to boost imaging technological developments, allowing scientifically sound, highly reliable and multi-informative intelligence to be provided to investigators, prosecutors and defence. COST support is crucial to conquer the challenge on short term basis and to provide a legacy to Europe to advance knowledge for the deployment of cutting edge, innovative and implementable imaging forensic science.

Project title: Compressing Sensing in Ultra-Wideband (UWB) Sensors for passive radar localization

Acronym:

Number:

Program/agency: Ministry of Education, Science, Research and Sport of the Slovak Republic, Slovak Academy of Sciences and Deutscher Akademischer Austauschdienst (DAAD),

Coordinator from TU: Mgr. Mária Švecová, PhD.

Project partners: Fraunhofer-Institut für Integrierte Schaltungen IIS

Start of project: 01/2017

End of project: 12/2018

Total funding: not defined

Annotation: The aim of the project is to examine approaches for enhancement of UWB sensors by means of Compressive Sensing. By implementing a new data capturing scheme collecting all available information from the received signal can be achieved without discarding portions nor increasing the measurement rate. Preliminary investigations of Fraunhofer IIS render the concept to be sound, practically feasible and ready for measurement verification. Technical University of Košice has long-time experience in measurements of moving persons, their detection, localization and moving-target tracking and estimation of wall-parameters by means of UWB radar. As sensors a set of UWB radars from Technical University of Ilmenau is available at Technical University of Košice. Profound knowledge in both signal processing and measurement design facilitate the early identification of possible methodological barriers and contribute greatly in the measurement and verification process as well as the implementation of algorithms maximizing the scientific return of the project.

4.2 National scientific projects

Project title: **Real-Time Operating UWB Sensor Network for Human Beings Detection, Localization and Tracking**

Acronym: ReTi-UWB-SS

Number: APVV-15-0692

Program/agency: APVV

Coordinator from TU: prof. Ing. Miloš Drutarovský, CSc.

Project partners:

Start of project: 07/2016

End of project: 06/2019

Total funding: 243.000,00 €

Annotation: Project ReTi-UWB-SS is the project of an applied research intent on the design and implementation of a testbed of real-time operating UWB sensor network (UWB-SS) to be applied for detection, localization and tracking of person at poor or zero optical visibility (e.g. through the wall person localization). The fundamental principle of the considered UWB-SS performance is based on the idea according to which the electromagnetic waves emitted by UWB radars in the frequency band up to 5 GHz are capable to penetrate through a variety of standard buildings materials. Hence, UWB radars (sensors) operating in frequency band DC-5 GHz networked by wireless communication infrastructure will be key components of the UWB-SS. The developed UWB-SS will be able to localize moving and static persons. In the case of static persons, the estimation of their breathing frequency will be provided, too. The UWB-SS performance will be based on up-to-date scientific findings in the field of real-time processing of UWB radar signals. The UWB-SS developed in the ReTi-UWB-SS project can be used with the advantage especially in field of the solution of emergency events (military, security, law enforcement, and emergency rescue operations).

Project title: **Implementation of Significant Research Results in Mobile Communication Technologies into Teaching**

Acronym:

Number: 046TUKÉ-4/2018

Program/agency: KEGA of Ministry of education of Slovak Republic

Coordinator from TU: doc. Ing. Lubomir Dobos, PhD.

Project partners:

Start of project: 01/2018

End of project: 12/2019

Funding in 2018: 6.979,00 €

Total funding: not defined

Annotation: The project has two aims. First aim is design and development of mobile application for access to study materials, control student activity on exercises, control home projects act. for study subjects: Mobile technologies and services, Introduction to digital communications, Mobile systems and Localisation in wireless networks. Second aim is build up experimental workplace based on software radio USRP for experiments and study modulation techniques (analog and digital) and signal spectral analysis. The laboratory will serve as a modelled workplace for the prospective designers of the virtual measuring systems with remote access

Project title: Laboratory for Support of the Advanced Tools for the Design and Realization of new Smart Electronic Systems

Acronym:

Number: 062TUKE-4/2017

Program/agency: KEGA of Ministry of education of Slovak Republic

Coordinator from TU: prof. Ing. Pavol Galajda, PhD.

Project partners:

Start of project: 01/2017

End of project: 12/2019

Total funding: not defined

Annotation: The project “Laboratory for support of the advanced tools for the design and realization of new smart electronic systems” is aimed on the development of the practical skills of students in the domain of new smart electronics systems in the automotive electronics, electronic circuits, digital signal processing methods, sensors and information and communication technologies. It is concentrated in the new study branches of bachelor, engineering and PhD. study on the Department of Electronics and Multimedia Communications, FEI, TU of Kosice as local as remote control laboratory experiments, measurements and design tools, within the frame of subject taught in the above mentioned field of study. The arrangement of the conditions delivering the knowledge and the practical skills of student will be the result of the project. It will be in the domain of the design of smart electronics systems and circuits in automotive electronics, electronic circuits, digital signal processing methods, sensors and information and communication technologies based on the advanced technology of electronics, world- wide through the advanced practices of learning, thus in the arbitrary time and at the arbitrary place (local and remote work of the students in the laboratory with the new CAD and EDA tools, with remote control of development kits, e-learning and with the learning which support multimedia). Within the project the multimedia manuals for the design and measurements of the electronic systems and circuits for specific experiments will also be developed.

Project title: Automatic Subtitling of Audiovisual Content for Hearing Impaired

Acronym: ACCeSS

Number: APVV-15-0517

Program/agency: APVV

Coordinator from TU: prof. Ing. Jozef Juhár, CSc.

Project partners: Institute of Informatics, Slovak Academy of Science, Bratislava

Start of project: 07/2016

End of project: 12/2018

Total funding: 249.175,00 €

Annotation: Only a few of us could imagine that obtaining information from TV broadcast is one of the basic problems of the hearing impaired. In the present time there is no equivalent access for the given group of people to the television broadcast content as it is in the case of the hearing population. Within the meaning of the legislation (Law no. 373/2013 of the Code from October 20. 2013), broadcaster is obliged to ensure multimodal approach to the digital broadcast service in a

way that at least 50% is accompanied with open or closed captions corresponding with the content of the program. In a similar way, at least 10% is obligatory in the case of the licensed broadcasters. Recently, the European Federation of Hard of Hearing People (EFHOH) is pushing ahead idea to enhance ratio of the programs accompanied by open or closed captions to 100% in each EU member state. Reaching the desired goal in Slovakia using the current approach of subtitling the audiovisual content would mean spending huge amount of financial resources by the television broadcaster, because manufacturing of the closed captions is subject of laborious manual transcription of the spoken words to text by certified workers and consecutive adjustment specified by the requirements of the edict of the Ministry of the Culture of the Slovak Republic. The only economically viable option is to head towards utilization of the automatic spontaneous speech recognition and to apply modern principles and methods of the speech technologies in automatic transcription of spoken words to text. The main goal of this project proposal is applied research in the area of the natural speech processing and development of a customized pilot system for automatic subtitling of audiovisual content based on large vocabulary continuous speech recognition. Results of the applied research are going to be a base of development of system solutions (in the form of a software application or service) for automatic subtitling in Slovak.

Project title: Cloud Based Human Robot Interaction

Acronym: Cloud-HRI

Number: APVV-15-0731

Program/agency: APVV

Coordinator from TU: prof. Ing. Peter Sinčák, CSc.

Coordinator from KEMT: prof. Ing. Jozef Juhár, CSc.

Project partners: STU Bratislava

Start of project: 2016

End of project: 2020

Total funding: 249.228,00 €

Annotation: Project deals with multimodal Human Robot Interaction. Cloud Computing Technologies inspired a new domain called Cloud Robotics. Development of integrated programming environment for robotic systems in distributed approach give occasions for agent environment with learning abilities, incremental knowledge acquisition sharing for group of robots. The goal of basic research is study of artificial intelligent tools for intelligent robotics, basic research in the area of natural language processing and also the study of innovative software tools for distributive software systems in cloud environment. The focus will be given also to image processing, virtual reality and speech processing in intelligent robotics.

Project title: Multiple Person Localization Based on Detection of Their Vital Signs Using Short-Range UWB Sensors

Acronym: DeViFu

Number: 1/0772/17

Program/agenc : VEGA

Coordinator from TU: prof. Ing. Dušan Kocur, CSc.

Project partners:

Start of project: 01/2017

End of project: 12/2019

Funding in 2018: 12.414,00 €

Total funding: not defined

Annotation: Detection and localizations of persons has found a variety of applications such as object monitoring during security operations, human lives saving during natural disasters as well as contactless monitoring of basic vital human functions (breathing and heart activity). During

emergency situation there is requirement to monitor living persons that do not change their location in a monitored space (e.g. person in unconsciousness). Project DeViFu is intent on the design and implementation of the experimental system based on UWB sensor that is capable to detect basic vital human functions and localize persons in 2D and 3D, as well as informative contactless monitoring of vital human functions. The proposed solutions will be based on the research of advanced radar signal processing methods and their efficient implementation on embedded processors as well as on research of RF circuits and antenna system for UWB sensors.

Project title: New Trends in the Optical Data Transmission

Acronym: NeTOpDaT

Number: 023TUKE-4/2017

Program/agency: KEGA of Ministry of education of Slovak Republic

Coordinator from TU: doc. Ing. Ľuboš Ovseník, PhD.

Project partners:

Start of project: 01/2017

End of project: 12/2019

Funding in 2018: 4.883,00 €

Total funding: not defined

Annotation: The project solves the implementation of the broad access for students to research results of the FSO long-term experimental measurement results will be involved in the educational process in optoelectronic sensors and communication systems field within the following subjects: Multimedia signals in communication networks, Optoelectronic systems, Optoelectronics, Optical communication systems and networks, Photonics, Sensor networks, Transmission media.

The significant objective is the cost reduction on experimental classes, thanks instruments and accessibility of laboratory stands out of regular time schedule devoted for laboratory experiments.

Project title: Resilient data communication using multihop mobile networks in disaster situations

Acronym:

Number: VEGA 1/0492/18

Program/agency: VEGA

Coordinator from TU: doc. Ing. Ján Papaj, PhD.

Project partners:

Start of project: 1/2018

End of project: 12/2021

Total funding: not defined

Annotation: The rapid development of ICT technology gives new challenges to creating the new types of services and applications that are dependent on the existence of a network infrastructure. The mobile networks are using a one-hop communication between mobile terminals. This type of communication is a largely limiting element if the emergencies, natural disasters and catastrophes occur when the infrastructure is destroyed and does not provide resilient communication. The present research project is focused on the analysis, design and implementation of new possibilities for resilient communication using multihop mobile networks namely hybrid MANET-DTN and cognitive MANET (CR-MANET) networks. The project will analyze the use of advanced routing methods with emphasis on the provision of communication services in emergency situations without the need to use network infrastructure with emphasis on the social context of communication, secure routing and effective using of the available spectrum.

Project title: Resilient mobile networks for content delivery**Acronym: REMONET****Number: APVV-17/0208****Program/agency: APVV****Coordinator from TU: doc. Ing. Ján Papaj, PhD.****Project partners:****Start of project: 8/2018****End of project: 12/2021****Total funding: 123.342,00 €**

Annotation: The main goal of the project is basic research of resilient data communication via multihop mobile data networks, not only in the area of Smart Cities but also in crisis situations. Therefore, research will focus on the integration of sensor networks (WSN - MESH), mobile ad-hoc networks (MANET) and delay tolerant network DTNs as well as drone networks DRONETs. The goal of integration is to create a resilient multihop mobile network that will provide robust and effective content delivery methods. The project is innovative in the term of fusion of the usage different types of networks as well as data processing and data transfer methods that allow resilient data communication even in cases, where existing infrastructure based networks are unable to deliver the given types of services. These networks can be used in smart cities as well as in crisis situations such as natural or technological disasters. This will provide communication capabilities not only to users but also to individual data transfer technologies needed for configuration or settings. The project addresses the highly current problem of providing robust data communication through mobile multihop networks and their subsequent use in intelligent locations. The main objective of the presented project proposal is the basic research in the field of mobile multihop networks, which will allow the transfer of large amounts of data between individual terminals in a smart place environment with emphasis on durable communication.

Project title: Deep Learning for Advanced Speech Enabled Applications**Acronym: DeepSpeech****Number: APVV- SK-TW-2017-0005****Program/agency: APVV****Coordinator from TU: Ing. Matúš Pleva, PhD.****Project partners: National Taipei University of Technology****Start of project: 2018****End of project: 2019****Total funding: 8.000,00 €**

Annotation: Goal of this project is to advance development of current multilingual speech enabled applications by exploring the state of the art deep learning techniques. The advancement is expected especially in automatic subtitling of broadcast television and radio programs, databases creation, indexing and information retrieval. The Speech Communication Lab from TaipeiTech has wide experiences in application of deep learning technologies. The laboratory currently closely cooperates with Taiwan's National Education Radio in the task of transcription of their radio archive and developing a Large-ScaleMandarin Radio Speech Corpus for next 3 years. The Laboratory of Speech and Mobile Technologies from TUKE has a long tradition and experience in the research and development of automatic speech recognition and synthesis systems, especially in the Slovak language. In line with the worldwide trend, the focus is concentrated on the use of deep learning and NN in the tasks of automated processing of acoustic data, as evidenced by the currently running national project aimed at automatically generating subtitles of TV broadcasting. Establishment of international cooperation will enable exchange of scientific knowledge and annotated data between partners resulting in joint publications and common project proposal.

Project title: Laboratory of Medical electronics and Sensor systems with remote access

Acronym:

Number: 015TUKE-4/2016

Program/agency: KEGA of Ministry of education of Slovak Republic

Coordinator from TU: prof. Ing. Ján Šaliga PhD.

Project partners:

Start of project: 01/2016

End of project: 12/2018

Funding in 2018: not defined

Total funding: not defined

Annotation: Easy access to experiments, which requires authorized experimentator only, is enabled by the tools of virtual instrumentation and information and communication technologies. It allows students to control remotely the measuring systems from a computer using any web page browser. The system focuses on the subjects devoted to biosignal measurement and monitoring of the selected nonelectrical quantities. It prevents the possible injury of the measured human objects by the incorrect measuring procedure and the compliance of the medical ethics issues. Laboratory controlled over the Internet prevents potential injury of the experimentator, when the tested non-electrical etalons are improperly handled in the laboratory for non-electrical measurement.

Access to the proposed virtual laboratory will be open not only for the students of the proposer but also to other students including those of medical disciplines. The laboratory will serve as a modelled workplace for the prospective designers of the virtual measuring systems with remote access.

Project title: Personalized Acoustic and Language Modeling

Acronym:

Number: VEGA 1/0511/17

Program/agency: VEGA

Coordinator from TU: Ing. Ján Staš, PhD.

Project partners:

Start of project: 01/2017

End of project: 12/2019

Total funding: not defined

Annotation: Nowadays, the automatic speech recognition systems are mostly based on statistical models trained on a huge speech and textual corpora, collected from a large number of speakers. Although, the speech recognition system based on this concept is providing satisfying results for a subset of the users, the speech recognition accuracy can be improved by additional adaptation of the acoustic and language models to the individual voice characteristics of a speaker and a specific speaker speaking style. The presented research project focuses on the analysis, design and implementation of advanced methods in personalization of speech recognition system and adaptation of the acoustic and language models using principles of linear regression, discriminative modeling and modern algorithms applicable with using deep neural networks (DNN). For implementation of the designed approaches, principles and methods, we plan to use parallel high-performance computing based on GPU accelerators.

5 CO-OPERATION

5.1 National co-operation

- Elcom s.r.o., Prešov
- Slovak Academy of Science
- Slovak Telekom, a.s.
- VUS - Výskumný ústav spojov, n.o., Banská Bystrica
- ZŤS výskumno-vývojový ústav Košice, a.s.
- Deloitte Advisory, s.r.o., Bratislava
- ITMG, s.r.o., Senec

5.2 International co-operation

- Austrian Research Institute for Artificial Intelligence (OFAI) of the Austrian Society for Cybernetic Studies
- FTW Telecommunications Research Center Vienna, Austria
- Ingenieur Büro Ralf Klukas, Germany
- INESC Lisabon, Portugal
- Instituto Superior Técnico (IST), Lisbon, Portugal
- Statens Råddningsverk, Sweden
- ŠkodaAuto Mladá Boleslav, Czech Republic
- Wuhan Technological Institute, Wuhan, China
- Second University of Naples, Italy
- Ilmenau University of Technology, Germany
- Ilmsens GmbH, Germany
- UWINLOC - Hosted by AIRBUS BizLab (France)
- BMF Infokom Inovátor (Hungary)
- Hamburg University of Technology, Germany
- AGH University of Science and Technology Krakow, Poland
- Gdansk University of Technology, Poland
- Bulgarian Academy of Sciences, Bulgaria
- Technische Universiteit Delft, Netherlands
- Universitat Ramon Llull, Barcelona, Spain
- Universitat Politècnica de Catalunya Barcelona Tech (UPC), Barcelona, Spain
- Technical University Budapest, Hungary
- Technical University of Ljubljana, Slovenia
- Technical University of Cluj-Napoca, Romania
- University of Firenze, Italy
- University of Gent, Belgium
- University of Maribor, Slovenia
- University of Sannio, Benevento, Italy
- University of Reggio Di Calabria, Italy
- University of Gävle, Sweden
- University in Oulu, Finland
- University of Veliko Turnovo, Bulgaria

- Gjøvik University College, Norway
- Mississippi State University, Starkville, USA
- Fraunhofer Institute for Integrated Circuits IIS (Wireless Distribution Systems / Digital Broadcasting Research Group), Germany
- European Polytechnical University, Pernik, Bulgaria
- Brunel University London, UK
- DigiRobotics, London, UK
- National Taipei University of Technology
- Institute for Information Industry (III), Taipei

6 FACULTY ESSAYS

Bugár Gabriel

Assistant professor

His research interests include hidden communication systems, steganography, steganalysis, digital image processing and watermarking, network technologies, information and network security.

Čižmár Anton

Full professor

His research interests include speech processing, data compression, digital communications, project management, telecommunication technologies and services.

Doboš Ľubomír

Associated professor

His current research interests include mobile and wireless communication systems with focus on Call Admission Control algorithms for next generation mobile systems, Routing protocols for Mobile Ad-Hoc systems, MIMO systems and Multimodal mobile systems and services (focus on Speech processing).

Drutarovský Miloš

Full professor

His research interests include applied cryptography, digital signal processing, algorithms and architectures for embedded cryptographic architectures and sensor networks, digital signal processors, FPGAs, microcontrollers and soft microcontrollers embedded into the FPGAs.

Galajda Pavol

Full professor

His research interests include nonlinear circuit's theory and Chaos theory, nonlinearities in digital transmission systems, analog and mixed signal ASIC design and implementation for UWB sensor systems.

Gamec Ján

Associated professor

His general research interests include digital signal processing, UWB radar signal processing, low profile antennas for UWB radars.

Gamcová Mária

Assistant professor

Her actual scientific research focuses on sensor networks and wireless communication technologies for automobiles, electronic devices, circuit theory and e-learning technologies.

Glaďšová Iveta

Assistant professor

Her research interests include signal theory, vector quantization, source coding, morphology and segmentation in image processing, radar and image sensor signals processing.

Hládek Daniel*Assistant professor*

His current research interests include natural language processing, language modelling and text processing for LVCSR language databases.

Juhár Jozef*Full professor*

His research interests are in digital speech/audio processing and transmission, automatic speech/speaker recognition, speech synthesis, dialogue modelling and application of speech technologies in developing and deploying automatic voice services in telecommunications and Internet.

Kocur Dušan*Full professor*

His research interest is in short-range UWB radar (sensor) systems applied for detection, localization and tracking of moving and static people, contactless measurement of breathing frequency and heart beating rate of persons, UWB radar with synthetic aperture, UWB impedance spectroscopy, localization of object carrying of an active tag, sensor networks.

Levický Dušan*Full professor*

His main interests and activities are in the multimedia communications, cryptography, watermarking and steganography.

Lojka Martin*Research assistant*

His current research interests include speech decoding based on WFST and front-end speech processing.

Maceková Ludmila*Assistant professor*

Her research interests or activities are in areas as follows: communications in various types of access networks, digital television, satellite communications, advanced e-learning methods and wireless sensor networks.

Marchevský Stanislav*Full professor*

His main research interests are multidimensional digital filters, linear and non-linear digital filters for image processing, and design of multi-user detectors for CDMA signals from satellites.

Mihalík Ján*Full professor*

His current research interest includes signal and information theory, image and video coding, digital image and video processing, application the techniques of coding and processing in the standard image and video codecs, finally multimedia videocommunications in telecommunication networks and Internet on the basis of the standards.

Michaeli Linus*Full professor*

His research interests are the pre-processing systems in the instrumentation, modelling of AD and DA converters and methods for correction of their uncertainties, industrial measurement and virtual instrumentation.

Ondáš Stanislav*Assistant professor*

His research interests include spoken dialogue systems, dialogue processing, spoken language understanding, speech processing and conversational agents.

Ovseník Luboš*Associated professor*

His general research interests include digital signal processing (Video Control and Video Surveillance Systems), fiber optical sensors and the fiber optics and its applications in communications (FSO-Free Space Optics, VLC-Visible Light Communication, etc.), sensing and signal processing (Optical Correlator, etc.).

Papaj Ján*Associated professor*

His current research interests include mobile ad hoc networks (MANET), QoS, security and routing protocols for MANET.

Pleva Matúš*Assistant professor*

His research interests include speech processing, human-robot interface, automatic broadcast news processing, digital communications, Voice over IP technologies and services, telecommunication technologies biometric applications and routing protocols.

Staš Ján*Assistant professor*

His current research interests include computational linguistics, natural language processing and statistical modeling of the Slovak language for LVCSR.

Šaliga Ján*Full professor*

His general research interests include ADC testing, distributed measurement systems, measurement instruments, systems and methods.

Švecová Mária*Research assistant*

Her general research interests and activities are in the UWB radar signal processing for detection, localization and tracking of people under disaster situations.

Turán Ján*Full professor*

His main interests and activities are in the digital signal processing, Hough transform, rapid transform, fiber optics and its applications in communications, sensing and signal processing.

Peter Vizlay*Research assistant*

His current research interests include robust speech processing and feature transformations, acoustic modeling of speech and speech recognition. He is also interested in separation of speech signals in different environments and new speech analysis approaches.

7 Ph.D. STUDENTS

<u>Name</u>	<u>Supervisor</u>	<u>Degree Course</u>
<i>Second year of study</i>		
<u>Internal form:</u>		
Ing. Renát Haluška	doc. Ovseník	Computer Networks
Ing. Tomáš Huszaník	prof. Turán	Electronic Systems and Signal Processing
Ing. Marianna Kocúrová	prof. Juhár	Computer Networks
Ing. Miroslav Sokol	prof. Galajda	Computer Networks
Ing. Peter Šul'aj	prof. Marchevský	Computer Networks
<i>Third year of study</i>		
<u>Internal form:</u>		
Ing. Dávid Hrabčák	doc. Doboš	Multimedia Communication Technologies
Ing. Michal Márton	doc. Ovseník	Electronic Systems and Signal Processing
Ing. Dominik Nezník	doc. Doboš	Multimedia Communication Technologies
Ing. Martin Pečovský	prof. Galajda	Electronic Systems and Signal Processing
<u>External form:</u>		
Ing. Marek Laban	prof. Drutarovský	Electronic Systems and Signal Processing
<i>Fourth year of study</i>		
<u>Internal form:</u>		
Ing. Imrich András	prof. Šaliga	Electronic Systems and Signal Processing
Ing. Dávid Čonka	prof. Čižmár	Multimedia Communication Technologies
Ing. Pavol Dolinský	prof. Šaliga	Electronic Systems and Signal Processing
Ing. Jozef Greššák	prof. Juhár	Multimedia Communication Technologies
Ing. Jakub Oravec	prof. Turán	Multimedia Communication Technologies
Ing. Miroslav Repko	doc. Gamec	Electronic Systems and Signal Processing
Ing. Stanislav Slovák	prof. Galajda	Electronic Systems and Signal Processing
<i>Fifth year of study</i>		
<u>External form:</u>		
Ing. Martin Kmec	prof. Galajda	Electronic Systems and Signal Processing
Ing. Roman Palitefka	doc. Doboš	Multimedia Communication Technologies
Ing. Peter Strnisko	doc. Ovseník	Electronic Systems and Signal Processing

8 MEMBERSHIP

Čižmár Anton, Member of Technical Standardization Commission No.41 for Telecommunications.

Čižmár Anton, Member IEEE Affiliate Computer Society, No. 41237162.

Čižmár Anton, Member of AES (Audio Engineering Society), New York, I.D. 44 154.

Doboš Ľubomír, Member of Technical Standardization Commission No.80 for Radiocommunications.

Drutarovský Miloš, Member of the editorial board of the journal "Acta Electrotechnica et Informatica".

Galajda Pavol, Member of Czech and Slovak Radioelectronics Engineering Society.

Galajda Pavol, Member of EURO PRACTICE IC Service.

Gamcová Mária, Member of Consortium TeamSoc2, The ICT Engineer of the 21st Century.

Juhár Jozef, Member of ISCA (International Speech Communication Association).

Juhár Jozef, Member of AES (Audio Engineering Society), Memb. No. 76122.

Juhár Jozef, Member of IEEE, Memb. No. 90402602.

Juhár Jozef, Member of the editorial board "International Journal of Signal and Imaging Systems Engineering", Issued by Inderscience Publishers, Geneva, Switzerland.

Juhár Jozef, Member of the editorial board of the journal "Slaboproudý obzor".

Juhár Jozef, Member of Technical Standardization Commission No.55 for Electroacoustics and ultrasound.

Kocur Dušan, Member of the editorial board of the journal "Infocommunications Journal".

Kocur Dušan, Member of "Informatics and Electrical Engineering Review Panel of National Research, Development and Innovation Office, Hungary".

Kocur Dušan, Member of the editorial board of the journal "Acta Electrotechnica et Informatica".

Kocur Dušan, Scientific Grant Agency of Slovak Republic.

Levický Dušan, Member of the editorial board of the journal "Acta Electrotechnica et Informatica".

Levický Dušan, Member of Czech and Slovak Radioelectronics Society.

Michaeli Linus, Head of Slovak IMEKO National Committee and head of the IMEKO Technical Committee TC-4 "Measurement of Electrical Quantities".

Michaeli Linus, Member of the editorial board „Computer Standard & Interfaces“, Issued by Elsevier, Amsterdam, New York.

Michaeli Linus, Member of the reviewer board "Measurement". Journal IMEKO, Issued by Elsevier, Amsterdam, New York.

Michaeli Linus, Co-ordinator of IMEKO Working Group "AD and DA metrology".

Michaeli Linus, Member of the IEEE, Instrumentation & Measurement Society.

Michaeli Linus, Member of the scientific board of Electrotechnical Faculty, University Transport and Communication, Žilina, Slovakia.

Michaeli Linus, Member of the editorial board „Measurement Science Review“, Issued by SAV, Bratislava.

Michaeli Linus, Editor in Chief of the editorial board of the journal "Acta Electrotechnica et Informatica".

Pleva Matúš, Member of European Network on High Performance and Embedded Architecture and Compilation (HiPEAC).

Šaliga Ján, Scientific Grant Agency of Slovak Republic.

Šaliga Ján, Member of scientific board of Slovak Institute of Metrology.

Šaliga Ján, Member of the international board of IMEKO Technical Committee TC-4 "Measurement of Electrical Quantities".

Šaliga Ján, Member of the editorial board of the journal "Acta Electrotechnica et Informatica".

Šaliga Ján, Member of the editorial board of the journal "Radioengineering".

Turán Ján, Member of the Slovak Technical Standardization Committee No.53 for Cables, Conductors and Isolating Materials.

Turán Ján, Member of the Slovak Technical Standardization Committee No.43 for Terminology.

Turán Ján, Senior Member of the IEEE.

Turán Ján, Member of Czech and Slovak Radioelectronics Society.

Turán Ján, Member of the editorial board of the journal "Acta Electrotechnica et Informatica".

9 OTHER ACTIVITIES

9.1 Student competitions and rewards

- The program committee of the 28th International Conference Radioelektronika 2018 awarded to Mr. Stanislav SLOVÁK certificate of achievement in the Radioelektronika 2018 *Best Student Paper* for paper “Integrated SoC UWB radar with built.in 15 bit M-sequence generator”.
- The program committee of the 22nd International Student Conference on Electrical Engineering POSTER 2018 awarded to Mr. Stanislav SLOVÁK certificate of achievement in the *Best Poster Competition* for the work “A differential fully integrated UWB radar”.
- The Elfa award for the *Best Presentation* at the Scientific Conference of Young Researchers SCYR 2018 in the section "EEE" was won by Ing. Miroslav Repko for the presentation of the paper “Window functions in the process of permittivity measurement by the UWB radar systems”.
- The SEZ award for the *Best Presentation* at the Scientific Conference of Young Researchers SCYR 2018 in the section "IT" was won by Ing. Dávid Hrabčák for the presentation of the paper “Adaptive Proactive Routing method for Cognitive Radio Mobile Ad-Hoc Network”.

9.2 Compositions for dissertation examinations

- HRABČÁK,D.: Adaptive routing protocols for CR MANET. FEI TU Košice, Slovakia, February 2018. (supervisor: Doboš,L.)
- MÁRTON,M.: Analysis of the properties of an experimental hybrid FSO/RF system. FEI TU Košice, Slovakia, January 2018. (supervisor: Ovseník,L.)
- NEZNÍK,D.: Radio resource management for cognitive mobile ad-hoc networks. FEI TU Košice, Slovakia, February 2018. (supervisor: Doboš,L.)
- PEČOVSKÝ,M.: A Novel Concept for M-Sequence GPR Front-end Circuits. FEI TU Košice, Slovakia, January 2018. (supervisor: Galajda,P.)

10 PUBLICATION ACTIVITY OF THE DEPARTMENT

10.1 Books

1. GLADIŠOVÁ,I.-MIHALÍK,J.-HANZÉLY,P.: Morfológická filtrácia obrazov. In: Košice: TU, Slovakia, 1st edition, 2018, 66 pp.
2. LEVICKÝ,D.: Aplikovaná kryptografia: Od utajenia správ ku kybernetickej bezpečnosti. In: Košice: ELFA, Slovakia, 1st edition, 2018, 437 pp.
3. MACEKOVÁ,L.: Prístupové siete – prednášky. In: Košice: TU, Slovakia, 1st edition, 2018, 144 pp.
4. MIHALÍK,J.: Číslícové spracovanie obrazov. In: Košice: TU, Slovakia, 1st edition, 2018, 96 pp.
5. MIHALÍK,J.-GLADIŠOVÁ,I.: Štatistická analýza obrazov (Návody na cvičenia). In: Košice: TU, Slovakia, 1st edition, 2018, 105 pp.
6. ŠALIGA,J.-ANDRÁŠ,I.-DOLINSKÝ,P.: Vybrané metódy merania neelektrických veličín. In: Košice: TU, Slovakia, 1st edition, 2018, 94 pp.

10.2 Journal papers

1. ANDRÁŠ,I.-DOLINSKÝ,P.-MICHAELI,L.-ŠALIGA,J.: A time domain reconstruction method of randomly sampled frequency sparse signal. In: Measurement, Vol. 127 (2018), pp. 68-77.
2. ANDRÁŠ,I.-DOLINSKÝ,P.-MICHAELI,L.-ŠALIGA,J.: Sparse Signal Acquisition via Compressed Sensing and Principal Component Analysis. In: Measurement Science Review: Journal of Institute of Measurement Science of Slovak Academy of Sciences, Vol. 18, no. 5 (2018), pp. 175-182.
3. ANDRÁŠ,I.-DOLINSKÝ,P.: Robustná identifikácia exponenciálnych zložiek signálu s predspracovaním. In: JIEE Časopis priemyselnej elektrotechniky, Vol. 2, no. 2 (2018), pp. 28-34.
4. DOLINSKÝ,P.-ANDRÁŠ,I.-MICHAELI,L.-GRIMALDI,D.: Model for Generating Simple Synthetic ECG Signals. In: Acta Electrotechnica et Informatica, Vol. 18, no. 3 (2018), pp. 3-8.
5. GALAJDA,P.-GALAJDOVÁ,A.-SLOVÁK,S.-PEČOVSKÝ,M.-DRUTAROVSKÝ,M.-SUKOP,M.-SAMANEH,I.B.A.: Robot vision ultra-wideband wireless sensor in non-cooperative industrial environments. In: International Journal of Advanced Robotic Systems, Vol. 15, no. 4 (2018), pp. 1-12.
6. GAZDA,J.-ŠLAPAK,E.-BUGÁR,G.-HORVÁTH,D.-MAKSYMUK,T.-JO,M.: Unsupervised learning algorithm for intelligent coverage planning and performance optimization of multitier heterogeneous network. In: IEEE Access, Vol. 6 (2018), pp. 39807-39819.
7. HRABČÁK,D.-MATIS,M.-DOBOŠ,L.-PAPAJ,J.: Tools for evaluation of social relations in mobility models. In: Telecommunication systems, Vol. 68, no. 3 (2018), pp. 409-424.
8. HUSZANÍK,T.-TURÁN,J.-OVSENÍK,L.: Demonstration of multimode optical fiber communication system using 1300 nm directly modulated VCSEL for Gigabit Ethernet. In: Infocommunications Journal, Vol. 10, no. 2 (2018), pp. 26-32.
9. HUSZANÍK,T.-TURÁN,J.-OVSENÍK,L.: Utilization of 10 Gbps DWDM System with Duobinary Modulation into Passive Optical Network. In: Journal of Communications Software and Systems, Vol. 14, no. 4 (2018), pp. 367-375.

10. HUSZANÍK,T.-TURÁN,J.-OVSENÍK,L.: Experimental Simulation of Coherent 40 GBPS 2-DPSK DWDM Long-haul Fiber Optical System with Counter-directional EDFA. In: *Acta Technica Napocensis*, Vol. 59, no. 2 (2018), pp. 5-8.
11. HUSZANÍK,T.-TURÁN,J.-OVSENÍK,L.: Simulation of Downlink of 10G-PON FTTH in the city of Košice. In: *Carpathian Journal of Electronic and Computer Engineering*, Vol. 11, no. 1 (2018), pp 33-39.
12. HUSZANÍK,T.-TURÁN,J.-OVSENÍK,L.: Realization of a Long-haul Optical Link with Erbium Doped Fiber Amplifier, In: *Carpathian Journal of Electronic and Computer Engineering* Vol. 11, no. 2 (2018), pp. 44-49.
13. IVANIGA,P.-IVANIGA,T.-TURÁN,J.-OVSENÍK,L.-MÁRTON,M.-SOLUS,D.-ORAVEC,J.-HUSZANÍK,T.: The influence of FWM with AWG multiplexor in DWDM system. In: *Przeglad Elektrotechniczny*, Vol. 94, no. 4 (2018), pp. 113-117.
14. KOSTEREC,M.-KURIMSKÝ,J.-CIMBALA,R.-ŠPES,M.-FARKAŠ,R.-DOLNÍK,B.-GAMCOVÁ,M.-RAJŇÁK,M.-TIMKO,M.-KOPČANSKÝ,P.-PAULOVÍČOVÁ,K.-VARGOVÁ,B.: Variation of magnetic fluid deformation related to nanoparticle concentration in steady electric field. In: *Acta Physica Polonica A*, Vol. 133, no. 3 (2018), pp. 570-573.
15. LABAN,M.-DRUTAROVSKÝ,M.: Low-cost ARM Cortex-M0 based TRNG for IoT Applications. In: *Acta Electrotechnica et Informatica*, Vol. 18, no. 1 (2018), pp. 52-56.
16. LABUN,J.-KRCHŇÁK,M.-KURDEL,P.-ČEŠKOVIČ,M.-NEKRASOV,A.-GAMCOVÁ,M.: Possibilities of Increasing the Low Altitude Measurement Precision of Airborne Radio Altimeters. In: *Electronics*, MDPI, Vol. 7, no. 9 (2018), pp. 191-191.
17. MATIS,M.-DOBOŠ,L.: Bezdrôtové viacpreskokové siete s využitím kognitívneho rádia. In: *QuoVadis Research*, Vol. 1, no. 1 (2018), pp. 52-69.
18. MÁRTON,M.-OVSENÍK,L.-HUSZANÍK,T.-ŠPES,M.: Analysis of possibilities for measurement effect of visibility in experimental FSO system. In: *Open Computer Science*, Vol. 8, no. 1 (2018), pp. 135-141.
19. MÁRTON,M.-OVSENÍK,L.-TURÁN,J.-ŠPES,M.: Design of Pyramidal Horn Antenna for 2.45GHz in FEKO for Application in Experimental FSORF Hybrid System. In: *Carpathian Journal of Electronic and Computer Engineering*, Vol. 11, no. 1 (2018), pp. 7-10.
20. MÁRTON,M.-OVSENÍK,L.-TURÁN,J.-ŠPES,M.-URBANSKÝ,J.: Design of Helix Antenna for 9.2GHz in FEKO for FSO/RF Hybrid System Focused on Height of Helix, In: *Carpathian Journal of Electronic and Computer Engineering* Vol. 11, no. 2 (2018), pp. 3-7.
21. MIHALÍK,J. Videokomunikácie v mobilných sieťach. In: *Slaboproudý obzor*, Vol. 74, no. 4 (2018), pp. 4-6.
22. MRNKA,M.-CUPAL,M.-RAIDA,Z.-PIETRIKOVÁ,A.-KOCUR,D.: Millimetre-wave dielectric resonator antenna array based on directive LTCC elements. In: *IET Microwaves Antennas and Propagation*, Vol. 12, no. 5 (2018), pp. 662-667.
23. NEKRASOV,A.-GAMCOVÁ,M.-KURDEL,P.-LABUN,J.: On off-nadir wind retrieval over the sea surface using APR-2 or similar radar geometry. In: *International Journal of Remote Sensing*. Abington, Taylor&Francis Group, Vol.39, no. 18 (2018), pp. 5934-5942.
24. ORAVEC,J.-TURÁN,J.-OVSENÍK,L.-IVANIGA,T.-SOLUS,D.-MÁRTON,M.: Asymmetric Image Encryption Approach with Plaintext-Related Diffusion. In: *Radioengineering*, Vol. 27, no. 1 (2018), pp. 281-288.
25. ORAVEC,J.-TURÁN,J.-OVSENÍK,L.-HUSZANÍK,T.: An image encryption scheme employing key related skipping. In: *Journal of Electrical Engineering*, Vol. 69, no. 2 (2018), pp. 93-105.

26. ORAVEC,J.-TURÁN,J.-OVSENÍK,L.: An Image Encryption Algorithm with Total Diffusion. In: Carpathian Journal of Electronic and Computer Engineering, Vol. 11, no. 1 (2018), pp. 15-25.
27. ORAVEC,J.-TURÁN,J.-OVSENÍK,L.: An Image Encryption Scheme Utilizing Harper's Map. In: Acta Electrotechnica et Informatica, Vol. 18, no. 1 (2018), pp. 47-51.
28. PALAHINA,E.-GAMCOVÁ,M.-GLADIŠOVÁ,I.-GAMEC,J.-PALAHIN,V.: Signal detection in correlated non-Gaussian noise using higher-order statistics. In: Circuits Systems and Signal Processing, Vol. 37, no. 4 (2018), pp. 1704-1723.
29. PEČOVSKÝ,M.-GALAJDA,P.-SLOVÁK,S.-SOKOL,M.-KMEC,M.: M-sequence ground-penetrating radar with novel front-end concept. In: Acta Electrotechnica et Informatica, Vol. 18, no. 2 (2018), pp. 11-18.
30. PLEVA,M.-ONDÁŠ,S.: Speech applications for human-robot interaction systems. In: Problems of Engineering Cybernetics and Robotics, Vol. 69 (2018), pp. 3-14.
31. SILAGHI,H.-GAMCOVÁ,M.-SILAGHI,A.M.-SPOIALĂ,V.-SILAGHI,A.M.-SPOIALĂ,D.: Intelligent control of electrical drive system used for electric vehicles. In: The Scientific Bulletin of Electrical Engineering Faculty, Vol. 18, no. 1 (2018), pp. 5-10.
32. TÓTH,J.-OVSENÍK,L.-TURÁN,J.-MICHAELI,L.-MÁRTON,M.: Classification prediction analysis of RSSI parameter in hard switching process for FSORF systems. In: Measurement, Vol. 116 (2018), pp. 602-610.
33. TURABZADEH,S.-MENG,H.-SWASH,R.M.-PLEVA,M.-JUHÁR,J.: Facial expression emotion detection for real-time embedded systems. In: Technologies, Vol. 6, no. 1 (2018), pp. 1-18.
34. VAVREK,J.-VISZLAY,P.-LOJKA,M.-JUHAR,J.-PLEVA,M.: Weighted fast sequential DTW for multilingual audio Query-by-Example retrieval. In: Journal of Intelligent Information Systems, Vol. 51, no. 2 (2018), pp. 439-455.

10.3 Conference papers

1. ANDRÁŠ,I.-DOLINSKÝ,P.-MICHAELI,L.-ŠALIGA,J.: Beamforming With Small Diameter Microphone Array. In: Radioelektronika 2018, Danvers: IEEE, 2018, pp. 1-5.
2. ANDRÁŠ, Imrich: Unconventional Sampling. In: SCYR 2018, Košice: TU, 2018, pp. 256-257.
3. BARAN,L.-DRUTAROVSKÝ,M.: Modul Flash pamäte pre vstavaný systém na báze Raspberry Pi. In: Electrical Engineering and Informatics 9: Proceedings of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, FEI TU, Slovakia, 2018, pp. 161-166.
4. BUŠA,J.-KOCUR,D.-ŠVECOVÁ,M.: Numerical Investigation on the Time Discretization Impact on the Accuracy of a Point Target Localization by UWB Radar. In: EPJ Web of Conferences volume 173: MMCP 2017, S.l.: EDT Science, 2018, pp. 1-4.
5. DOLINSKÝ,P.: Compressed Sensing of an ECG Signal. In: SCYR 2018, Košice: TU, 2018, pp. 57-58.
6. DOLINSKÝ,P.-ANDRÁŠ,I.-ŠALIGA,J.-MICHAELI,L.: High sensitivity experimental QRS detector. In: Radioelektronika 2018, Danvers: IEEE, 2018, pp. 1-4.
7. DOLINSKÝ,P.-ANDRÁŠ,I.-MICHAELI,L.: Detektor QRS komplexov v EKG signáloch. In: Electrical Engineering and Informatics 9: Proceedings of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, FEI TU, Slovakia, 2018, pp. 44-47.
8. DŽURŇÁKOVÁ,K.-HORNYÁKOVÁ,A.-ANDRÁŠ,I.-DOLINSKÝ,P.-ŠALIGA,J.: Meranie tepovej frekvencie pomocou fotopletyzmozografu. In: Electrical Engineering and Informatics 9:

- Proceedings of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, FEI TU, Slovakia, 2018, pp. 63-66.
9. GLADIŠOVÁ,I.-KOVÁČ,O.-ANDRÁSSY,P.: Rýchly algoritmus vyhľadávania v kódovej knihe vektorového predikčného kódovacieho systému. In: Electrical Engineering and Informatics 9: Proceedings of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, FEI TU, Slovakia, 2018, pp. 21-27.
 10. GLADIŠOVÁ,I.-MIHALÍK,J.: Algoritmy tvorby zreteľných kódov segmentových a hranových obrysov In: Electrical Engineering and Informatics 9: Proceedings of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, FEI TU, Slovakia, 2018, pp. 34-38.
 11. GREŠŠÁK,J.: Spherical Harmonic Domain Beamforming for Microphone Array Signal Processing. In: SCYR 2018, Košice: TU, 2018, pp. 235-236.
 12. GREŠŠÁK,J.-JUHÁR,J.: Metódy beamformingu na spracovanie signálov zo sférického mikrofónového poľa. In: Electrical Engineering and Informatics 9: Proceedings of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, FEI TU, Slovakia, 2018, pp. 538-542.
 13. GREŠŠÁK,J.-PORTELEKY,T.-ŠVINGÁL,M.: Výpočet tempa v hudbe a jeho vplyv na človeka. In: Electrical Engineering and Informatics 9: Proceedings of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, FEI TU, Slovakia, 2018, pp. 741-745.
 14. HAJDUK,V.-LEVICKÝ,D.: Steganografia s výberom krycieho obrazu s vnútro-snímkovým prehľadávaním. In: Electrical Engineering and Informatics 9: Proceedings of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, FEI TU, Slovakia, 2018, pp. 278-282.
 15. HAJDUK,V.: The summarization of novel cover selection steganography methods. In: SCYR 2018, Košice: TU, 2018, pp. 250-251.
 16. HALUŠKA,R.: Parameters influencing data transfer through hybrid FSO/RF system. In: SCYR 2018, Košice: TU, 2018, pp. 180-183.
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10.4 Thesis

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3. KOCTÚR, T.: Automatické spracovanie akustických dát pre systémy automatického rozpoznávania reči (Automatic processing of acoustic data for speech recognition systems). Dissertation for Ph.D. degree, FEI TU Košice, Slovakia, June 2018. (supervisor: Juhár, J.)

4. MATIS,M.: Bezdrôtové viacpreskokové siete s využitím kognitívneho rádia (Cognitive radio based multihop networks). Dissertation for Ph.D. degree, FEI TU Košice, Slovakia, June 2018. (supervisor: Doboš,L.)
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10.5 Patents

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