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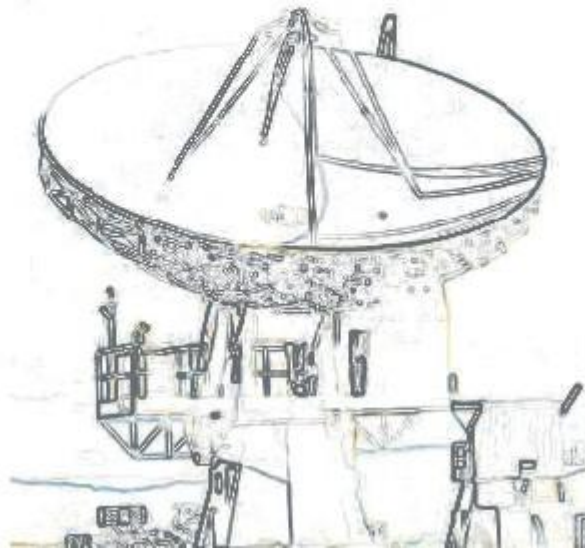
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# DEPARTMENT OF ELECTRONICS AND MULTIMEDIA TELECOMMUNICATIONS

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Department Of  
Electronics  
& Multimedia Communications



## Annual Report 2011

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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 2011

**Edited by Ľuboš Ovseník**

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# CONTENTS

<b>CONTENTS</b> .....	<b>1</b>
<b>1 DEPARTMENT PROFILE</b> .....	<b>2</b>
1.1 BRIEF OVERVIEW .....	2
1.2 DEPARTMENT STAFF AND STRUCTURE .....	2
<b>2 DIVISIONS OF THE DEPARTMENT</b> .....	<b>3</b>
2.1 TEACHING AND RESEARCH LABORATORIES .....	3
2.2 SPECIAL LABORATORIES AND EQUIPMENTS .....	5
<b>3 TEACHING</b> .....	<b>9</b>
3.1 COURSES .....	9
3.2 LIST OF SUBJECTS TAUGHT .....	10
3.2.1 <i>Study plan for Bc. degree</i> .....	10
3.2.2 <i>Study plan for MSc. degree</i> .....	11
3.2.3 <i>Study plan for Ph.D. degree</i> .....	12
<b>4 RESEARCH AND PROJECTS</b> .....	<b>14</b>
4.1 INTERNATIONAL SCIENTIFIC PROJECTS .....	14
4.2 NATIONAL SCIENTIFIC PROJECTS .....	16
4.3 OPERATIONAL PROGRAM RESEARCH AND DEVELOPMENT .....	19
<b>5 CO-OPERATION</b> .....	<b>21</b>
5.1 NATIONAL CO-OPERATION .....	21
5.2 INTERNATIONAL CO-OPERATION .....	21
<b>6 FACULTY ESSAYS</b> .....	<b>22</b>
<b>7 PH.D. STUDENTS</b> .....	<b>26</b>
<b>8 MEMBERSHIP</b> .....	<b>27</b>
<b>9 PUBLICATION ACTIVITY OF THE DEPARTMENT</b> .....	<b>28</b>
9.1 BOOKS .....	28
9.2 JOURNAL PAPERS .....	28
9.3 CONFERENCE PAPERS .....	30
9.4 THESIS .....	38
9.5 OTHER .....	38

# 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 3 years and is leading to degree PhD. The graduates get erudition in scientific areas

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

The subjects in the degree courses are orientated to the linear and non-linear analogue circuits, automotive electronics and diagnostic of cars, digital electronics, microwave technology, optoelectronics, signal and systems, acoustics, digital signal processing, digital filtering, signal processors and microcontrollers, electronic measurement systems, television systems, signal recording, digital communication and digital transmission systems, optoelectronic communication systems, photonics, sensor systems, multimedia communication systems, mobile and satellite communication systems, digital image communication systems and medical electronics.

The basic research activities of Department are concentrated on digital image and speech processing, multimedia communications, digital filtering, optoelectronics and optical communication, A/D convertors modelling and testing.

## 1.2 Department staff and structure

**Total number of staff members is 34.**

- ◆ Professors: Anton Čižmár, Dušan Kocur, Dušan Levický, Stanislav Marchevský, Ján Mihalík, Linus Michaeli, Viktor Špány, Ján Turán
- ◆ Associate Professors: Ľubomír Doboš, Miloš Drutarovský, Pavol Galajda, Ján Gamec, Jozef Juhár, Ľuboš Ovseník, Ján Šaliga
- ◆ Assistant Professors: Gabriel Bugár, Mária Gamcová, Iveta Gladišová, Zita Klenovičová, Ľudmila Maceková, Stanislav Ondáš, Mária Švecová (Michal Varchola), Jozef Zavacký
- ◆ Research Assistant: Vladimír Bánoci, Daniel Hládek, Martin Lojka, Ján Papaj, Matúš Pleva, Jana Rovňáková, Ján Staš
- ◆ Support staff: Božena Marchevská, Milan Peška, Viera Šumáková, Lenka Talpašová (Zuzana Dittelová)

## 2 DIVISIONS OF THE DEPARTMENT

### 2.1 Teaching and research laboratories

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

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### ***Laboratory of Digital Image Processing and Videocommunication***

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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:

- Analogue and digital oscilloscopes by Tektronix, Hameg etc.,
- Spectral analyzers up to 3GHz,
- Network analyser R&S upto 3GHz,
- Various generators by Agilent, Stanford Research, Panasonic, Metex, etc.,
- Multimeters by. Agilent, Metex, Unitest, etc.,
- Logic analyzer Philips,
- Measurement system PXI by National Instruments,
- Multifunction data acquisition cards by National Instruments up to 2MHz and 18 bits,
- Communication cards and modules by National Instruments, e.g. GPIB, CAN, RS488, etc.,
- Department site license of all software by National Instruments (LabVIEW, LabWindows, SignalExpress, etc.),
- Special test stand (hardware and software) for analog-to-digital converters and interfaces testing up to 18 bits,
- Many other instrumentations, educational and research stands, and equipment for Bc. Ms. and PhD students.

***Laboratory of communication technologies and advanced digital signal processing***

- Advanced measurement equipments:
  - ◆ UWB m-sequence radar,
  - ◆ 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),
  - ◆ 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, multimediu 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),
  - ◆ 2 x Laptop,
  - ◆ Switch (16 port and 8 port)
  - ◆ 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),
  - ◆ Multimedia ToolBook software.
- 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 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),
- Web and FTP server department of KEMT (OS Linux, 1GB RAM, 1TB HDD, kemt.fei.tuke.sk),
- MediaServer (cooperation with TV cable company S-team, recording of broadcast TV news corpus KEMT-BN, R+TV),
- 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 (6 pcs),
- IBM DS3300/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***

The Bachelor degree course is orientated into the field of Electronics into the basic electronics systems. The students achieve good skills in electrical measurement, electronics components, linear and non-linear circuits, digital electronics, microprocessors and signal processors and optoelectronics.

#### ***Bachelor Degree Course (title Bc.) –Telecommunications***

The Bachelor degree course is orientated into the field of Telecommunication mainly into the basic telecommunication systems and networks. The students achieve good skills in telecommunication services, management of telecommunication networks and economics in telecommunications.

#### ***Master Degree Course (title Ing.) – Infoelectronics***

The Master degree course is oriented into the field of Infoelectronics the students have been achieve good skills in mathematics, physics, electromagnetic field, electrical measurement, electronics components, linear and non-linear circuits, digital electronics, microprocessors and signal processors, optoelectronics and digital signal processing.

#### ***Master Degree Course (title Ing.) – Multimedia telecommunications***

The Master degree course is oriented into the field of Multimedia telecommunications the students have been achieve good 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 course 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 course is orientated into the field of multimedia communications, mobile and satellite communications as well as modern telecommunication technologies and networks and digital signal processing in telecommunications.

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

The Ph.D. degree course is focused into the methodology of instrumentation in industry, scientific research and monitoring of physical parameters. The related scientific areas are metrology, sensors of different physical qualities, digital signal processing and pre-processing, calibration and self-diagnostic as well as virtual instrumentation.

### 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	Micheali
Circuit theory	3 <sup>rd</sup>	3/2	Kocur
Digital electronics	3 <sup>rd</sup>	3/3	Levický
Microelectronic circuits	4 <sup>th</sup>	3/2	Michaeli
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
Mobile networks and services	6 <sup>th</sup>	3/2	Doboš

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

Subject	Semester	Lectures/exercises (hours per week)	Name of Lecturer
Basics of electronics	2 <sup>nd</sup>	3/2	Micheali
Circuit theory	3 <sup>rd</sup>	3/2	Kocur
Signals and systems	3 <sup>rd</sup>	3/2	Mihalík, Zavacký
Programming environments for electronics and communications	3 <sup>rd</sup>	1/2	Varchola, Šaliga
Electronic measurement systems	4 <sup>th</sup>	2/2	Šaliga
Networks technology	4 <sup>th</sup>	2/2	Čížmár
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
CAD in electronics	4 <sup>th</sup>	2/2	Galajda
High frequency and microwave technology	5 <sup>th</sup>	2/2	Gamec
Semestral projects	5 <sup>th</sup>	0/6	Galajda
Microprocessors technology	5 <sup>th</sup>	2/2	Drutarovský
Networks architecture	5 <sup>th</sup>	3/2	Čížmár
Videocommunications	5 <sup>th</sup>	2/2	Mihalík
Automotive electronics	5 <sup>th</sup>	2/2	Gamec
FPGA circuits	5 <sup>th</sup>	2/2	Drutarovský, Galajda
Bachelor work	6 <sup>th</sup>	0/9	Galajda
Optoelectronic systems	6 <sup>th</sup>	2/2	Turán
Smart measurement systems	6 <sup>th</sup>	2/2	Šaliga
Mobile networks and services	6 <sup>th</sup>	3/2	Doboš
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	Micheali
Circuit theory	3 <sup>rd</sup>	3/2	Kocur
Signals and systems	3 <sup>rd</sup>	3/2	Mihalík, Zavacký
Digital electronics	3 <sup>rd</sup>	3/3	Levický
Networks technology	4 <sup>th</sup>	2/2	Čížmár
Programming environments for electronics and communications	3 <sup>rd</sup>	1/2	Varchola, Šaliga
Electronic measurement systems	4 <sup>th</sup>	2/2	Šaliga
Electromagnetic waves and antennas	4 <sup>th</sup>	2/2	Ovseník
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>
Electroacoustics	4 <sup>th</sup>	2/2	Juhár
Semestral projects	5 <sup>th</sup>	0/6	Galajda
Switching technology	5 <sup>th</sup>	3/2	Marchevský
Networks architecture	5 <sup>th</sup>	3/2	Čížmár
Access networks	5 <sup>th</sup>	3/2	Marchevský, Maceková
High frequency and microwave technology	5 <sup>th</sup>	2/2	Gamec
Microprocessor technology	5 <sup>th</sup>	2/2	Drutarovský
Videocommunications	5 <sup>th</sup>	2/2	Mihalík
FPGA circuits	5 <sup>th</sup>	2/2	Drutarovský, Galajda
Mobile networks and services	6 <sup>th</sup>	3/2	Doboš
Bachelor work	6 <sup>th</sup>	0/9	Galajda
Satellite technology and services	6 <sup>th</sup>	3/2	Marchevský
Optoelectronic systems	6 <sup>th</sup>	2/2	Turán
Smart measurement systems	6 <sup>th</sup>	2/2	Šaliga

### 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
Programmable logic devices	1 <sup>th</sup>	2/2	Varchola, Galajda
Optoelectronics	1 <sup>th</sup>	2/2	Turán
Signal processors	1 <sup>th</sup>	3/2	Drutarovský
Semestral projects	2 <sup>nd</sup>	0/4	Galajda
Microwave circuits and systems	2 <sup>nd</sup>	3/2	Gamec
Digital image processing and coding	2 <sup>nd</sup>	3/2	Mihalík
Processing and transmission of speech and audio	2 <sup>nd</sup>	3/2	Juhár
Optical communication systems	2 <sup>nd</sup>	3/2	Turán
Digital filters	2 <sup>nd</sup>	2/2	Kocur
Applied cryptography	2 <sup>nd</sup>	3/2	Levický
Digital television	3 <sup>rd</sup>	3/2	Marchevský
Photonics	3 <sup>rd</sup>	3/2	Turán
Multimedia technologies	3 <sup>rd</sup>	3/2	Levický
Master thesis I.	3 <sup>rd</sup>	0/6	Galajda
Sensory networks	3 <sup>rd</sup>	2/2	Kocur
Database systems - Oracle SQL	3 <sup>rd</sup>	2/2	Juhár
Medical electronics	3 <sup>rd</sup>	3/2	Michaeli
Interactive telecommunications systems and services	3 <sup>rd</sup>	3/2	Juhár
Mobile communications	3 <sup>rd</sup>	3/2	Doboš
Satellite communications	3 <sup>rd</sup>	3/2	Marchevský
Project management	4 <sup>th</sup>	0/2	Marchevský
Master thesis II.	4 <sup>th</sup>	0/18	Galajda

#### 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
Communication channel modelling	1 <sup>th</sup>	2/2	Kocur
Spread-spectrum communication systems	1 <sup>th</sup>	3/2	Kocur
Semestral projects	2 <sup>nd</sup>	0/4	Galajda
Telecommunications systems theory	2 <sup>nd</sup>	3/2	Čížmár
Digital image processing and coding	2 <sup>nd</sup>	3/2	Mihalík

<b>Subject</b>	<b>Semester</b>	<b>Lectures/exercises (hours per week)</b>	<b>Name of Lecturer</b>
Optical communication systems	2 <sup>nd</sup>	3/2	Turán
Processing and transmission of speech and audio	2 <sup>nd</sup>	3/2	Juhár
Digital filters	2 <sup>nd</sup>	2/2	Kocur
Applied cryptography	2 <sup>nd</sup>	3/2	Levický
Multimedia technologies	3 <sup>rd</sup>	3/2	Levický
Mobile communications	3 <sup>rd</sup>	3/2	Doboš
Database systems - Oracle SQL	3 <sup>rd</sup>	2/2	Juhár
Interactive telecommunications systems and services	3 <sup>rd</sup>	3/2	Juhár
Satellite communications	3 <sup>rd</sup>	3/2	Marchevský
Master thesis I.	3 <sup>rd</sup>	0/6	Galajda
Photonics	3 <sup>rd</sup>	3/2	Turán
Digital television	3 <sup>rd</sup>	3/2	Marchevský
Project management	4 <sup>th</sup>	0/2	Marchevský
Master thesis II.	4 <sup>th</sup>	0/18	Galajda

### 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	
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: 12/2013**

**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: Limburg Catholic University College, 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: RF/Microwave Communication Subsystems for Emerging Wireless Technologies**

**Acronym: RFCSET**

**Number: COST Action IC0803**

**Program/agency: COST**

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

**Project partners: 25 partners from university, research and industrial institutions**

**Start of project: 04/2009**

**End of project: 04/2012**

**Total founding: 10.850,00 EUR**

**Annotation:** The research within RFCSET is focused on two different directions. The former is represented by MIMO-OFDM systems, considering channel estimation problems, peak-to-average-power ratio reduction problem, MIMO-OFDM receiver design and compensation of the non-linear distortion due to the high power amplifiers of the transmitters. The latter research line of RFCSET is intent on radar signal processing for through wall tracking of moving target by UWB radar systems. Some of the problems considered here will be the design of new sophisticated methods of background subtraction and weak signal enhancement, development of new methods of multiple-target detection and tracking and the development of suitable cooperative methods of target localization by two independent UWB radar systems.

**Project title: Propagation Tools and Data for Integrated Telecommunication, Navigation and Earth Observation Systems**

**Acronym:**

**Number: COST Action IC0802**

**Program/agency: COST**

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

**Project partners: TU Graz, TU Budapest, TU Toulouse, University Nothumbia UK, CVUT Prague, University Bonn, University Roma, University Vigo**

**Start of project: 09/2009**

**End of project: 09/2012**

**Total founding: 24.000,00 EUR**

**Annotation:** Telecommunication, Navigation and Earth Observation systems and services are developing world-wide with a multiplicity of standalone terrestrial and space systems that operate in diverse frequency bands. Global Integrated Networks (GIN) will be necessary in the near future to provide better integrated services. Their design requires a comprehensive knowledge of the various propagation media. Up to now radio channel modelling has been performed separately for each type of radio systems.

This activity will develop a coordinated set of models, techniques and data related to the radio channel in order to improve the design and performance of Global Integrated Networks.

The activity will recommend and provide the most appropriate radio channel models, channel assessment techniques and data for the design and operation of these GINs.

The frequencies of interest range from 100 MHz to 100 GHz (VHF to W band) and cover optical free space communications. The target architectures include mobile and fixed, satellite and terrestrial communication systems (including optical links), satellite navigation systems and Earth Observation systems.

The activity will bring together remote sensing, propagation and systems experts. The physical propagation fundamentals will be based on experimental and climatological data.

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

**Project title: Intelligent Control of Service Robot**

**Acronym: INTRO**

**Number: VMSP-P-0004-09**

**Program/agency: APVV**

**Coordinator from TU: doc. Ing. Jozef Juhár, CSc.**

**Project partners: ZŤS VVÚ Košice a.s., STU in Bratislava**

**Start of project: 09/2009**

**End of project: 12/2011**

**Total funding: 43.150,00 EUR**

**Annotation:** The project deals with intelligent control of mobile service robots, meant for using in nuclear plants, in fight against terrorism and in pyrotechnics. The goal of the project is to improve the self-reliance of the robots by introducing abilities to recognize speech, to analyze picture, to respond to information from sensors and to cooperate and coordinate its activity with other robots. The goal of KEMT TUKE team is to develop a robust module for voice control of robot, based on speech recognition of isolated commands in Slovak language and its experimental evaluation in real conditions.

**Project title: Complex Modular Robotic System of Middle Category with Increased Intelligence**

**Acronym: KomoRob**

**Number: Req-00169-0001**

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

**Coordinator from TU: doc. Ing. Jozef Juhár, CSc.**

**Project partners: ZŤS VVÚ Košice, a.s., SĽF TU v Košiciach**

**Start of project: 01/2010**

**End of project: 08/2013**

**Total funding: 184.797,00 EUR**

**Annotation:** The main objective of the project is research and development of complex system of intelligent modules for construction of robotic systems meant for using in heavy environment conditions like natural disasters, fire infernos, etc.

**Project title: Development of Measurement Apparatus and Multimedia e-Learning Book Supporting Education in the Field of UWB Sensor Networks**

**Acronym: UWB-BSS**

**Number: 3/7523/09**

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

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

**Project partners:**

**Start of project: 01/2009**

**End of project: 06/2011**

**Total funding: 48.064,79 EUR**

**Annotation:** Project UWB-BSS is intent on the evolution of students' knowledge in the field of UWB wireless networks within M.Sc. study programs Infoelectronics and Multimedia Telecommunications given at the Technical University of Košice through the development of the new subject „UWB Wireless Networks” to be provided within the mentioned study programs. The project results will be represented by the creation of the excellent conditions for education in the field of UWB sensor networks (new top world-standard technology) with the application of the

advanced education methods (lectures and exercises held in the specialized laboratory, education supported by multimedia and e-learning technology).

**Project title: Through Wall Tracking of Moving Targets by Using UWB Radar Systems**

Acronym: TW-MTT-UWB

Number: LPP-0080-09

Program/agency: APVV

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

Project partners:

Start of project: 09/2009

End of project: 08/2012

Total founding: 49.800,00 EUR

Annotation: The project is intent on the design of new methods of radar signal processing obtained by the UWB radar for the purpose of through obstacle (e.g. wall) detection and tracking of moving multiple targets with a possibility to track individual targets within a group of targets. For that purpose, two research lines will be followed and investigated. The former will be represented by the development of a multiple target tracking method based on a modification and extension of the trace estimation method. On the contrary, the latter approach will be based on the application of two independent radar systems in combination with the advanced methods of the multiple target localization by using cooperative positioning methods.

**Project title: Security of Next Generation Telecommunication Networks and Systems**

Acronym:

Number: 1/0065/10

Program/agency: VEGA

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

Project partners:

Start of project: 01/2010

End of project: 12/2011

Total founding: 31.000,00 EUR

Annotation: Proposed scientific project will be oriented to chosen aspect of the telecommunication network security and systems of the next generation (NGN). The main results of project are oriented into following field : development and verification of new methods for the multimedia content protection with respect to using of the digital watermarking for still colour images, video and speech signals, design of the effective algorithm for the location determination of the mobile nodes in MANET network and design of the agent system for transmission, gathering and exchange of the location data to increase personal security and design, implementation and evaluation of the new methods and approaches for detection of the acoustic events indicating abnormal situations.

**Project title: Advanced Signal Processing Techniques for Reconfigurable Wireless Sensor Networks**

Acronym:

Number: 1/0045/10

Program/agency: VEGA of Ministry of Education of Slovak Republic

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

Project partners:

Start of project: 01/2010

End of project: 12/2011

Total founding: 28.685,00 EUR

**Annotation:** The scientific project will be focused on both elaboration and verifying of design methods in area of Wireless Sensor Networks (WSN), satisfying the IEEE 802.15.4 recommendation. The aim is the reduction of the energy consumption in intelligent nodes of WSN with both several sensor types and several and several communication facilities. In the projects there will be elaborated advanced signal processing algorithms in WSN area focused on signal processing from video sensors, UWB and optical sensors. As well, the object will be elaboration of advanced methods of OFDM, CDMA, MC-CDM, MIMO signal processing aimed at new circuit structures of MIMO-STBC/SFBC-OFDM/OFDMA receivers. The WSN security will be realized by modification of existing cryptographic blocks and by design of new ones, based on reconfigurable nano-power FPGAs.

The project will solve also the new optoelectronic methods for signal transfer and processing in wireless optical distributed sensory networks (WODSN).

**Project title: New Testing Methods for Analog-to-Digital Interfaces Based on the Error Model Identification**

**Acronym:**

**Number:** 1/0555/11

**Program/agency:** VEGA

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

**Project partners:**

**Start of project:** 01/2011

**End of project:** 12/2013

**Total founding:** 21.000,00 EUR

**Annotation:** Research of the new testing approaches Analog to Digital Interfaces based on the identification of their error models, suitable for assessment main parameters in the less equipped laboratories. Proposed method will match error parameters of technologically new components and accuracy needs appropriate to the particular implementation. Existing standards do not cover the actual needs for parameter description of end users and system designers because of their persistence in the standards.

Proper error model will be utilized for dynamic error characterization both functional and integral error parameters from the testing of chosen segments of the full scale range. Implementation of non standardized easily generated testing signals and error estimation in time and stochastic domain using already recommended testing procedures will be another objective of the project. Traceability of the proposed method to the actual standards will be estimated in both approaches.

**Project title: WEBLAB - Exploitation of WEB Technologies for Electronic Courses Requiring Laboratory Exercises**

**Acronym:**

**Number:** 3/7115/09

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

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

**Project partners:**

**Start of project:** 01/2009

**End of project:** 12/2011

**Total founding:** 16.000,00 EUR

**Annotation:** The main objective of the project is implementation of the experiences from the existing web portal <http://meas-lab.fei.tuke.sk>, to create measuring laboratory with on-line access for students performing laboratory exercises from the courses "Basic electronics" and "Microelectronics". Next objective was to evaluate possibilities of information and communication technologies for the laboratory experiment in the vocational training.

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

**Project title: Center of Information and Communication Technologies for Knowledge Systems**

**Acronym: CE-FEI-I**

**Number: IMTS-26220120020**

**Program/agency: Operational Program Research and Development, Call OPVaV-2008/2.1/01-SORO**

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

**Project partners:**

**Start of project: 05/2009**

**End of project: 04/2011**

**Total founding: 1.327.756,75 EUR**

**Annotation:** The project objective is to establish the “Center of Information and Communication Technologies for Knowledge Systems” as the excellency center of the research and development in the field of information and communication technologies and artificial intelligence with the stress to basic and applied research, development and technology transfer providing extensive support to all stages of the university education in the field of information and communication technologies and artificial intelligence. The Center will be build up in such a way as to be the important subject of the Technical University of Košice with regard to creation of the meaningful support and development of the research and development and university education at Technical University of Košice in the field of the Center scope.

**Project title: Development of the Center of Information and Communication Technologies for Knowledge Systems**

**Acronym: CE-FEI-II**

**Number: IMTS-26220120030**

**Program/agency: Operational Program Research and Development**

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

**Project partners:**

**Start of project: 04/2010**

**End of project: 03/2013**

**Total founding: 2.782.500,00 EUR**

**Annotation:** The project objective is to develop the “Center of Information and Communication Technologies for Knowledge Systems” as the excellency center of the research and development in the field of information and communication technologies and artificial intelligence with the stress to basic and applied research, development and technology transfer providing extensive support to all stages of the university education in the field of information and communication technologies and artificial intelligence. The Center will be completed with instrumentation, software and other equipments with goal to create the meaningful support and development of the research and development and university education at Technical University of Košice in the field of the Center scope.

**Project title: Centre of Excellence of the Integrated Research & Exploitation the Advanced Materials and Technologies in the Automotive Electronics**

**Acronym: CE III**

**Number: IMTS-26220120055**

**Program/agency: Operational Program Research and Development**

**Coordinator from TU: prof. Ing. Alena Pietriková,CSc.**

**Project partners: KEMT FEI TUKE (Gamcová M., Gamec J., Gladišová I., Maceková L., Ovseník Ľ., Tatarko M., Urdzík D.)**

Start of project: 09/2010

End of project: 08/2013

Total founding: 4.123.558,00 EUR

Annotation: The project objective is to establish the “Centre of Excellence of the Integrated Research & Exploitation the Advanced Materials and Technologies in the Automotive Electronics” as the excellency center of the research and development in the field using of the advanced materials and technologies in the automotive electronics with the stress to basic and applied research, development and technology transfer providing extensive support to all stages of the university education in the field of information and communication technologies and artificial intelligence. The Center will be build up in such a way as to be the important subject of the Technical University of Košice with regard to creation of the meaningful support and development of the research and development and university education at Technical University of Košice in the field of the Center scope.

Project title: **Research of Modules for Intelligent Robotic Systems**

Acronym: IntelliRobs

Number: IMTS- 26220220141

Program/agency: Operational Program Research and Development

Coordinators from TUKE: doc. 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: IMTS- 26220220155

Program/agency: Operational Program Research and Development

Coordinator from TUKE: prof. Ing. Stanislav Kmeť, CSc., doc. 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 an 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***

- Contineo s.r.o., Košice
- Elcom s.r.o., Prešov
- Slovak Academy of Science
- Slovak Telecom
- Volkswagen Slovakia a.s.
- VSE, Košice (RWE Group)
- 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
- Crabbe Consulting Ltd, Germany
- FTW Telecommunications Research Center Vienna, Austria
- Geozondas Ltd., Lithuania
- Ingenieur Büro Ralf Klukas, Germany
- INESC Lisabon, Portugal
- IMEC, Netherlands
- MEDAV GmbH, Germany
- Meodat Meßtechnik, Germany
- Statens Råddningsverk, Sweden
- ŠkodaAuto Mladá Boleslav, Czech Republic
- Second University of Naples, Italy
- Vrije Universiteit Brussel, Belgium
- Technische Universität Ilmenau, Germany
- Hamburg University of Technology, Germany
- Technische Universiteit Delft, Netherlands
- Universitat Ramon Llull, Barcelona, Spain
- Technical University Budapest, Hungary
- Technical University of Ljubljana, Slovenia
- Technical University of Clju-Napoca, Romania
- University of Firenze, Italy
- University of Gent
- University of Maribor, Slovenia
- University of Sannio, Benevento, Italy
- University of Reggio Di Calabria, Italy
- University of Mediteranea, Italy
- University of Bologna, Italy
- University of Gävle, Sweden

## 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.

### **Galajda Pavol**

*Associated professor*

His research interests include nonlinear circuit's theory and Chaos theory, nonlinearities in digital transmission systems MC-CDMA OFDM, High Altitude Platforms (HAPs) and programmable logic devices- ALTERA and FPGA circuits.

### **Gamec Ján**

*Associated professor*

His general research interests include digital signal processing, block - matching algorithm and motion estimation.

### **Gamcová Mária**

*Assistant professor*

Her general research interests include one and two-dimensional processing based on the method of digital filtering.

**Gladišová Iveta***Assistant professor*

Her research interests are in the digital signal processing, geometric source coding and vector quantization, an algorithm for lattice and pyramid quantizers and codes.

**Hládek Daniel***Research assistant*

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

**Juhár Jozef***Associated 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.

**Klenovičová Zita***Assistant professor*

Her research interests include digital circuits and digital picture processing.

**Kocur Dušan***Full professor*

His research interest is in spread spectrum communication systems; CDMA, MC-CDMA and UWB transmission systems; UWB radar signal processing, psychoacoustics and digital signal processing.

**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 main interests and activities are in area of communications in various types of access 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.

**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.

**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.

**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***Research assistant*

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.

**Rovňáková 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.

**Staš Ján***Research assistant*

His current research interests include Slovak language modelling for LVCSR.

**Šaliga Ján***Associated 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***Assistant professor*

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***Assistant professor*

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.

**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. Ondrej Kováč	prof. Mihalík	Infoelectronics
Ing. Jozef Lipták	doc. Šaliga	Measurement technique
Ing. Marián Mižák	doc. Doboš	Telecommunications
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
<b><i>Second year of study</i></b>		
<u>Internal form:</u>		
Ing. Denis Dupák	prof. Kocur	Infoelectronics
Ing. Patrik Gallo	prof. Levický	Telecommunications
Ing. Marek Godla	doc. Šaliga	Measurement technique
Ing. Tomáš Harasthy	prof. Turán	Infoelectronics
Ing. Ján Krekáň	doc. Doboš	Telecommunications
Ing. Jozef Vavrek	prof. Čižmár	Telecommunications
<b><i>Third year of study</i></b>		
<u>Internal form:</u>		
Ing. Vladimír Cipov	doc. Doboš	Telecommunications
Ing. Peter Goč-Matis	prof. Levický	Telecommunications
Ing. Branislav Hrušovský	prof. Marchevský	Telecommunications
Ing. Anna Kažimírová Kolesárová	doc. Ovseník	Infoelectronics
Ing. Martin Liptaj	doc. Galajda	Infoelectronics
Ing. Pavol Mišenčík	prof. Turán	Infoelectronics
Ing. Martin Sekerák	prof. Michaeli	Measurement technique
Ing. Daniel Urdzík	prof. Kocur	Infoelectronics
Ing. Peter Viszlaj	doc. Juhár	Infoelectronics
Ing. Eva Vozáriková	prof. Čižmár	Telecommunications
<u>External form:</u>		
Ing. Daniel Fábry	doc. Šaliga	Telecommunications
<b><i>Fifth year of study</i></b>		
<u>External form:</u>		
Ing. Rastislav Kokoška	prof. Marchevský	Telecommunications
Ing. Kamil Šindlery	prof. Marchevský	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.

**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 Technical Standardization Commission No.55 for Electroacoustics and ultrasound.

**Kocur Dušan**, Executive editor of the editorial board of the journal "Acta Electrotechnica et Informatica".

**Kocur Dušan**, Member of the editorial board of the journal "Acta Polytechnica Hungarica".

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

**Levický Dušan**, Member of the editorial board of the journal "Slaboproudý obzor".

**Levický Dušan**, Member of the IEEE.

**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".

**Michaeli Linus**, Scientific Grant Agency of Slovak Republic.

**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. CERŇAK,M.-ČIŽMÁR,A.-DARJAA,S.-DOBOŠ,L.-HLÁDEK,D.-JARINA,R.-JUHÁR,J.-LOJKA,M.-MIRILOVIČ,M.-PAPAJ,J.-PAPCO,M.-PLEVA,M.-RUSKO,M.-ONDÁŠ,S.-STAŠ,J.-TICHÁ,D.-TRNKA,M.-VAVREK,J.-VISZLAY,P.-VOZÁRIKOVÁ,E.: Rečové technológie v telekomunikačných a informačných systémoch. In: EQUILIBRIA, Košice, Slovakia, 2011, 517 pp.
2. DRUTAROVSKÝ,M.: Ochrana obsahu vysielaného v systémoch DVB. In: Progresívne technológie v DVB-T, FEI TU Košice, Slovakia, 2011, pp. 95-118.
3. GALAJDA,P.: DVB-T. In: Progresívne technológie v DVB-T, FEI TU Košice, Slovakia, 2011, pp. 48-69.
4. GAMEC,J.-GAMCOVÁ,M.-MICÁK,J.: Smithov diagram riešené príklady. In: FEI TU Košice, Slovakia, 2011, 65 pp.
5. KOCUR,D.-GAZDA,J.-DROTÁR,P.-DUPÁK,D.: Modulácia OFDM. In: Progresívne technológie v DVB-T, FEI TU Košice, Slovakia, 2011, pp. 71-91.
6. MACEKOVÁ,L.-LEVICKÝ,D.-MARCHEVSKÝ,S.: Digitálna televízia, teória a prax. In: Progresívne technológie v DVB-T, FEI TU Košice, Slovakia, 2011, pp. 18-44.
7. MARCHEVSKÝ,S.-LEVICKÝ,D.-MACEKOVÁ,L.-PILLAR,S.-HRUŠOVSKÝ,B.-HOLOVÁČ,L.: IPTV : Základné technologické riešenie. In: Progresívne technológie v DVB-T, FEI TU Košice, Slovakia, 2011, pp. 150-199.
8. TURÁN,J.-OVSENÍK,L.: Prvky optoelektroniky v spoločných rozvodoch pre príjem DVB-C,T,S. In: Progresívne technológie v DVB-T, FEI TU Košice, Slovakia, 2011, pp. 121-148.
9. VARCHOLA,M.-DRUTAROVSKÝ,M.: Cryptographic True Random Number Generator with Malfunction Detector Mathematical Model of the Noise Source, Synthesis and Testing in FPGAs, and Built-in Malfunction Detector Architecture. In: Saarbrücken: LAP LAMBERT Academic Publishing, 2011, 136 pp.

### 9.2 Journal papers

1. CIPOV,V.-DOBOŠ,L.-PAPAJ,J.: Cooperative Trilateration-based Positioning Algorithm for WLAN Nodes Using Round Trip Time Estimation. In: Journal of Electrical and Electronics Engineering, Vol. 4, no. 1 (2011), 29-34.
2. DRUTAROVSKÝ,M.-GALAJDA,P.-ŠIMŠÍK,D.-GALAJDOVÁ,A.: Embedded Control of Mechatronical Rehabilitation Shoe. In: Strojárstvo/Strojírenství, Vol. 15, no. 5 (2011), 1-6.
3. HLÁDEK,D.-STAŠ,J.-JUHÁR,J.: A Morphological Tagger Based on a Learning Classifier System. In: Journal of Electrical and Electronics Engineering, Vol. 4, no. 1 (2011), 65-70.
4. HRUŠOVSKÝ,B.-MOCHNÁČ,J.-MARCHEVSKÝ,S.: Error Concealment Method Based on Motion Vector Prediction Using Particle Filters. In: Radioengineering, Vol. 20, no. 3 (2011), 692-702.
5. HRUŠOVSKÝ,B.-MARCHEVSKÝ,S.-MACEKOVÁ,L.: Error Concealment Algorithms Applied on Multi-View Video Sequences. In: Acta Electrotechnica et Informatica, Vol. 11, no. 2 (2011), 11-16.



6. KOŠČ,P.-GAMCOVÁ,M.-ŠTEC,J.-KOCUR,D.: Benchmarking of Free Authoring Tools for Multimedia Courses Development. In: Acta Electrotechnica et Informatica, Vol. 11, no. 3 (2011), 36-41.
7. KREKÁŇ,J.-DOBOŠ,Ľ.-PAPAJ,J.: Intrusion Detection Methods in Wireless Network Systems. In: Journal of Electrical and Electronics Engineering, Vol. 4, no. 1 (2011), 79-82.
8. LEVICKÝ,D.-KLENOVIČOVÁ,Z.-BUGÁR,G.: Metódy a systémy digitálnej vodotlače v statických obrazoch. In: Slaboproudý obzor, Vol. 67, no. 3 (2011), 1-8.
9. MIHALÍK,J.: Generation of Knot Net for Calculation of Quadratic Triangular B-spline Surface of Human Head. In: Journal of Electrical Engineering, Vol. 62, no. 5 (2011), 274-279.
10. MIŠENČÍK,P.-OVSENÍK,Ľ.-TURÁN,J.: Design and Analysis of FSO Systems Using the Software Package "FSO System Simulator" – Steady Model. In: Carpathian Journal of Electronic and Computer Engineering, Vol. 4, no. 1 (2011), 81-87.
11. MIŠENČÍK,P.-TURÁN,J.-OVSENÍK,Ľ.: Design and Analysis of FSO Systems Using the Software Package "FSO System Simulator" – Statistical Model. In: Carpathian Journal of Electronic and Computer Engineering, Vol. 4, no. 1 (2011), 75-79.
12. ONDÁŠ,S.-JUHÁR,J.-ČIŽMÁR,A.-HOLCER,R.-PLEVA,M.-HLÁDEK,D.-PAPCO,M.: Speech Interface for Controlling Service Robot SCORPIO. In: Journal of Electrical and Electronics Engineering, Vol. 4, no. 1 (2011), 143-146.
13. PALUBOVÁ,H.-GALAJDA,P.: Performance Analysis of MC-CDMA Systems Using Chaotic and Conventional Spreading Sequences. In: Acta Electrotechnica et Informatica, Vol. 11, no. 2 (2011), 44-51.
14. PAPAJ,J.-ČIŽMÁR,A.-DOBOŠ,Ľ.: Implementation of the Integration Model of Security and QoS for MANET to the OPNET. In: Communications in Computer and Information Science: Multimedia Communications, Services and Security, Vol. 149 (2011), 310-316.
15. PAPAJ,J.-DOBOŠ,Ľ.-ČIŽMÁR,A.: OPNET Modeler and Cross Layer Model for the New Integration Model of Security and QoS as a One Parameter in MANET. In: Journal of Electrical and Electronics Engineering, Vol. 4, no. 1 (2011), 163-168.
16. PAPAJ,J.-DOBOŠ,Ľ.-ČIŽMÁR,A.: Performance Analysis of New Integration Model of Security and QoS as a One Parameter in MANET. In: Journal of Electrical and Electronics Engineering, Vol. 4, no. 1 (2011), 169-172.
17. PLEVA,M.-VOZÁRIKOVÁ,E.-DOBOŠ,Ľ.-ČIŽMÁR,A.: The joint database of audio events and backgrounds for monitoring of urban areas. In: Journal of Electrical and Electronics Engineering, Vol. 4, no. 1 (2011), 185-188.
18. RIDZOŇ,R.-LEVICKÝ,D.: Content Protection in Grayscale and Color Images Based on Robust Digital Watermarking. In: Telecommunication Systems, Vol. 48 (2011), 1-15.
19. SEKERÁK,M.-MICHAELI,L.-ŠALIGA,J.-GODLA,M.: Dynamic DAC Testing by Registration of the Input Code Wordin Equality when the DAC Output Matches a Reference Signal. In: Acta Electrotechnica et Informatica, Vol. 11, no. 3 (2011), 31-35.
20. ŠIMŠÍK,D.-GALAJDOVÁ,A.-SIMAN,D.-BUJŇÁK,J.-KRAJŇÁK,S.-GALAJDA,P.: Automatizácia domácnosti osamelých seniorov a služby v inteligentnom prostredí. In: Strojárstvo/Strojirenství, Vol. 15, no. 5 (2011), 1- 5.
21. STAŠ,J.-HLÁDEK,D.-PLEVA,M.-JUHÁR,J.: Slovak Language Model from Internet Text Data. In: Lecture Notes in Computer Science, Vol. 6456 (2011), 340-346.
22. ŠIMKA,M.-DRUTAROVSKÝ,M.-FISCHER,V.: Testing of PLL-Based True Random Number Generator in Changing Working Conditions. In: Radioengineering: Proceedings of Czech and Slovak Technical Universities and URSI Committees, Vol. 20, no. 1 (2011), 94-101.

23. TURÁN,J.-SZOBOSZLAI,P.-VÁSÁRHELYI,J.: Mojette Transform Software - Hardware Implementations and its Applications. In: Infocommunications Journal, Vol. 3, no. 1 (2011), 40-48.
24. VISZLAY,P.-PLEVA,M.-JUHÁR,J.: Dimension Reduction with Principal Component Analysis Applied to Speech Supervectors. In: Journal of Electrical and Electronics Engineering, Vol. 4, no. 1 (2011), 245-250.
25. VOZÁRIKOVÁ,E.-JUHÁR,J.-ČIŽMÁR,A.: Acoustic Events Detection Using MFCC and MPEG-7 Descriptors. In: Communications in Computer and Information Science: Multimedia Communications, Services and Security, Vol. 149 (2011), 191-197.
26. VOZÁRIKOVÁ,E.-PLEVA,M.-JUHÁR,J.-ČIŽMÁR,A.: Surveillance system based on the acoustic events detection. In: Journal of Electrical and Electronics Engineering, Vol. 4, no. 1 (2011), 255-258.

### 9.3 Conference papers

1. BÁNOCI,V.-BUGÁR,G.-KANÓCZ,T.-KLENOVIČOVÁ,Z.-LEVICKÝ,D.:                    Obrazová steganografia v komunikačných systémoch. In: Electrical Engineering and Informatics II. Proceeding of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, Košice, Slovak Republic, March 2011, 165-169.
2. BÁNOCI,V.-BUGÁR,G.-KANÓCZ,T.-KLENOVIČOVÁ,Z.-LEVICKÝ,D.:                    Slepá steganografia na báze DWT. In: Electrical Engineering and Informatics II. Proceeding of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, Košice, Slovak Republic, March 2011, 170-175.
3. BÁNOCI,V.-BUGÁR,G.-KANÓCZ,T.-KLENOVIČOVÁ,Z.-LEVICKÝ,D.:                    Steganografia s vyhľadávaním perceptívne vhodných oblastí v krycích obrazoch. In: Electrical Engineering and Informatics II. Proceeding of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, Košice, Slovak Republic, March 2011, 176-181.
4. BÁNOCI,V.-BUGÁR,G.-KANÓCZ,T.-KLENOVIČOVÁ,Z.-LEVICKÝ,D.:                    Steganografia v statických farebných obrazoch. In: Electrical Engineering and Informatics II. Proceeding of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, Košice, Slovak Republic, March 2011, 182-187.
5. BÁNOCI,V.-BUGÁR,G.-LEVICKÝ,D.: A Novel Method of Image Steganography in DWT Domain. In: Radioelektronika 2011: Proceedings of 21<sup>th</sup> International Conference, University of Technology Brno, Brno, Czech Republic, April 19-20, 2011, 241-248.
6. BÁNOCI,V.-BUGÁR,G.-LEVICKÝ,D.:                    Techniky obrazovej steganografie. In: Bezpečné Slovensko a Európska Únia: Zborník príspevkov zo 4. medzinárodnej vedeckej konferencie, Košice, Slovak Republic, November 11–12, 2010, 17-25.
7. BLIČHA,R.-HRUŠOVSKÝ,B.-LIPTAJ,M.: An Analysis of OFDM, Precoded OFDM, OFDMA and Single Carrier — FDMA in Cellular Systems. In: SCYR 2011: 11<sup>th</sup> Scientific Conference of Young Researchers of Faculty of Electrical Engineering and Informatics Technical University of Košice, Herľany, Slovakia, May 17<sup>th</sup>, 2011, 20-23.
8. BUGÁR,G.-BÁNOCI,V.-LEVICKÝ,D.: A New Blind Steganography Method Based on DWT Transform with Haar Wavelet. In: RTT2011: 13<sup>th</sup> International Conference on Research in Telecommunication Technologies, VUT Brno, Techov, Czech Republic, September 7-9, 2011, 102-106.
9. CIPOV,V.-DOBOŠ,Ľ.-DRABIK,R.: Trilateration-based Positioning System Using ToA Estimation with LoS and NLoS Detection. In: AEI '2011: International Conference on Applied Electrical Engineering and Informatics 2011, Pisa, Italy, September 3-10, 2011, 42-48.

10. CIPOV, V.: Round Trip Time Distance Estimation for WLAN 802.11 Devices. In: SCYR 2011: 11<sup>th</sup> Scientific Conference of Young Researchers of Faculty of Electrical Engineering and Informatics Technical University of Košice, Herľany, Slovakia, May 17<sup>th</sup>, 2011, 343-345.
11. CSURGAI-HORVÁTH, L.-LEITGEB, E.-TURÁN, J.: Measurement Data for FSO and E-band Radio Propagation Modeling. In: EuCAP 2011: 5<sup>th</sup> European Conference on Antennas and Propagation, Rome, Italy, April 11-15, 2011, 2895-2898.
12. DOBOŠ, Ľ.-PAPAJ, J.-ČIŽMÁR, A.: Mobile Opportunistic Networks - New Way of Mobile Ad-hoc Networks. In: AEI '2011: International Conference on Applied Electrical Engineering and Informatics 2011, Pisa, Italy, September 3-10, 2011, 21-26.
13. DRUTAROVSKÝ, M.-ŠIMŠÍK, D.-GALAJDA, P.-GALAJDOVÁ, A.: Embedded Control of Mechatronical Rehabilitation Shoe. In: Automatizácia a riadenie v teórii a praxi: Workshop odborníkov z univerzít, vysokých škôl a praxe v oblasti automatizácie a riadenia, Stará Lesná, Slovak Republic, February 16-18, 2011, 14-1 - 14-10.
14. GALAJDA, P.-GUZAN, M.-ŠPÁNY, V.: The Control of a Memory Cell with the Multiple Stable States. In: Radioelektronika 2011: Proceedings of 21<sup>th</sup> International Conference, University of Technology Brno, Brno, Czech Republic, April 19-20, 2011, 211-214.
15. GALLO, P.-GOČ-MATIS, P.-LEVICKÝ, D.: Parallel Processing Applied on Elliptic Curve Arithmetic in Affine Coordinates. In: Electrical Engineering and Informatics II. Proceeding of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, Košice, Slovak Republic, March 2011, 153-158.
16. GALLO, P.-GOČ-MATIS, P.-LEVICKÝ, D.: Parallel Processing Applied on Elliptic Curve Arithmetic in Jacobian Projective Coordinates. In: Electrical Engineering and Informatics II. Proceeding of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, Košice, Slovak Republic, March 2011, 159-164.
17. GALLO, P.-LEVICKÝ, D.: Parallelizing Computations over Elliptic Curve Arithmetic in Affine and Jacobian Projective Coordinates. In: Radioelektronika 2011: Proceedings of 21<sup>th</sup> International Conference, University of Technology Brno, Brno, Czech Republic, April 19-20, 2011, 401-404.
18. GAMEC, J.-GLADIŠOVÁ, I.-GAMCOVÁ, M.: Radarové systémy v automobiloch. In: Electrical Engineering and Informatics II. Proceeding of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, Košice, Slovak Republic, March 2011, 97-102.
19. GAMEC, J.-GLADIŠOVÁ, I.-GAMCOVÁ, M.: Elektronické systémy automobilov a trendy ich vývoja. In: Electrical Engineering and Informatics II. Proceeding of the Faculty of Electrical Engineering and Informatics of the Technical University of Košice, Košice, Slovak Republic, March 2011, 103-106.
20. GAMEC, J.: Symbol Recognition Based on Modified Rapid Transform. In: AEI '2011: International Conference on Applied Electrical Engineering and Informatics 2011, Pisa, Italy, September 3-10, 2011, 36-41.
21. GAMEC, J.-URDZÍK, D.-GAMCOVÁ, M.: Traffic Sign Recognition Based on the Rapid Transform. In: INFORMATICS'2011 – 11th event of International Scientific Conference on Informatics, Rožňava, Slovak Republic, November 16–18, 2011, 138-142.
22. GASPAR, L.-FISCHER, V.-BOSSUET, L.-DRUTAROVSKÝ, M.: Cryptographic Extension for Soft General-purpose Processors with Secure Key Management. In: FPL 2011: 21<sup>st</sup> International Conference on Field Programmable Logic and Applications, Chania, Greece, September 5-7, 2011, 500-505.

23. GAZDA,J.-DUPÁK,D.-KOCUR,D.: M-APSK Modulation for SC-FDMA Communication Systems. In: Radioelektronika 2011: Proceedings of 21<sup>th</sup> International Conference, University of Technology Brno, Brno, Czech Republic, April 19-20, 2011, 129-132.
24. GAZDA,J.-DROTÁR,P.-DEUMAL,M.-KOCUR,D.-GALAJDA,P.: Tone Reservation for SFBC-OFDM Transmission Systems Using Null Subcarriers. In: SIU 2011: 19<sup>th</sup> IEEE Conference on Signal Processing and Communications Applications, Kemer, Antalya, Turkey, April 20-22, 2011, 1208-1211.
25. GAZDA,J.-DUPÁK,D.-KOCUR,D.: Performance Evaluation of M-APSK Modulation in the LTE Uplink. In: InOWo'11: Proceedings 16<sup>th</sup> International OFDM-Workshop 2011, University of Technology Hamburg, Germany, August 31 - September 1, 2011, 1-5.
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