
**DEPARTMENT OF ELECTRONICS AND
MULTIMEDIA TELECOMMUNICATIONS**



Annual Report
2016

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 2016

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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,
- ◆ Smart 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 34.

- ◆ Professors: Anton Čižmár, Jozef Juhár, Dušan Kocur, Dušan Levický, Stanislav Marchevský, Ján Mihalík, Linus Michaeli, Ján Šaliga, Ján Turán
- ◆ Associate Professors: Ľubomír Doboš, Miloš Drutarovský, Pavol Galajda, Ján Gamec, Ľuboš Ovseník
- ◆ Assistant Professors: Gabriel Bugár, Mária Gamcová, Iveta Gladišová, Daniel Hládek, Ľudmila Maceková, Stanislav Ondáš, Ján Papaj, Ján Staš,
- ◆ Research Assistant: Eva Kiktová, Martin Lojka, Matúš Pleva, Mária Švecová, Peter Vízlay
- ◆ Support staff: Viera Šumáková, Natália Topolčanská

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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Laboratory of Digital Image Processing and Videocommunication

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

Head: Professor: prof. Ing. Ján Mihalík, CSc.

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Laboratory of Optoelectronic Communications

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

Head: Professor: Dr.h.c. prof. RNDr. Ing. Ján Turán, DrSc., Senior Member of the IEEE

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Laboratory of Electronic Circuits & Measurement

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2.2 Special laboratories and equipments

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 equipments:
 - ◆ 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 equipments:
 - ◆ 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 equipments:
 - ◆ 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 equipments:
 - ◆ 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 (XEON 2GB RAM, 2TB HDD, OS Debian Linux),
- Computing server for speech analysis and synthesis (HP ProLiant DL380 G7, 2xCore2Quad 2.4GHz, 12GB RAM, 4x HP 146-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 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.) –Smart 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	2/3	Galajda
Analogue circuits	3 rd	3/2	Kocur
Digital electronics	3 rd	3/2	Galajda
Signals and systems	3 rd	3/2	Mihalík, Gladišová
Measurements in electronics and telecommunications	4 th	2/3	Šaliga
Electronic design tools	4 th	3/2	Galajda
Active and passive safety systems of cars	5 th	3/2	Gamec
Automotive electronics	5 th	3/2	Gamec
Microwave circuits and systems	6 th	3/3	Gamec
Programming of embedded systems	6 th	2/3	Drutarovský

Undergraduate Study (Bc.) – Smart Electronics

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of electronics	2 nd	2/3	Galajda
Analogue circuits	3 rd	3/2	Kocur
Basics of telecommunications technology	3 rd	3/2	Levický
Digital electronics	3 rd	3/2	Galajda
Signals and systems	3 rd	3/2	Mihalík, Gladišová
Measurements in electronics and telecommunications	4 th	2/3	Šaliga
Microwave circuits and systems	4 th	3/3	Gamec
Electronic design tools	4 th	3/2	Galajda
Networks technology 1	4 th	3/2	Levický
Communication acoustics	4 th	3/2	Juhár
Bachelor thesis	5 th	0/6	Juhár
Graphical programming	5 th	3/2	Šaliga
Microprocessor technology	5 th	3/2	Drutarovský
Networks architecture	5 th	3/2	Čížmár
Automotive electronics	5 th	3/2	Gamec
Electromagnetic waves and antennas	5 th	3/2	Ovseník
Interactive electronic and communication systems	5 th	2/3	Juhár
Videocommunications	5 th	3/2	Mihalík
Multimedia database systems	5 th	2/3	Juhár
Networks technology 2	5 th	2/2	Levický
Programming of embedded systems	6 th	2/3	Drutarovský
Active and passive safety systems of cars	6 th	3/2	Gamec
Optoelectronic systems	6 th	3/2	Turán
Satellite technology and services	6 th	3/2	Marchevský

Undergraduate Study (Bc.) – Multimedia Communication Technologies

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of electronics	2 nd	2/3	Galajda
Analogue circuits	3 rd	3/2	Kocur

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of telecommunications technology	3 rd	3/2	Levický
Digital electronics	3 rd	3/2	Galajda
Signals and systems	3 rd	3/2	Mihalík, Gladišová
Measurements in electronics and telecommunications	4 th	2/3	Šaliga
Multimedia technologies	4 th	3/2	Staš
Networks technology 1	4 th	3/2	Levický
Communication acoustics	4 th	3/2	Juhár
Microwave circuits and systems	4 th	3/3	Gamec
Bachelor thesis	5 th	0/6	Juhár
Communication technology 1	5 th	3/2	Marchevský
Networks architecture	5 th	3/2	Čižmár
Electromagnetic waves and antennas	5 th	3/2	Ovseník
Graphical programming	5 th	3/2	Šaliga
Interactive electronic and communication systems	5 th	2/3	Juhár
Multimedia database systems	5 th	2/3	Juhár
Mobile technologies and services	5 th	3/2	Doboš
Videocommunications	5 th	3/2	Mihalík
Networks technology 2	5 th	2/2	Levický
Communication technology 2	6 th	3/2	Maceková
Programming of embedded systems	6 th	2/3	Drutarovský
Optoelectronic systems	6 th	3/2	Turán
Satellite technology and services	6 th	3/2	Marchevský

Undergraduate Study (Bc.) – Computer Networks

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of algorithms and programming	1 st	3/2	Novitzká, Hládek
Programming	2 nd	2/2	Tomášek, Hládek
Principles of computer engineering	2 nd	2/2	Vokorokos, Maceková
Basic of software engineering	2 nd	2/2	Havlice, Ondáš
Computer system architectures	3 rd	2/2	Vokorokos, Drutarovský
Object oriented programming	3 rd	2/2	Tomášek, Ondáš
Operating systems	3 rd	3/2	Genči, 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	Čižmár, Bugár
Database systems	4 th	3/2	Genči, Staš
Programming in a DotNET	4 th	2/2	Havlice
Transmission media	4 th	2/2	Ovseník
Multimedia signals in communication networks	4 th	2/2	Ovseník
Component programming	4 th	2/2	Porubän
Bachelor thesis	5 th	0/8	Čižmár
Application of computer networks	5 th	2/2	Čižmár, Papaj
Data structures and algorithms	5 th	2/2	Kollár, 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
Bachelor thesis	6 th	0/12	Čižmár
Security of computer systems	6 th	3/2	Vokorokos, Drutarovský
Programming of embedded systems	6 th	2/2	Drutarovský
Speech interactive communication systems	6 th	2/2	Juhár

3.2.2 Study plan for MSc. degree

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
Programmable logic circuits	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	3/2	Šaliga
Design of integrated circuits for smart applications	2 nd	3/2	Galajda
Optical communication systems	2 nd	3/2	Turán
High frequency and microwave technology	2 nd	3/2	Gamec
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

Graduate Study (Ing.) – Multimedia Communication Technologies

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Applied cryptography	1 th	3/2	Drutarovský
Digital signal processing	1 th	3/2	Mihalík, Gladišová
Optoelectronics	1 th	3/2	Turán
Signal and communication interfaces	1 th	3/2	Šaliga
Programmable logic circuits	1 th	3/2	Drutarovský
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
Diploma project 1	2 nd	0/6	Juhár
Processing and transmission of speech and audio signals	2 nd	3/2	Juhár
Optical communication systems	2 nd	3/2	Turán
Telecommunication systems theory	2 nd	3/2	Čižmár
Design of integrated circuits for smart applications	2 nd	3/2	Galajda
Digital image processing and coding	2 nd	3/2	Mihalík
High frequency and microwave technology	2 nd	3/2	Gamec
Smart measuring systems	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

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Photonics	3 rd	3/2	Turán
UWB sensor networks	3 rd	2/2	Kocur
Satellite technology and services	6 th	3/2	Marchevský

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
Programmable logic circuits	1 th	3/2	Drutarovský
High frequency and microwave technology	2 nd	3/2	Gamec
Design of integrated circuits for smart applications	2 nd	3/2	Galajda
Smart measuring systems	2 nd	3/2	Šaliga
Advanced communication systems	3 rd	3/2	Kocur
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.) –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: **Trustworthy Manufacturing and Utilization of Secure Devices**

Acronym: TRUEDEVICE

Number: COST Action IC1204

Program/agency: COST

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

Project partners: 17 partners from university, research and industrial institutions

Start of project: December 12/2012

End of project: December 11/2016

Total funding: not defined

Annotation: Hardware security is becoming increasingly important for many embedded systems applications ranging from small RFID tag to satellites orbiting the earth. Its relevance is expected to increase in the upcoming decades as secure applications such as public services, communication, control and healthcare will keep growing. The vulnerability of hardware devices that implement cryptography functions (including smart cards) has become the Achilles's heel in the last decade. Therefore, the industry is recognizing the significance of hardware security to combat semiconductor device counterfeiting, theft of service and tampering. This COST Action aims at creating a European network of competence and experts on all aspects of hardware security including design, manufacturing, testing, reliability, validation and utilization. The network will play a key role in developing solutions responding to the hardware security challenges, hence strengthening the position of Europe in the field.

Project title: **Wireless Power Transmission for Sustainable Electronics**

Acronym: WiPE

Number: COST Action IC1301

Program/agency: COST

Coordinator from TU: doc. Ing. Pavol Galajda, CSc.

Project partners: 22 partners from university, research and industrial institutions

Start of project: October 24/2013

End of project: October 23/2017

Total funding: not defined

Annotation: The COST Action activity aims to address efficient Wireless Power Transmission (WPT) circuits, systems and strategies specially tailored for battery-less systems. Battery-free sensors, passive RFID, Near Field Communications (NFC) are all closely related concepts that make use of WPT and energy harvesting systems to remotely power up mobile devices or to remotely charge batteries, contributing to develop and foster the Internet of Things (IoT) evolution. In this context, this COST Action aims at bringing together RF circuit and system designers with different backgrounds to: 1) provide enhanced circuit and subsystem solutions to increase the efficiency in WPT; and 2) investigate the use of novel materials and technologies that allow minimizing cost and maximizing integration of the electronics with the environment and with the targeted applications.

Project title: **Innovative ICT Solutions for the Societal Challenges**

Acronym: INNOSOC

Number: 2015-1-HR01-KA203-013124

Program/agency: Erasmus+

Coordinator from TU: Ing. Mária Gamcová, PhD.

Project partners: Croatia, Slovakia, Hungary, Spain, Romania, Bulgaria, Germany, France

Start of project: 09/2015

End of project: 08/2017

Total funding: not defined

Annotation: The main objective of the INNOSOC project is to set up a transnational multidisciplinary intensive study program in the field of innovations based on information's and communication technology targeting societal challenges defined by Europe 2020 and Horizon 2020 programs.

Student projects will be based on the "blended" mobility approach and organized in two phases: (i) preparatory (virtual mobility); and (ii) execution phase (physical mobility). Physical mobility will be implemented through three two-week workshops hosted by partner universities in 2016 (Zagreb), 2017 (Leipzig) and 2018 (Valencia). Workshop participants will be professors (16 professors from 11 universities from 8 countries) and students (100 students from 11 universities from 8 countries) from partner universities.

Multilingual (on 8 EU languages) open course materials on innovation and entrepreneurship including case studies on how ICT can contribute to innovative societal development will be made free to access through the project web site. In that way INNOSOC project will have significant impact on national and EU level through serving on the long-term benefit of all citizens, academia and industry.

Project title: **Civil Engineering Applications of Ground Penetrating Radar**

Acronym:

Number: COST Action TU1208

Program/agency: COST

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

Project partners: 40 partners from university, research and industrial institutions

Start of project: April 4/2013

End of project: October 03/2017

Total funding: not defined

Annotation: This Action focuses on the exchange of scientific-technical knowledge and experience of Ground Penetrating Radar (GPR) techniques in Civil Engineering (CE). The project is developed within the frame of a unique approach based on the integrated contribution of university researchers, software developers, geophysics experts, non-destructive testing equipment designers and producers, end users from private companies and public agencies. In this interdisciplinary action, advantages and limitations of GPR will be highlighted leading to the identification of gaps in knowledge and technology. Protocols and guidelines for EU Standards are going to be developed, for effective application of GPR in CE. A novel GPR should be designed and realized: a multi-static system, with dedicated software and calibration procedures, able to construct real-time lane 3D high resolution images of investigated areas. Advanced electromagnetic-scattering and data-processing techniques will be developed. Within this project, the research team from Technical University of Kosice (TUKE) has been focused on GPR for localization of static human beings based on the detection of their vital signs such as breathing or heart beating. The solution of such task can be used e.g. to rescue survivors trapped in a collapsed building or beneath snow. The most important scientific results reached by TUKE at the project solution can be summarized as follows: (1) Design of new UWB radar signal processing procedure referred to as WP-STAPELOC method for through-the-obstacle multiple static person localization based on the detection of their respiratory motion. (2) Design of new UWB radar signal processing procedure referred to as bank filter method for through-the-obstacle multiple static person localization based on the detection of their respiratory

motion. (3) Design of new UWB radar signal processing procedure intent on the joint multiple static person localization and the estimation of their respiratory rate.

Project title: COST Action IC1303: Algorithms, Architectures and Platforms for Enhanced Living Environments

Acronym: AAPELE

Number: COST Action IC1303

Program/agency: COST

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

Project partners: 34 partners from university, research and industrial institutions

Start of project: November 13/2013

End of project: November 12/2017

Total funding: not defined

Annotation: Ambient Assisted Living (AAL) is an area of research based on Information and Communication Technologies (ICT), medical research, and sociological research. AAL is based on the notion that technology and science can provide improvements in the quality of life for people in their homes. The concept of Enhanced Living Environments (ELE) refers to the AAL area that is more related with the Information and Communication Technologies. To design, plan, deploy and operate, an AAL system often comprehends the integration of several scientific areas. The AAPELE project addresses the issues of defining software, hardware and service architectures for AAL, on studying and creating more efficient algorithms for AAL, particularly those related to the processing of large amounts of data and of biosignals in lossy environments, and on the research of protocols for AAL or, with more detail, on studying communication and data transmission protocols for AAL. This Action aims to promote interdisciplinary research on AAL, through the creation of a research and development community of scientists and entrepreneurs, focusing on AAL algorithms, architectures and platforms, having in view the advance of science in this area and the development of new and innovative solutions. Within this project, the research team from Technical University of Kosice (TUKE) has been focused on person localization using UWB sensor systems with the application within AAL program. The most important scientific results reached by TUKE at the project solution can be summarized as follows: (1) Design of a new UWB radar sensor network for person detection and localization. (2) A new signal processing procedures for multiple static person localization based on the detection of their respiratory motion. (3) A new UWB radar signal processing procedure for person localization moving with with the changing nature of their movement. (3) Anew UWB radar signal processing procedure intent on the joint multiple static person localization and the estimation of their respiratory rate.

Project title: Research and Development of Modules for Language-Adaptive Multimodal Interfaces

Acronym: MOLAMI

Number: SK-HU-2013-0015

Program/agency: APVV

Coordinator from TU: Ing. Stanislav Ondáš, PhD.

Project partners: University of Miskolc, Hungary

Start of project: 01/2015

End of project: 12/2016

Total funding: 3.000,00 €

Annotation: Goals of the proposed project are research and development of the modules of the multimodal human-machine interfaces, where the multilingualism resp. easy language adaptation

plays the important role. Designed interface will be tested on Slovak as well as Hungarian languages. Modules for the language-adaptive multimodal HMI together with joint publications and joint participation on conferences will be the results of proposed project.

Project title: Integrating Biometrics and Forensics for the Digital Age

Acronym:

Number: COST Action IC1106

Program/agency: COST

Coordinator from TU: Ing. Matúš Pleva, PhD.

Project partners: 27 partners from university, research and industrial institutions

Start of project: March 14/2012

End of project: March 13/2016

Total funding: 8.154,88 €

Annotation: Forensics is the application of a broad spectrum of sciences to answer questions of interest to a legal system. This may be in relation to a crime or a civil action” [Wikipedia]. Since many such questions boil down to identifying, or verifying the identity, of people allegedly involved in some action, a clear relationship exists between forensics and biometrics. Biometrics developed a number of techniques which can clearly facilitate the identification of people involved in criminal actions or civil incidents. Thus, although the two communities have traditionally often operated in relative isolation, there are many scenarios where the synergic cooperation of multimodal biometrics and forensics can be successfully applied. To address such multifaceted areas it is important to develop an interdisciplinary network with complementary competences, to foster the birth of a new community which can develop novel technological solutions to crucial issues and new challenges in forensic science.

Project title: Technological Transfer Network

Acronym: TecTNet

Number: 544197-TEMPUS-1-2013-1-IT-TEMPUS-JPHES

Program/agency: TEMPUS

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

Project partners: 11 partners from university, research and industrial institutions in Italy, Portugal, Romania and Moldavia

Start of project: December 1/2013

End of project: November 30/2016

Total funding: 513.091,98 €

Annotation: The project proposal called TecTNet is motivated to solve some uncovered issues in the public universities in the Rep. of Moldova:

- a) the lack of availability of a Master Course Program (MCP) providing advanced knowledge about the management of innovation, research and development, project management, intellectual property (IP) and technology transfer (TT), law and economy about IP protection, marketing of new products, etc.
- b) the lack of availability of a standalone Office of Technology Transfer (OTT) in each university for innovation/ technological transfer and the cooperation among the public universities in Rep. of Moldova and the industry/private sector;
- c) the low cooperation/promotion among Moldavian universities and the national industry/private sector in the fields of: (i) TT, (ii) IP, (iii) management of innovation, and (iv) project realization and management.

The goal of the project is to improve the quality of education and management of education in universities and industry partners in Moldavia and to enhance the technology transfer among universities and industry in Moldavia and EU countries. The expected impacts cover education

(master courses), economics (Moldavian universities will improve their equipment) and social effects (new specialists for 21st centuries challenges upon the worldwide economy).

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

Acronym:

Number: APVV-0696-12

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: doc. 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. T

he 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: New Generation of Interface for Service Robots Teleoperatoric Control

Acronym: TELEROB

Number: APVV-14-0894

Program/agency: APVV

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

Project partners: ZŤS VVÚ Košice, STU Bratislava

Start of project: 2015

End of project: 2017

Total funding: 249.747,00 €

Annotation: The project deals with the enhancement of the operator-robot interface by elements that will secure improved environment perception by the operator, improvement of robot haptic feedback and design of new robot control system for several movement axes at one time, using new technologies, virtual models, voice commands, etc. On this basis a new testing and training facility for mobile robot operators will also be set up. The project exploits the suitable timing for the implementation, when technologies investigated in laboratories have by far overtaken the systems that still pertain in practice. This will enable quality improvement of teleoperatory control of service robots by a whole generation and will generate a comparative advantage for the applicant in the placement of his products on the market. An economic effect will be the increase in added value in new robots by approx. 30% in turnover and increase of employment.

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: Persons Localization in 3D Under Emergency Event based on UWB Radar

System

Acronym: PerLoc-3D-UWB

Number: APVV-0404-12

Program/agency: APVV

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

Project partners:

Start of project: 10/2013

End of project: 09/2016

Total funding: 202.000,00 €

Annotation: Project PerLoc-3D-UWB was focused on the detection, localization and tracking of human beings in 3D using UWB sensor (radar) system. The most important scientific results reached at the project solution can be summarized as follows: (1) A new concept of person localization in 3D based on application of multistatic UWB sensor (1 transmitted and 4 receiving channel) was developed. (2) A new antenna array of a multistatic UWB radar for person in 3D was proposed. The mentioned antenna array was optimized for the development of person localization algorithms. (3) New radar signal procedures for moving and static person localization was developed. The procedures consist of the successive signal processing phases, which are implemented using proper signal processing methods. The procedures were optimized considering their data flow processing and computational complexity taking into account their real time performance and joint localization of moving and static persons.(4) Two new detectors of static persons were designed (detector employing Welch periodogram method and detector employing bank filter). (5) A set of new original localization methods of persons in 3D was developed (especially 3D-2D method, optimization method and their combination with a method of Taylor series). (6) New approaches for an analysis of performance proper-ties of the person localization methods in 3D were developed and implemented (probability of error of the person localization,

visualization of errors of the person localization in 3D). (7) A real-time operating experimental 3D-UWB scanner was developed and implemented. With regard to the results reached within PerLoc-3D-UWB project, it can be concluded in our opinion, that the tasks of PerLoc-3D-UWB project specified in the project proposal have been fulfilled.

Project title : Selected Security Topics in Advanced Telecommunications

Acronym:

Number: 1/0075/15

Program/agenc : VEGA

Coordinator from TU: prof. Ing. Dušan Levický, PhD.

Project partners:

Start of project: 01/2015

End of project: 12/2017

Funding in 2016: 15.639 €

Annotation: Proposed scientific project is oriented to selected security aspects in the advanced telecommunication with references to the three areas: multimedia content protection with orientation into image content authentication, image steganography and steganalysis, security of mobile networks with orientation into protected communication in network environment with active attacks and emotional speech analysis for speaker verification. In the area of multimedia content security the development of the new methods for multimedia content protection by using digital watermarking in colour images and image steganography are expected. In the field of mobile networks security design of new routing algorithms and algorithms for node localization are expected. In the field of emotional speech analysis design of new methods for emotional features extraction and reduction of obtained feature vectors for emotional speech.

Project title: Interactive Multiview Video Streaming for Supporting Education

Acronym:

Number: 062TUKE-4/2014

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

Coordinator from TU: Ing. Ľudmila Maceková, PhD.

Project partners:

Start of project: 01/2014

End of project: 12/2016

Funding in 2016: 10.052,00 €

Total funding: 28.886,00 €

Annotation: The project was oriented to development and application of accessible software and hardware for interactive streaming of multimedia content, without necessity to save it in local data store. The aim of project was to elaborate and realize methods of access to various formats of multimedia content, such as video, sound record, and access to web cameras array with multiple visual angles (multiview video streaming), as well. We produced multimedia educational content for exploitation of such access. That all was dedicated for supporting teaching in 1-st to 3-rd degrees of university education in the frame of telecommunication subjects as follows: Switching Technology, Digital Television, Satellite Technologies and Services, etc. Access to learning materials mentioned above will serve naturally to support distance education.

Project title: The Research of Coexistence between Broadband LTE Networks and Digital Terrestrial TV Broadcasting DVB-T/DVB-T2

Acronym:

Number: APVV-0696-12

Program/agency: APVV

Coordinator from TU: prof. Ing. Stanislav Marchevský, CSc.

Project partners: Výskumný ústav spojov, n.o., Banská Bystrica

Start of project: 2013

End of project: 2016

Total funding: not defined

Annotation: The objectives of the project can be divided into main and sub-objectives, while the sub-objectives are based on the main ones and their content is supplemented.

The main objectives of the project are: 1.) Identification of areas of the Slovak Republic, which may result in degradation of the reception of DVB-T/-T2 signal as a result of the introduction of LTE800 transmission. 2.) Establishment the functional public information system to identify the risk of interference of terrestrial DVB-T/-T2 system. 3.) Proposals on measures to prevent unwanted interactions between LTE800 and DVB-T/-T2 systems and solutions leading to elimination of problems in practical operation.

The sub-objectives of the project are as follows: 1.) Analysis of the impact of mutual interference of LTE800 and DVB-T/-T2 systems on population coverage with TV signal and the ability to access broadband services to residents. 2.) The elaboration of principles for the design of LTE800 networks in order to prevent possible future problems caused by interference with networks DVB-T/-T2. 3.) Providing technical support with the design of measures to prevent adverse effects caused by interference between LTE800 and DVB-T/-T2 systems in specific cases of practical operation. 4.) Set-up the testing facility for measurement and evaluation of user equipment in terms of immunity to interference and assessment of specific user equipment.

Project title: **Transfer of Substantial Results of Research in Speech Technology into Education**

Acronym:

Number: 055TUKE-4/2016

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

Coordinator from TU: Ing. Stanislav Ondáš, PhD.

Project partners:

Start of project: 01/2016

End of project: 12/2017

Funding in 2016: 7.365,00 €

Total funding: not defined

Annotation: The proposed project focuses on the transfer of substantial results of the research in area of speech technologies into the education in studying programs, which are offered by Department of Electronics and Multimedia Communications (KEMT). The goal of the project is to support, to accelerate and to make more effective the transfer of newest knowledge and results, which have been reached by the research team of the Laboratory of speech and mobile technologies in telecommunications during the past more than ten years of intensive scientific research and development, into the teaching process. This transfer will be realized by development of a series of educational exercises and supporting tutorials, with focusing on project-oriented education in area of speech telecommunication technologies. Moreover a separate learning material for the subject Interactive telecommunication systems and services will be prepared. Project outputs will be dedicated for supporting teaching in 1-st to 3-rd degrees of university education in the frame of telecommunication subjects as follows: Communications Acoustic, Speech and audio processing and transmission, Multimedia databases, Interactive telecommunication systems and services and Modern speech applications for communication technologies. The outputs of the project, using cloud-based speech technologies, will be also useful to support postgraduate distance learning of the experts in this field.

Project title: Automatic Dialogue Acts Labelling in Spoken Dialogues**Acronym: DiaLAB****Number:****Program/agency: Grant FEI TUKE of Slovak Republic****Coordinator from TU: Ing. Stanislav Ondáš, PhD.****Project partners:****Start of project: 01/2016****End of project: 12/2016****Funding in 2016: 1.740,00 €****Total funding: 1.740,00 €**

Annotation: The project focuses on the research and development of the automatic system for dialogue acts recognition for Slovak. Dialogue acts express the interaction function of particular utterances in the dialog. This topic is highly current due to the facts that computer systems are still not capable to lead such natural and fluent dialog as people can. The second important issue is the language-dependency of this technology. Moreover, mostly all dialogues are placed in the context of emotions, which influences both the way of interaction (dialogue grammar) and also prosodic properties of particular utterances.

The aim of the project is the development of the dialogue acts automatic recognition system, which will be realized through extending of the corpus with annotated dialogues, through preparation of the training data and through training of dialogue acts models and dialogue grammar model. The corpus will be extended mostly with emotionally colored dialogues and their prosodic properties will be analyzed.

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.

Project title: Utilization of the Maximum Likelihood Method for Analog to Digital Interface Testing and for the Measurement of Distorted Waveforms by the Non-orthogonal Components**Acronym:****Number: 1/0281/14****Program/agency: VEGA**

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

Project partners:

Start of project: 01/2014

End of project: 12/2016

Total funding: not defined

Annotation: The aim of the project is testing of the analogue to digital interfaces using the maximum likelihood method applied on the output signal samples within the time domain analysis. The research is focused on the determination of the initial conditions and iterative maximum likelihood procedures with respect to systematic errors and parasitic noise. Studied method is devoted to these application areas.

Dynamic testing properties of the AD interfaces by the method of analysis in the time domain. The proposed procedures allow to determine the parameters of static and dynamic nonlinearities in the selected points of the input range using error model as well as distortion measurement of the various stimulus signals.

The use of the maximum likelihood method on the measurement of waveforms sampled in the time and amplitude domain will be studied for identified ADC error model. The proposed method will be implemented as well as on the waveform identification where partial components are non-ortogonal.

Project title: Mitigation of Stochastic Effect in High-Bitrate All Optical Networks

Acronym: MISTICAL

Number: APVV-0025-12

Program/agency: EMC-IND

Coordinator from TU: Dr.h.c. prof. RNDr. Ing. Ján Turán, DrSc.

Project partners: KEMT FEI TUKE (Ovseník Ľ., Ružbarský J., Tatarko M., Tóth J.), EF ŽU

Start of project: 10/2013

End of project: 09/2016

Total funding: not defined

Annotation: The project is focused investigation in the are of linear and non-linear influences of the transmitted optical signals in the multichannel all-optical systems and networks. Main goal is to investigate origin of these effects and their impact on the transmission of various types of the high-order modulated optical signals and on mitigation of degradation mechanisms using switching and routing in all-optical multi-channel networks.

The project will be solved in three phases. In first phase the physical layer in investigated considering different mainly the stochastic effects. In the second phase also protocols for switching and routing in high-speed all-optical multichannel networks are investigated. Third phase is focused on the integration of the influences in the physical layer with the protocol design for switching and routing into one platform. It will be main precognition for creation of the new properties of the reservation protocols which will meet basic requirements for achieving most effective data transmission with the high-level quality of services through the nodes of the high-speed multichannel all-optical networks based on the OPS with next targeting into all-optical IP networks.

Project title: The Use of TUKE PON Experimental Model in Teaching

Acronym: PONEMT

Number: 006TUKE-4/2014

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

Coordinator from TU: Dr.h.c. prof. RNDr. Ing. Ján Turán, DrSc.

Project partners:

Start of project: 01/2014

End of project: 12/2016

Total funding: not defined

Annotation: The project will solve the implementation of broad access for students to unique equipment PON TUKE physical network model and its application in teaching.

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. Developed system will be an example of measuring system for students in the subject Optical Fibre Networks.

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
- Smart house, s.r.o., Bratislava
- NAF, s.r.o., Bratislava

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
- 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

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

Associated 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

Associated 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, block - matching algorithm and motion estimation.

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.

Gladišová 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.

Kiktová Eva*Research assistant*

Her research is oriented on the field of the acoustic event detection and classification, speaker recognition and digital speech and audio processing.

Kocur Dušan*Full professor*

His research interest is in short-range UWB radar systems and sensor networks applied for detection, localization and tracking of people under disaster situations; as well as in the physical layer of wireless communication systems with the special stress to OFDM, SC-FDMA, FBMD, and OFDM/OQAM transmission systems.

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*Assistant professor*

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

Pleva Matúš*Research assistant*

His research interests include speech processing, automatic broadcast news processing, digital communications, Voice over IP technologies and services, telecommunication technologies biometric applications and routing backbone networks.

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

Name	Supervisor	Degree Course
<i>First 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	doc. Galajda	Electronic Systems and Signal Processing
<u>External form:</u>		
Ing. Marek Laban	doc. Drutarovský	Electronic Systems and Signal Processing
<i>Second year of study</i>		
<u>Internal form:</u>		
Ing. Imrich Andráš	prof. Šaliga	Electronic Systems and Signal Processing
Ing. Pavol Dolinský	prof. Šaliga	Electronic Systems and Signal Processing
Ing. Jozef Greššák	prof. Čižmár	Multimedia Communication Technologies
Ing. Jakub Oravec	prof. Turán	Multimedia Communication Technologies
Ing. Miroslav Repko	doc. Gamec	Electronic Systems and Signal Processing
Ing. Stanislav Slovák	doc. Galajda	Electronic Systems and Signal Processing
<i>Third year of study</i>		
<u>Internal form:</u>		
Ing. Dávid Čonka	prof. Čižmár	Multimedia Communication Technologies
Ing. Vladimír Hajduk	prof. Levický	Multimedia Communication Technologies
Ing. Tomáš Ivaniga	prof. Turán	Electronic Systems and Signal Processing
Ing. Tomáš Koctúr	prof. Juhár	Multimedia Communication Technologies
Ing. Martin Matis	doc. Doboš	Multimedia Communication Technologies
Ing. Dávid Solus	doc. Ovseník	Electronic Systems and Signal Processing
<i>Fourth year of study</i>		
<u>Internal form:</u>		
Ing. Peter Kažimír	prof. Kocur	Electronic Systems and Signal Processing
Ing. Daniel Novák	prof. Kocur	Electronic Systems and Signal Processing
Ing. Ján Pastirčák	prof. Kocur	Multimedia Communication Technologies
Ing. Ján Ružbarský	prof. Turán	Electronic Systems and Signal Processing
Ing. Ján Schneider	doc. Gamec	Electronic Systems and Signal Processing
Ing. Ján Tóth	doc. Ovseník	Electronic Systems and Signal Processing
<u>External form:</u>		
Ing. Peter Strnisko	doc. Ovseník	Electronic Systems and Signal Processing
<i>Fifth year of study</i>		
<u>External form:</u>		
Ing. Martin Kmec	doc. Galajda	Electronic Systems and Signal Processing
Ing. Roman Palitefka	doc. Doboš	Multimedia Communication Technologies
Ing. František Rakoci	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.

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 EU Domain Committee COST for ICT (Information and Communication Technologies) – national delegate.

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 2014".

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".

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".

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 Conferences, seminars

26th International Conference RADIOELEKTRONIKA 2016 is organized by the the Association of Slovak Scientific and Technological Societies – Slovak Electrical Engineering Society in collaboration with the Technical University of Kosice. The scope of the conference is to create a discussion forum for researchers, academics, people in industry, and students who are interested in the latest development in the area of electronics, signal processing, information technologies, microwave technology, their applications and related disciplines. The official language of the convention is English. KEMT FEI TU Košice, Slovakia, April 19-20, 2016.

(<http://kemt.fei.tuke.sk/radioelektronika2016/>)

9.2 Awards

Slovak Electrotechnical Society announced the winners of Josef Murgaš Awards for year 2015. The award was won by Ing. Ján Papaj, PhD., from KEMT FEI TU Košice for publishing original theoretical contributions supporting the development of electronic communications in the article "Cooperation between Trust and Routing Mechanisms for Relay Node Selection in Hybrid MANET-DTN". The paper was published in "Mobile Information Systems" journal.

(http://www.vus.sk/ses/dokumenty/SDT/SDTaIS_2016/Tlac_sprava_SDTaIS_2016.pdf)

9.3 Student competitions and rewards

- The award for the Best presentation at the Scientific Conference of Young Researchers SCYR 2016 in the section "IT 2-4 year of studies" was won by Ing. Ján Pastirčák for the presentation of the paper "Covariance-based spectrum sensing".
- The Elfa award for the Best presentation at the Scientific Conference of Young Researchers SCYR 2016 in the section "EEE 3rd year of study" was won by Ing. Ján Schneider for the presentation of the paper "Wideband Antennas for UWB Radar Systems and their Measurements".

9.4 Compositions for dissertation examinations

- ČONKA,D.: Speech Processing for Security and Industrial Applications. FEI TU Košice, Slovakia, March 2016. (supervisor: Čížmár,A.)
- HAJDUK, V.: Modern Methods of Image Steganography and Steganalysis. FEI TU Košice, Slovakia, March 2016. (supervisor: Levický,D.)
- KMEC,M.: Integrated M- sequence based UWB Sensors for Short Range Sensing. FEI TU Košice, Slovakia, September 2016. (supervisor: Galajda,P.)
- KOCTÚR,T.: Recognition and Searching of Information in Audio Documents. FEI TU Košice, Slovakia, March 2016. (supervisor: Juhár,J.)
- MATIS,M.: Context Oriented Routing Protocols for Hybrid MANET-DTN Mobile Network. FEI TU Košice, Slovakia, March 2016. (supervisor: Doboš,L.)
- ORAVEC,J.: Transformation Methods of Image and Video Processing. FEI TU Košice, Slovakia, December 2016. (supervisor: Turán,J.)

10 PUBLICATION ACTIVITY OF THE DEPARTMENT

10.1 Books

1. ČIŽMÁR,A.-PAPAJ,J.: Theory of Telecommunications Networks In: Košice: TU, Slovakia, 2016, 176 pp.
2. DRUTAROVSKÝ,M.: Jednočípové mikropočítače a jazyk C. In: Košice: TU, Slovakia, 2016, 98 pp.
3. GALAJDA,P.-KMEC,M.-GALAJDOVÁ,A.-LIPTAJ,M.: Širokopásmové obvody, technológie a systémy. In: Košice: TU, Slovakia, 2016, 303 pp.
4. GALAJDA,P.: Návrh integrovaných obvodov. In: Košice: TU, Slovakia, 2016, 149 pp.
5. GLADIŠOVÁ,I.-MIHALÍK,J.: Modulované signály. In: Košice: TU, Slovakia, 2016, 63 pp.
6. KOCUR,D.-BUŠA,J.-FORTES,J.-GAMCOVÁ,M.-GAMEC,J.-NOVÁK,D.-PLAVKA,J.-SCHNEIDER,J.-ŠVECOVÁ,M.-URDZÍK,D.: Detekcia, lokalizácia a sledovanie osôb UWB radarmi krátkého dosahu. In: Košice: TU, Slovakia, 2016, 229 pp.
7. LEVICKÝ,D.: Kryptografia a bezpečnosť komunikačných sietí. In: Košice: elfa, Slovakia, 2016, 352 pp.
8. MACEKOVÁ,L.-MARCHEVSKÝ,S.: Vybrané problémy teórie a praxe vysielania jedno a viacpohľadových videostrímov v IP sieťach. In: Košice: TU, Slovakia, 2016, 81 pp.
9. MIHALÍK,J.-GLADIŠOVÁ,I.: Náhodné signály a obrazy. In: Košice: TU, Slovakia, 2016, 65 pp.
10. RUIZ,S.-GARCIA-LOZANO,M.-GONZALEZ,D.-LEMA,M.-PAPAJ,J.-JOSEPH,W.-DERUYCK,M.-CARDONA,N.-GARCIA,C.-VELEZ,F.J.-CORREIA,L.-STUDER,L.-GRAZIOSO,P.-CHATZINOTAS,S.: Green and efficient RAN architectures. In: Cooperative Radio Communications for Green Smart Environments, Gistrup: River Publishers, 2016, 195-269 pp.

10.2 Journal papers

1. GAMEC,J.-SCHNEIDER,J.-GAMCOVÁ,M.: Vivaldi Antenna for UWB Sensor Networks. In: Elektronika ir Elektrotechnika, Vol. 22, no. 4 (2016), pp. 41-45.
2. GLADIŠOVÁ,I.-MIHALÍK,J.-TÓTH,M.: Zovšeobecnená DCT obrazových segmentov pomocou Householderovho algoritmu. In: Posterus, Vol. 9, no. 4 (2016), pp. 1-9.
3. IVANIGA,T.-OVSENÍK,L.-TURÁN,J.: Investigation of SPM in WDM System with EDFA. In: Carpathian Journal of Electronic and Computer Engineering. Vol. 9, no. 2 (2016), pp. 7-12.
4. KOCUR,D.-NOVÁK,D.-ŠVECOVÁ,M.: UWB Radar Signal Processing for Localization of Persons with the Changing Nature of Their Movement. In: Sensors & Transducers, IFSA Publishing, S. L., 2016.
5. KOVÁČ,O.-MIHALÍK,J.: Tvarovanie 3R modelu ľudskej hlavy pomocou stereoskopického snímání. In: Elektrovie, Vol. 18, no. 1 (2016), pp. 15-20.
6. KOVÁČ,O.-MIHALÍK,J.-ČAJKO,P.: Obrazové textúry a ich popisovanie. In: Posterus, Vol. 9, no. 3 (2016), pp. 1-8.
7. KOVÁČ,O.-MIHALÍK,J.-ČAJKO,P.: Algoritmus popisovania obrazových textúr v priestore DWT. In: Posterus, Vol. 9, no. 7 (2016), pp. 1-9.

8. LOJKA,M.-PLEVA,M.-KIKTOVÁ,E.-JUHÁR,J.-ČIŽMÁR,A.: Efficient Acoustic Detector of Gunshots and Glass Breaking. In: *Multimedia Tools and Applications*, Vol. 75, no. 17 (2016), pp. 10441-10469.
9. MATIS,M.-DOBOŠ,L.-PAPAJ,J.: An Enhanced Hybrid Social Based Routing Algorithm for MANET-DTN. In: *Mobile Information Systems*. Vol. 2016, (2016), pp. 1-12.
10. MÁRTON,M.-OVSENÍK,L.-TURÁN,J.-ŠPES,M.: Application Principle of Sagnac Interferometer in Optical Fiber Gyroscopic System. In: *Carpathian Journal of Electronic and Computer Engineering*. Vol. 9, no. 2 (2016), pp. 13-17.
11. MÁRTON,M.-IVANIGA,T.-OVSENÍK,L.-ŠPES,M.: Optický vláknový gyroskopický systém ako interferometrický optický senzor. In: *Posterus*, Vol. 9, no. 2 (2016), pp. 1-14.
12. NOVÁK,D.-SCHNEIDER,J.-KOCUR,D.: Static Person Detection and Localization Based on Their Respiratory Motion Using Various Antenna Types. In: *Acta Electrotechnica et Informatica*, Vol. 16, no. 3 (2016), pp. 54-59.
13. ORAVEC,J.-TURÁN,J.-OVSENÍK,L.: DWT Steganography with Usage of Scrambling. In: *Carpathian Journal of Electronic and Computer Engineering*. Vol. 9, no. 1 (2016), pp. 26-29.
14. ORAVEC,J.-OVSENÍK,L.: Arnoldovo zobrazenie, jeho vlastnosti a možné využitie. In: *Posterus*, Vol. 9, no. 4 (2016), pp. 1-8.
15. PALAHIN,V.-JUHÁR,J.: Joint Signal Parameter Estimation in Non-Gaussian Noise by the Method of Polynomial Maximization. In: *Journal of Electrical Engineering*, Vol. 67, no. 3 (2016), pp. 217-221.
16. PAPAJ,J.-DOBOŠ,L.: Cooperation between Trust and Routing Mechanisms for Relay Node Selection in Hybrid MANET-DTN. In: *Mobile Information Systems*, Vol. 2016, (2016), pp. 1-18.
17. PASTIRČÁK,J.-FRIGA,L.-KOVÁČ,V.-GAZDA,J.-GAZDA,V.: An Agent-Based Economy Model of Real-Time Secondary Market for the Cognitive Radio Networks. In: *Journal of Networks and System Management*, Vol. 24, no. 2 (2016), pp. 427-443.
18. PETRVALSKÝ,M.-DRUTAROVSKÝ,M.-VARCHOLA,M.: Compact FPGA Hardware Platform for Power Analysis Attacks on Cryptographic Algorithms Implementations. In: *Acta Electrotechnica et Informatica*, Vol. 16, no. 2 (2016), pp. 3-7.
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