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**DEPARTMENT OF ELECTRONICS AND  
MULTIMEDIA TELECOMMUNICATIONS**

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Annual Report  
2014

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Technical University of Košice  
Faculty of Electrical Engineering and Informatics

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

**DEPARTMENT OF ELECTRONICS AND**  
**MULTIMEDIA TELECOMMUNICATIONS**

ANNUAL REPORT 2014

**Edited by Ľuboš Ovseník**

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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

- ◆ Electronics,
- ◆ Telecommunications.

**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

- ◆ Infoelectronics,
- ◆ Multimedia telecommunications.

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

- ◆ Infoelectronics,
- ◆ Telecommunications,
- ◆ Electronics measurement systems.

Teaching and research activities of the department are focused on advanced technologies of electronics, telecommunications and smart measuring systems. In addition to the theoretical and practical basics, the teaching is more concentrated on mobile and satellite technologies and services, automotive electronics, digital processing and transmission of multimedia signals (image, video, speech), cryptography and security in 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
- ◆ Professors Emeritus: Viktor Špány
- ◆ Associate Professors: Ľubomír Doboš, Miloš Drutarovský, Pavol Galajda, Ján Gamec, Ľuboš Ovseník
- ◆ Assistant Professors: Gabriel Bugár, Mária Gamcová, Juraj Gazda, Iveta Gladišová, Ľudmila Maceková, Stanislav Ondáš, Ján Papaj, Jozef Zavacký
- ◆ Research Assistant: Vladimír Bánoci, Jana Fortes, Daniel Hládek, Martin Lojka, Eva Kiktová, Matúš Pleva, Ján Staš, Mária Švecová, Michal Varchola, Jozef Vavrek, Peter Vizslay, Matej Žiga
- ◆ Support staff: Zuzana Ciulisová, Božena Marchevská, Viera Šumáková

## 2 DIVISIONS OF THE DEPARTMENT

### 2.1 Teaching and research laboratories

#### **Laboratory of Multimedia Communications**

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*Professor emeritus:* prof. Ing. Viktor Špány, DrSc.

Phone:

e-mail:

## 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 a PSTN link,
- Telecommunication workstation with 4 port Dialogic D40JCT card,
- 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),
- Web and FTP server department of KEMT (OS Linux, 1GB RAM, 1TB HDD, kemt.fei.tuke.sk),
- 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 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 (3 disks – 5TB already installed) with iSCSI interface. The high performance 3x4CPU servers are used for acoustical and language modeling issues, which could be parallelized and needs also a huge storage and high performance access to the databases. These server provides also totally 84GB 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.) –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.) –Telecommunications***

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.) – Infoelectronics***

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 telecommunications***

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.) – Infoelectronics***

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.) – Telecommunications***

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.

#### ***Ph.D. Degree Courses (title Ph.D.) – Electronics measurement systems***

The Ph.D. degree program is focused on modern instrumentation, sensor systems, digital signal processing in measurement, calibration and self-diagnostic, virtual instrumentation, and test methods for industry, scientific research, and monitoring of physical parameters.

## 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 <sup>nd</sup>	3/2	Michaeli
Circuit theory	3 <sup>rd</sup>	3/2	Kocur
Digital electronics	3 <sup>rd</sup>	3/3	Galajda
Signals and systems	3 <sup>rd</sup>	3/2	Mihalík, Gladišová
Microelectronic circuits	4 <sup>th</sup>	3/2	Michaeli
Electronic measurement systems	4 <sup>th</sup>	2/2	Šaliga
Digital electronic systems	4 <sup>th</sup>	2/2	Galajda
CAD in electronics	5 <sup>th</sup>	2/2	Galajda
Automotive electronics	5 <sup>th</sup>	2/2	Gamec
Automotive embedded systems	6 <sup>th</sup>	3/2	Drutarovský
Active and passive safety systems	6 <sup>th</sup>	3/2	Gamec
Networks technology	6 <sup>th</sup>	3/2	Čižmár

#### Undergraduate Study (Bc.) – Electronics

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of electronics	2 <sup>nd</sup>	3/2	Michaeli
Digital electronics	3 <sup>rd</sup>	3/3	Galajda
Circuit theory	3 <sup>rd</sup>	3/2	Kocur
Signals and systems	3 <sup>rd</sup>	3/2	Mihalík, Gladišová
High frequency and microwave technology	3 <sup>rd</sup>	2/2	Gamec
Electronic measurement systems	4 <sup>th</sup>	2/2	Šaliga
Digital electronic systems	4 <sup>th</sup>	2/2	Galajda
Networks technology	4 <sup>th</sup>	2/2	Čižmár
Microelectronic circuits	4 <sup>th</sup>	3/2	Michaeli
Electroacoustics	4 <sup>th</sup>	2/2	Juhár
Electromagnetic waves and antennas	4 <sup>th</sup>	2/2	Ovseník
Programming environments for electronics and communications	4 <sup>th</sup>	1/2	Varchola, Šaliga
Videocommunications	5 <sup>th</sup>	2/2	Mihalík
Networks architecture	5 <sup>th</sup>	3/2	Čižmár
Bachelor thesis I.	5 <sup>th</sup>	0/6	Turán
CAD in electronics	5 <sup>th</sup>	2/2	Galajda
Automotive electronics	5 <sup>th</sup>	2/2	Gamec
Microprocessor technology	5 <sup>th</sup>	2/2	Drutarovský
Bachelor thesis II.	6 <sup>th</sup>	0/9	Turán
Optoelectronic systems	6 <sup>th</sup>	2/2	Turán
Smart measurement systems	6 <sup>th</sup>	2/2	Šaliga
Satellite technology and services	6 <sup>th</sup>	3/2	Marchevský
Active and passive safety systems	6 <sup>th</sup>	3/2	Gamec

#### Undergraduate Study (Bc.) – Telecommunications

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of electronics	2 <sup>nd</sup>	3/2	Michaeli
Digital electronics	3 <sup>rd</sup>	3/3	Levický
Circuit theory	3 <sup>rd</sup>	3/2	Kocur
Signals and systems	3 <sup>rd</sup>	3/2	Mihalík, Gladišová
High frequency and microwave technology	3 <sup>rd</sup>	2/2	Gamec
Electronic measurement systems	4 <sup>th</sup>	2/2	Šaliga
Introduction to telecommunication	4 <sup>th</sup>	3/2	Levický



<b>Subject</b>	<b>Semester</b>	<b>Lectures/exercises (hours per week)</b>	<b>Name of Lecturer</b>
Networks technology	4 <sup>th</sup>	2/2	Čížmár
Electromagnetic waves and antennas	4 <sup>th</sup>	2/2	Ovseník
Electroacoustics	4 <sup>th</sup>	2/2	Juhár
Digital electronic systems	4 <sup>th</sup>	2/2	Galajda
Programming environments for electronics and communications	4 <sup>th</sup>	1/2	Varchola, Šaliga
Bachelor thesis I.	5 <sup>th</sup>	0/6	Kocur
Switching technology	5 <sup>th</sup>	3/2	Marchevský
Networks architecture	5 <sup>th</sup>	3/2	Čížmár
Videocommunications	5 <sup>th</sup>	2/2	Mihalík
Access networks	5 <sup>th</sup>	3/2	Marchevský, Maceková
Microprocessor technology	5 <sup>th</sup>	2/2	Drutarovský
Bachelor thesis II.	6 <sup>th</sup>	0/9	Kocur
FPGA circuits	5 <sup>th</sup>	2/2	Galajda
Satellite technology and services	6 <sup>th</sup>	3/2	Marchevský
Mobile networks and services	6 <sup>th</sup>	3/2	Doboš
Smart measurement systems	6 <sup>th</sup>	2/2	Šaliga
Optoelectronic systems	6 <sup>th</sup>	2/2	Turán

### 3.2.2 Study plan for MSc. degree

#### Graduate Study (Ing.) – Infoelectronics

<b>Subject</b>	<b>Semester</b>	<b>Lectures/exercises (hours per week)</b>	<b>Name of Lecturer</b>
Digital signal processing	1 <sup>th</sup>	3/2	Mihalík, Zavacký
Optoelectronics	1 <sup>th</sup>	2/2	Turán
Programmable logic devices	1 <sup>th</sup>	2/2	Varchola, Drutarovský
Signal processors	1 <sup>th</sup>	3/2	Drutarovský
Electronic measurement	1 <sup>th</sup>	3/2	Šaliga
Digital image processing and coding	2 <sup>nd</sup>	3/2	Mihalík
Semestral projects	2 <sup>nd</sup>	0/4	Mihalík
Processing and transmission of speech and audio	2 <sup>nd</sup>	3/2	Juhár
Applied cryptography	2 <sup>nd</sup>	3/2	Levický
Digital filters	2 <sup>nd</sup>	2/2	Kocur
Microwave circuits and systems	2 <sup>nd</sup>	3/2	Gamec
Optical communication systems	2 <sup>nd</sup>	3/2	Turán
Master thesis I.	3 <sup>rd</sup>	0/6	Mihalík
Database systems – SQL Oracle	3 <sup>rd</sup>	2/2	Juhár
Digital television	3 <sup>rd</sup>	3/2	Marchevský
Photonics	3 <sup>rd</sup>	3/2	Turán
Medical electronics	3 <sup>rd</sup>	3/2	Michaeli
Multimedia technologies	3 <sup>rd</sup>	3/2	Levický
Mobile communications	3 <sup>rd</sup>	3/2	Doboš
UWB sensor networks	3 <sup>rd</sup>	2/2	Kocur
Interactive telecommunications systems and services	3 <sup>rd</sup>	3/2	Juhár
Master thesis II.	4 <sup>th</sup>	0/18	Mihalík
Project management	4 <sup>th</sup>	0/2	Marchevský

#### Graduate Study (Ing.) – Multimedia telecommunications

<b>Subject</b>	<b>Semester</b>	<b>Lectures/exercises (hours per week)</b>	<b>Name of Lecturer</b>
Digital signal processing	1 <sup>th</sup>	3/2	Mihalík
Optoelectronics	1 <sup>th</sup>	2/2	Turán
Spread-spectrum communication systems	1 <sup>th</sup>	3/2	Kocur

<b>Subject</b>	<b>Semester</b>	<b>Lectures/exercises (hours per week)</b>	<b>Name of Lecturer</b>
Communication channel modelling	1 <sup>th</sup>	2/2	Kocur
Signal processors	1 <sup>th</sup>	3/2	Drutarovský
Processing and transmission of speech and audio	2 <sup>nd</sup>	3/2	Juhár
Telecommunications systems theory	2 <sup>nd</sup>	3/2	Čížmár
Optical communication systems	2 <sup>nd</sup>	3/2	Turán
Semestral projects	2 <sup>nd</sup>	0/4	Čížmár
Digital image processing and coding	2 <sup>nd</sup>	3/2	Mihalík
Digital filters	2 <sup>nd</sup>	2/2	Kocur
Applied cryptography	2 <sup>nd</sup>	3/2	Levický
Master thesis I.	3 <sup>rd</sup>	0/6	Čížmár
Database systems – SQL Oracle	3 <sup>rd</sup>	2/2	Juhár
Mobile communications	3 <sup>rd</sup>	3/2	Doboš
UWB sensor networks	3 <sup>rd</sup>	2/2	Kocur
Photonics	3 <sup>rd</sup>	3/2	Turán
Digital television	3 <sup>rd</sup>	3/2	Marchevský
Multimedia technologies	3 <sup>rd</sup>	3/2	Levický
Interactive telecommunications systems and services	3 <sup>rd</sup>	3/2	Juhár
Master thesis II.	4 <sup>th</sup>	0/18	Čížmár
Project management	4 <sup>th</sup>	0/2	Marchevský

### 3.2.3 Study plan for Ph.D. degree

#### Graduate Study (PhD.) – Infoelectronics

<b>Subject</b>	<b>Semester</b>	<b>Lectures/exercises (hours per week)</b>	<b>Name of Lecturer</b>
Theory of infoelectronics	1 <sup>th</sup>	0/2	
Foreign language	1 <sup>th</sup>	0/2	
Research project I.	1 <sup>th</sup>	0/2	
Foreign language	2 <sup>nd</sup>	0/2	
Infoelectronics systems	2 <sup>nd</sup>	0/2	
Research project II.	2 <sup>nd</sup>	0/2	
Specialization subject	3 <sup>rd</sup>	0/2	
Research work	3 <sup>rd</sup>	0/8	
Research project III.	3 <sup>rd</sup>	0/4	
Research work	4 <sup>th</sup>	0/8	
Research project IV.	4 <sup>th</sup>	0/2	
Research work	5 <sup>th</sup>	0/12	
Research project V.	5 <sup>th</sup>	0/2	
Thesis - Research work	6 <sup>th</sup>	0/9	

#### Graduate Study (PhD.) – Electronics measurement systems

<b>Subject</b>	<b>Semester</b>	<b>Lectures/exercises (hours per week)</b>	<b>Name of Lecturer</b>
Topics from mathematics and physics	1 <sup>th</sup>	0/2	
Foreign language	1 <sup>th</sup>	0/2	
Research project I.	1 <sup>th</sup>	0/2	
Foreign language	2 <sup>nd</sup>	0/2	
Measure theory	2 <sup>nd</sup>	0/2	
Research project II.	2 <sup>nd</sup>	0/2	
Specialization subject	3 <sup>rd</sup>	0/2	
Research work	3 <sup>rd</sup>	0/8	
Research project III.	3 <sup>rd</sup>	0/4	
Research work	4 <sup>th</sup>	0/8	
Research project IV.	4 <sup>th</sup>	0/2	
Research work	5 <sup>th</sup>	0/12	

<b>Subject</b>	<b>Semester</b>	<b>Lectures/exercises (hours per week)</b>	<b>Name of Lecturer</b>
Research project V.	5 <sup>th</sup>	0/2	
Thesis - Research work	6 <sup>th</sup>	0/9	

**Graduate Study (PhD.) – Telecommunications**

<b>Subject</b>	<b>Semester</b>	<b>Lectures/exercises (hours per week)</b>	<b>Name of Lecturer</b>
Communication system theory	1 <sup>th</sup>	0/2	
Foreign language	1 <sup>th</sup>	0/2	
Research project I.	1 <sup>th</sup>	0/2	
Foreign language	2 <sup>nd</sup>	0/2	
Advanced communication technology	2 <sup>nd</sup>	0/2	
Research project II.	2 <sup>nd</sup>	0/2	
Specialization subject	3 <sup>rd</sup>	0/2	
Research work	3 <sup>rd</sup>	0/8	
Research project III.	3 <sup>rd</sup>	0/4	
Research work	4 <sup>th</sup>	0/8	
Research project IV.	4 <sup>th</sup>	0/2	
Research work	5 <sup>th</sup>	0/12	
Research project V.	5 <sup>th</sup>	0/2	
Thesis - Research work	6 <sup>th</sup>	0/9	

## 4 RESEARCH AND PROJECTS

### *4.1 International scientific projects*

**Project title: INDECT – Intelligent Information System Supporting Observation, Searching and Detection for Security of Citizens in Urban Environment**

**Acronym: INDECT**

**Number: Contract No 218086**

**Program/agency: 7. FP**

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

**Project partners: Coordinator AGH Cracow + next 16 partners from EU countries**

**Start of project: 01/2009**

**End of project: 06/2014**

**Total founding: 287.203,00 EUR**

**Annotation:** The main objectives of the INDECT project are: (1) to develop a platform for: the registration and exchange of operational data, acquisition of multimedia content, intelligent processing of all information and automatic detection of threats and recognition of abnormal behavior or violence, (2) to develop the prototype of an integrated, network-centric system supporting the operational activities of police officers, providing techniques and tools for observation of various mobile objects, (3) to develop a new type of search engine combining direct search of images and video based on watermarked contents, and the storage of metadata in the form of digital watermarks, (4) to develop a set of techniques supporting surveillance of internet resources, analysis of the acquired information, and detection of criminal activities and threats. The main expected results of the INDECT project are: (a) to realise a trial installation of the monitoring and surveillance system in various points of city agglomeration and demonstration of the prototype of the system with 15 node stations, (b) implementation of a distributed computer system that is capable of acquisition, storage and effective sharing on demand of the data as well as intelligent processing, (c) construction of a family of prototypes of devices used for mobile object tracking, (d) construction of a search engine for fast detection of persons and documents based on watermarking technology and utilizing comprehensive research on watermarking technology used for semantic search, (e) construction of agents assigned to continuous and automatic monitoring of public resources such as: web sites, discussion forums, UseNet groups, file servers, p2p networks as well as individual computer systems, (f) elaboration of Internet based intelligence gathering system, both active and passive, and demonstrating its efficiency in a measurable way.

**Project title: European Digital Virtual Design Lab**

**Acronym: eDiViDe**

**Number: 518565-LLP-1-2011-1-BE-ERASMUS-ESMO**

**Program/agency: LLP**

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

**Project partners: KU Leuven - KHLim, Hochschule Bonn-Rhein-Sieg, University of Oslo**

**Start of project: 10/2011**

**End of project: 09/2014**

**Total founding: 34.590,00 EUR**

**Annotation:** In this project, we will develop a virtual laboratory that allows students to access several real-life FPGA setups whenever they are connected to the internet. These setups will be developed by the partnering institutes and will be made programmable through the internet using VHDL. Each setup will be accompanied by a camera that films the behaviour of the setup and

sends back the result to the student. This way, the verification of the design is done by checking the behaviour of the application instead of digital simulation results.

**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 founding:** 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 founding:** 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: Wireless Sensor Network for Water Quality Monitoring**

**Acronym:** WSN-AQUA

**Number:** HUSK/1101/1.2.1/0091

**Program/agency:** Hungary-Slovakia Cross-border Co-operation, Programme 2007-2015

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

**Project partners:** LP - BME-Infokom Innovátor Nonprofit Ltd., Budapest, Hungary

Start of project: 07/2013

End of project: 06/2015

Total founding: 164.462,00 EUR

Annotation: The overall objective of the joint research project is to build an intensive co-operation between Hungarian and Slovak R&D partners in order to strengthen the economic competitiveness of the cross-border area and to develop the capacities on both sides of the border jointly. The specific purpose of the project is to develop a wireless sensor network applied for water quality monitoring in order to contribute to environment protection with stress to the river Dunaj which can be extended to further rivers and water. It will show good engineering solution to be applied for a lot of applications in the field of environment protection on both sides of the border. The main result of the joint research project will represent the new, vintage technological solution for the water quality monitoring of the river Dunaj represented by the wireless sensor network based on the application of the advanced information and communication technologies, electronics, signal and data processing. It is expected that the utilization of the project results could be included into a production programme of Hungarian and Slovak companies. The implementation of that approach will result in strengthening the economic competitiveness of this area.

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 founding: not defined

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 founding: 513.091,98 EUR

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).

## ***4.2 National scientific projects***

### **Project title: Agent Based Modelling of the Spectrum Distribution in the Cognitive Radio Networks**

**Acronym:** AMSD\_CRN

**Number:** 1/0766/14

**Program/agency:** VEGA

**Coordinator from TU:** Ing. Juraj Gazda, PhD.

**Project partners:**

**Start of project:** 01/2014

**End of project:** 12/2016

**Funding in 2014:** 9.974,00 EUR

**Total funding:** not defined

**Annotation:** The goal of the project is the design of the novel and efficient models of the spectrum trading mechanisms in CR networks. The special emphasis is put on the exploiting of the agent-based models incorporating strong interdisciplinary character. Algorithms including Bak-Sneppen model of co-evolution, Potts model describing the interacting spins on a crystalline lattice and Demon algorithm are extensively used in the assumptions. The proposed models developed within the project are able to capture the behaviour of dozen entities operating in CR network, thus provide more general solutions compared to the existing models.

### **Project title: Development of Experimental Measurement Apparatuses and Multimedial e-Learning Textbook for the Purpose of the Education Process Support in the Field of UWB Radar System**

**Acronym:** UWB-RSS

**Number:** 010TUKÉ-4/2012

**Program/agency:** KEGA

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

**Project partners:**

**Start of project:** 01/2012

**End of project:** 12/2014

**Total founding:** 23.471,00 EUR

Annotation: Project UWB-RSS is intent on the development of students' cognitive abilities in the field of UWB radar system within the master study program Infoelectronics provided at Technical University of Košice by the development of the experimental parts of the subject „UWB Sensor Networks“. Within the project, two apparatuses for the measurement execution by the UWB radar with a synthetic aperture (SAR) at laboratory and landscape conditions will be developed. These apparatuses will enable to create the radar images of the static objects localized in a free space, behind an obstacle or underground. The software development for processing of radar signals scanned by the measurement apparatuses will be also included into the project tasks. Except of the measurement apparatuses and software, the e-learning textbook focused on the static object imaging by a short range UWB radar will be developed, too. Following this partial project goals, the creation of the suitable environment and conditions for receiving practical skills and knowledge concerning UWB radar technology fundamentals and applications will be the most important project output.

**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 founding: 202.000,00 EUR

Annotation: Detection and positioning of human beings situated behind an obstacle have been very interesting for military, security and emergency rescue operations. Here, UWB radars using low frequencies (0.1-5 GHz) have been proposed for through wall localization of vital persons. The UWB sensors developed recently for the mentioned applications usually provide the localization in 2D only. However, the specialists for the security and rescue operations have indicated that the person localization in 3D is strongly requested. The state-of the art of person positioning in 3D has shown that the range of applications of UWB radars for the outlined scenarios are limited on the present because of the absence of efficient procedures of radar signal processing capable to localize human beings in 3D. Motivated by this state of affairs, PerLoc-3D-UWB project is intent on the development of new procedures of UWB radar signal processing to be applied for the person detection, localization and tracking in 3D. The procedures appropriate for real-time applications will be developed for the localization of persons situated behind an obstacle for the scenarios typical for person saving and their safety increasing. The efficiency of the proposed procedures will be tested by the measurements for proper scenarios. The experimental 3D through wall UWB scanner employing the developed signal processing methods will be constructed within the PerLoc-3D-UWB project, too.

**Project title: Short-Range UWB Sensor Networks for Detection, Localization and Tracking of Moving Persons**

Acronym: UWB-SeNet

Number: 1/0563/13

Program/agency: VEGA

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

Project partners:

Start of project: 01/2013

End of project: 12/2015

Total founding: 40.931,00 EUR



**Annotation:** Moving person detection, localization and tracking has found a variety of applications such as object monitoring, through wall detection of moving persons during security operations and human lives saving at unrestrained disasters. UWB radars have been identified as the attractive tool for the person localization under these circumstances. The analysis of their performance has shown that due to the shadowing effect the single UWB radar cannot provide a high reliability of multiple target detection for multiple-moving person scenarios. The solution of that problem can be provided by UWB radar/sensor network (SN). Project „Short-Range UWB Sensor Networks for Detection, Localization and Tracking of Moving Persons (UWB-SeNet)“ is intent on the design and implementation of the experimental UWB SN based on novel signal processing methods and new knowledge of SN theory developed within the project. Besides, the design and implementation of UWB sensor components by 0.35 $\mu$ m SiGe BiCMOS technology will be also studied.

**Project title:** **Security in Modern Telecommunication Networks**

**Acronym:**

**Number:** 1/0386/12

**Program/agency:** VEGA

**Coordinator from TU:** prof. Ing. Dušan Levický, CSc.

**Project partners:**

**Start of project:** 01/2012

**End of project:** 12/2014

**Total founding:** 16.600,00 EUR

**Annotation:** Scientific project is oriented to selected aspects of the modern telecommunication network security with references to three areas: multimedia content security, security of mobile networks and information content analysis of audio signals. In the area of multimedia content security the development of the new methods for multimedia content protection by using digital watermarking in video and image steganography is expected. In the area of mobile networks security design of cross-layer model for new generation of mobile networks with respect to robust multi-layer security and implementation of security mechanisms which protect mobile networks from various types of attacks is expected. In the area of information content evaluation for audio signals the development and verification of the new methods and approaches for detection and evaluation of the audio events indicating abnormal situations from point of view people's security is expected.

**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 2014:** 10.649,00 EUR

**Total founding:** not defined

**Annotation:** The project is 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 is 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. It is planned to design multimedia educational content for exploitation of such access. That all will be 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 founding: 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: Laboratory Workplace for Electronic Course Controlled by IT Technology (E-Lab)**

Acronym:

Number: 029TUKÉ-4/2012

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

Coordinator from TU: prof. Ing. Linus Michaeli, DrSc.

Project partners:

Start of project: 01/2012

End of project: 12/2014

Total founding: not defined

Annotation: (E-Lab) represents one component of e-learning in subjects of the course "Electronics" and "Telecommunication" where the laboratory exercises are scheduled for gaining practical skills with electronic systems. It allows full time and distance students to become familiar with standard measuring instruments and their utilisation in the electronic measurement using any web browser.

The significant objective is the cost reduction on experimental classes, thanks virtual instruments and accessibility of laboratory stands out of regular time schedule devoted for laboratory experiments. Developed system will be an example of virtual measuring system for students in the subject Instrumentation. It will serve professionals from the industry as the demonstration sample of the virtual instrumentation.

**Project title: The Use of Remote Controlled Optical Fibre Refractometer in Teaching****Acronym:** URCORFT**Number:** 063TUKE-4/2013**Program/agency:** KEGA of Ministry of education of Slovak Republic**Coordinator from TU:** doc. Ing. Ľuboš Ovseník, PhD.**Project partners:****Start of project:** 01/2013**End of project:** 12/2014**Total founding:** 6.502,00 EUR**Annotation:** The project will solve the implementation of broad access for students (or general professional public) to unique equipment – optical fibre refractometer, i.e. optoelectronic measurement system for measuring the refractive index of liquids using WWW.

The significant objective is the cost reduction on experimental classes, thanks remote instruments and accessibility of laboratory stands out of regular time schedule devoted for laboratory experiments. Developed system will be an example of remote measuring system for students in the subject Photonics.

**Project title: Electromagnetic Compatibility of Technological Equipment in Tyre Industry****Acronym:** INTRO**Number:** APVV-0333-11**Program/agency:** EMC-IND**Coordinator from TU:** prof. Ing. Ján Šaliga, PhD.**Project partners:** STU in Bratislava, Koštrukta Trenčín, a.s.**Start of project:** 07/2012**End of project:** 12/2015**Funding in 2014:** not defined**Total funding:** 248.469,00 EUR**Annotation:** The project deals with innovation of technological equipments in tire industry in term of EMC properties, that increase the usability, utility value and also the competitiveness of the equipment developed and designed in Slovakia, which is reflected particularly at international level. The project involves identifying sources of interference, their analysis in term of behaviour in the electromagnetic environment and suppression of their negative effects. Also parts of equipments will be identifies which are sensitive to electromagnetic interference and other task within the project realisation is to ensure their failure-free operation.**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**Funding in 2014:** 6.700,00 EUR**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-orthogonal.

**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 L., Ružbarský J., Tatarko M., Tóth J.), EF ŽU

**Start of project:** 10/2013

**End of project:** 09/2016

**Total founding:** not defined

**Annotation:** The project is focused investigation in the area 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 is 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:** KEPA 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 founding:** 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.

**Project title: Digital Signature Power Analysis Attack and Countermeasures****Acronym:** DISIPA**Number:** APVV-0586-11**Program/agency:** EMC-IND**Coordinator from TU:** Ing. Michal Varchola, PhD.**Project partners:** STU in Bratislava, Micronic, s.r.o.**Start of project:** 07/2012**End of project:** 12/2015**Funding in 2014:** not defined**Total funding:** 246.658,00 EUR

**Annotation:** Research and development of advanced methods of side channel attacks against elliptic curve cryptography (ECC) based digital signatures schemes is main focus of this project as well as research and development of suitable countermeasures. Power analysis attack can reveal the secret of digital signatures and so alien person can sign documents using a false identity. We intend to develop and evaluate rigorous algorithmic countermeasures and countermeasures based on suitable topology of electronic circuits. These countermeasures should practically inhibit the successful attacks based on the power analysis. The result of this project will be suite of regulations, instructions, and recommendations how to use various countermeasure methods in order to avoid the power analysis attacks against digital signatures based on the ECC in various commercial or diplomatic cryptographic devices. Next goal of project is to optimize power analysis attack methods using highly parallel processor structure of the CUDA video adapters in order to shorten time which is needed for the successful attack. The Micronic Company will be a purchaser of the developed technology. Micronic develops and produces various cryptographic devices and systems for the various state institutions and agencies as well as for the commercial market. Digital signatures based on the ECC are essential component of their devices. That is why the secure implementation of digital signatures is highly top priority for them.

### ***4.3 Operational program research and development***

**Project title: Research of Modules for Intelligent Robotic Systems****Acronym:** IntelliRobs**Number:** ITMS- 26220220141**Program/agency:** Operational Program Research and Development**Coordinators from TUKE:** prof. Ing. Jozef Juhár, CSc., Dr.h.c. mult. prof. Ing. František Trebuňa, CSc.**Project partners:** ZŤS VVÚ Košice, a.s., SPINEA, s.r.o., PROCONT, s.r.o.,**Start of project:** 01/2011**End of project:** 12/2014**Total founding:** 2.334.416,49 EUR

**Annotation:** The goal of the project is research enforcement of intelligent robotic platforms and convertible modules, autonomous control of robots based on artificial intelligence and building of laboratory for applied research in robotics.

**Project title: Competency Centre for Knowledge Technologies Applied at Innovation of Production Systems in Industry and Services****Acronym:** ZATIPS**Number:** ITMS- 26220220155**Program/agency:** Operational Program Research and Development**Coordinator from TUKE:** prof. Ing. Stanislav Kmeť, CSc., prof. Ing. Jozef Juhár, CSc. (KEMT)

Project partners: Žilinská univerzita, Prešovská univerzita, ZŤS VVÚ Košice a.s., T-Systems Slovakia s.r.o., Elcom s.r.o., ANTIK Telecom s.r.o., CEIT SK, s.r.o., ITKON, spol. s r.o., IPM SOLUTIONS, s.r.o.

Start of project: 09/2011

End of project: 12/2014

Total founding: 5.252.128,28 EUR

Annotation: Establishment of the competency centre and farming of its functionality and long-term sustainability out. Scientific management of the competency centre. Providing of the competency centre with important equipment. Excellent research and development in the competency centre. Research and development knowledge technologies for innovation of producing systems and services.

## **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.

### ***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
- Geozondas Ltd., Lithuania
- Ingenieur Büro Ralf Klukas, Germany
- INESC Lisabon, Portugal
- Instituto Superior Técnico (IST), Lisbon, Portugal
- Statens Räddningsverk, Sweden
- ŠkodaAuto Mladá Boleslav, Czech Republic
- Wuhan Technological Institute, Wuhan, China
- Second University of Naples, Italy
- Technische Universität Ilmenau, 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

## 6 FACULTY ESSAYS

### **Bánoci Vladimír**

*Research assistant*

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

### **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 Lubomír**

*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.

### **Fortes Jana**

*Research assistant*

Her general research interests are focused on advanced methods of signal processing whereby her main activities are in the field of UWB radar signal processing.

### **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.

**Gazda Juraj***Assistant professor*

He is focused mostly on the advanced wireless communication systems, including LTE, LTE-Advanced and WiMax. He also deals with the spectrum trading and sharing theory for cognitive radio schemes.

**Glađišová 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***Research assistant*

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 and watermarking.

**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 Euboš***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 and routing backbone networks.

**Staš Ján***Research assistant*

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.

**Špány Viktor***Professor Emeritus*

His main interests and activities are in the non-linear circuits theory, smart sensors, flip-flop sensors, integrated functional blocks and statistical sensors.

**Švecová Mária***Research assistant*

Her general research interests and activities are in the UWB radar signal processing.

**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.

**Michal Varchola***Research assistant*

His main research interests are cryptography for embedded systems, particularly true random number generators and elliptic curve crypto-processors, wireless sensor networks and embedded systems based on FPGAs and microprocessors generally.

**Jozef Vavrek***Research assistant*

His current research activities cover area of speech processing, audio events classification, automatic audio information retrieving. He is also interested in pattern recognition utilizing support vector machine classifier.

**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.

**Zavacký Jozef***Assistant professor*

His current interest includes signal and information theory, sampling of the one-dimensional and multidimensional signals.

## 7 Ph.D. STUDENTS

<u>Name</u>	<u>Supervisor</u>	<u>Degree Course</u>
<b><i>First year of study</i></b>		
<u>Internal form:</u>		
Ing. Dávid Čonka	prof. Čižmár	Telecommunications
Ing. Vladimír Hajduk	prof. Levický	Telecommunications
Ing. Tomáš Ivaniga	prof. Turán	Infoelectronics
Ing. Tomáš Koctúr	prof. Juhár	Telecommunications
Ing. Martin Matis	doc. Doboš	Telecommunications
Ing. Dávid Solus	doc. Ovseník	Infoelectronics
<b><i>Second year of study</i></b>		
<u>Internal form:</u>		
Ing. Daniel Novák	prof. Kocur	Infoelectronics
Ing. Ján Pastirčák	prof. Kocur	Telecommunications
Ing. Ján Ružbarský	prof. Turán	Infoelectronics
Ing. Ján Schneider	doc. Gamec	Infoelectronics
Ing. Ján Tóth	doc. Ovseník	Infoelectronics
<u>External form:</u>		
Ing. Peter Strnisko	doc. Ovseník	Infoelectronics
<b><i>Third year of study</i></b>		
<u>Internal form:</u>		
Ing. Martin Broda	prof. Levický	Telecommunications
Ing. Peter Kažimír	prof. Kocur	Infoelectronics
Ing. Lenka Macková	prof. Čižmár	Telecommunications
Ing. Martin Petrvalský	doc. Drutarovský	Infoelectronics
Ing. Lukáš Sendrei	prof. Marchevský	Infoelectronics
Ing. Martin Sulír	prof. Juhár	Telecommunications
Ing. Daniel Zlacky	prof. Čižmár	Telecommunications
<u>External form:</u>		
Ing. Matej Žiga	doc. Galajda	Infoelectronics
<b><i>Fourth year of study</i></b>		
<u>Internal form:</u>		
Ing. Ondrej Kováč	prof. Mihalík	Infoelectronics
Ing. Jozef Lipták	prof. Šaliga	Measurement technique
Ing. Ján Valiska	prof. Marchevský	Telecommunications
Ing. Matúš Tatarko	doc. Ovseník	Infoelectronics
<u>External form:</u>		
Ing. Martin Kmec	doc. Galajda	Infoelectronics
Ing. Matúš Kozák	prof. Kocur	Infoelectronics
Ing. František Rakoci	doc. Ovseník	Infoelectronics

## 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 the editorial board of the journal "Radioengineering".

**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 "Acta Polytechnica Hungarica".

**Kocur Dušan**, Associated editor of the journal "Radioengineering".

**Kocur Dušan**, Member of committee of Scientific Grant Agency of the Ministry of Education of the Slovak Republic and of Slovak Academy of Sciences.

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

**Levický Dušan**, Member of Czech and Slovak Radioelectronics Society.

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

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

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

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

**Michaelli Linus**, Member of the IEEE, Instrumentation & Measurement Society.

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

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

**Michaelli 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 PUBLICATION ACTIVITY OF THE DEPARTMENT

### 9.1 Books

1. GAMCOVÁ,M.-GAMEC,J.: Multimedia Course Basic of Electronics - Problem Solvers. In: Košice: TU, Slovakia, 2014, 85 pp.
2. GAMEC,J.-GAMCOVÁ,M.: CAN a CANoe In: Košice: TU, Slovakia, 2014, 69 pp.
3. LEVICKÝ,D.: Kryptografia v komunikačnej bezpečnosti. In: Košice: Elfa, Slovakia, 2014, 298 pp.
4. MIHALÍK,J.-KOVÁČ,O.: Číslíkové spracovanie textúr ľudskej hlavy. In: Košice: TU, Slovakia, 2014, 65 pp.
5. MIHALÍK,J.: Diskrétné ortogonálne transformácie a korelačná analýza v transformovanom priestore. In: Košice: TU, Slovakia, 2014, 66 pp.
6. MIHALÍK,J.-GLADIŠOVÁ,I.: Solutions of image coding problems. In: Košice: TU, Slovakia, 2014, 64 pp.
7. MIHALÍK,J.-GLADIŠOVÁ,I.-ZAVACKÝ,J.: Neperiodické a modulované signály (Návody na cvičenia). In: Košice: TU, Slovakia, 2014, 62 pp.
8. TURÁN,J.-OVSENÍK,L.-HARASTHY,T.: Projekčné transformácie a optický korelátor v systémoch spracovania obrazu a videa. In: Košice: TU, Slovakia, 2014, 257 pp.
9. ZAVACKÝ,J.-MIHALÍK,J.: Diskrétné systavy. In: Košice: TU, Slovakia, 2014, 69 pp.
10. ZAVACKÝ,J.-MIHALÍK,J.-GLADIŠOVÁ,I.: Pôsobenie lineárnych spojitéch sústav na determinované a náhodné signály (Návody na cvičenia In: Košice: TU, Slovakia, 2014, 73 pp.
11. ZAVACKÝ,J.-MIHALÍK,J.: Waveletová transformácia a jej implementácie. In: Košice: TU, Slovakia, 2014, 79 pp.

### 9.2 Journal papers

1. ABDULLAEV,A.-TURÁN,J.: Analisis of the Methods of Preventing of Contention Resolution in Optical Packet Switching Networks. In: Carpathian Journal of Electronic and Computer Engineering, Vol. 7, no. 1 (2014), pp. 3-6.
2. ABDULLAEV,A.-TURÁN,J.: Survey of the Problems and Solutions of Arrayed Waveguide Gratings Used in the Optical Networks. In: Acta Electrotechnica et Informatica, Vol. 14, no. 3 (2014), pp. 49-53.
3. BOULIOU-HELLO,V.-LIPTÁK,J.-ORIOLO PASCUAL,M.: Automatic Morse Transceiver. In: Instrumentation Viewpoint, no. 16 (2014), pp. 36-37.
4. DUPÁK,D.-KOCUR,D.: Optimalizácia 16-APSK modulácie pre SC-FDMA prenosové systémy. In: Posterus, Vol. 7, no. 9 (2014), pp. 1-12.
5. DUPÁK,D.-GAZDA,J.-KOCUR,D.-PETRÍK,M.: Optimization of 16-APSK by Maximizing Mutual Information Criteria in SC-FDMA Communication Systems. In: Acta Electrotechnica et Informatica. Vol. 14, no. 1 (2014), pp. 3-8.
6. HOFFMANN,J.-KOVÁČ,O.: Trigonometrická analýza súosového stereoskopického kamerového systému. In: Posterus, Vol. 7, no. 4 (2014), pp. 1-10.
7. IVANIGA,T.-RUŽBARSKÝ,J.-OVSENÍK,L.-TURÁN,J.: Optical Networks FTTx and Reduced Attenuation Balance with Passive Optical Splitter. In: Carpathian Journal of Electronic and Computer Engineering, Vol. 7, no. 1 (2014), pp. 30-35.

8. JACKO,M.-ZAVACKÝ,J.: Zmena vzorkovacej frekvencie s ľubovoľným faktorom In: Posterus, Vol. 7, no. 8 (2014), pp. 1-11.
9. JURČIŠIN,M.-RUMAN,K.-KOVÁČ,O.: Bezkontaktný EKG monitorovací system. In: Posterus, Vol. 7, no. 7 (2014), pp. 1-7.
10. KIKTOVÁ,E.-LOJKA,M.-JUHÁR,J.-ČIŽMÁR,A.: Feature Selection for Audio Surveillance in Urban Environment. In: Journal of Electrical and Electronics Engineering. Vol. 7, no. 1 (2014), pp. 69-72.
11. KOKOŠKA,R.-HANDRIKOVÁ,J.-VALISKA,J.: Zabezpečenie kvality prenosu NGN IPTV videotoku v IP sieťach v programe Opnet. In: Posterus, Vol. 7, no. 3 (2014), pp. 1-9.
12. KOKOŠKA,R.-HANDRIKOVÁ,J.-VALISKA,J.: Software Network Simulators for IPTV Quality of Services. In: Acta Electrotechnica et Informatica. Vol. 14, no. 1 (2014), pp. 18-22.
13. KOKOŠKA,R.-HANDRIKOVÁ,J.-VALISKA,J.: Analysis of QoS Tree for MHP Services in IP Networks in Fragile Environments Incentive Opnet. In: Acta Electrotechnica et Informatica. Vol. 14, no. 1 (2014), pp. 43-47.
14. KOVÁČ,O.-MIHALÍK,J.: Teoretická analýza geometrickej kalibrácie kamery. In: Posterus, Vol. 7, no. 7 (2014), pp. 1-9.
15. KOVÁČ,O.-MIHALÍK,J.: Generovanie a vyhladzovanie textúr ľudskej hlavy. In: Elektrovue, Vol. 16, no. 1 (2014), pp. 4-9.
16. KOVÁČ,V.-PASTIRČÁK,J.-FRIGA,L.: Brief Guide for Agent-Based Modelling. In: Acta Electrotechnica and Informatica. Vol. 14, no. 2 (2014), pp. 19-27.
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