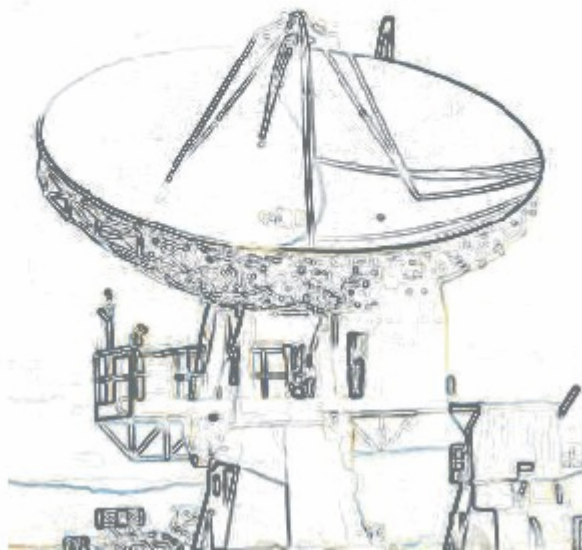

DEPARTMENT OF ELECTRONICS AND MULTIMEDIA TELECOMMUNICATIONS

Department Of
Electronics
& Multimedia Communications



Annual Report 2005

Technical University of Košice
Faculty of Electrical Engineering and Informatics

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

DEPARTMENT OF ELECTRONICS AND
MULTIMEDIA TELECOMMUNICATIONS

ANNUAL REPORT 2005

Edited by Ľuboš Ovseník

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BRIEF OVERVIEW

The Department of Electronics and Multimedia Communications is responsible for degree course Electronics and Telecommunication Engineering at MSc. level as well as for degree courses Electronics, Telecommunications and Measurement Techniques at PhD. level.

The subjects in degree course Electronics and Telecommunications Engineering are orientated to the linear and non-linear analogue circuits, digital electronics, microwave technology, optoelectronics, signal and systems, acoustics, digital signal processing, digital filtering, VLSI processors and microcontrollers, radioelectronic measurements, 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, implementation on neural network in digital signal processing and A/D converters modelling.

The history of the Department: The Department of Electronics and Multimedia Communications was founded in 1969. The original name of department was Department of Electronics and first head of department was Prof. Špány. In the first 5 years Department was responsible for some subjects in the field of electronics.

The name of Department has been change to Department of Electronic Circuits and System in 1974. It was responsible for the new degree course Electronics Systems. First students have been finished his study in this degree course at 1976. The new degree course Radioelectronics at the Department has been started in 1979, which was orientated in the field of microwave technology, analog and digital electronics, digital signal processing and radioelectronic systems. The name of Department has been change to Department of Radioelectronics. Since 1986 the head of Department is Prof. Levický. The process of degree course Radioelectronics transformation to the new degree course Electronics and Telecommunication engineering at the department has been finished in 1997. The recent name of department since 1997 is Department of Electronics and Multimedia Communications.

DEPARTMENT STAFF AND STRUCTURE

Total number of staff members is 26.

- ◆ Professors: Anton Čižmár, Dušan Kocur, Dušan Levický, Stanislav Marcheviský, Ján Mihalík, Linus Michaeli, Ján Turán

- ◆ Associated Professors: Ľubomír Doboš, Miloš Drutarovský, Pavol Galajda, Jozef Juhár, Ján Šaliga

- ◆ Assistant Professors: Mária Gamcová, Ján Gamec, Iveta Gladišová, Rastislav Hovančák, Zita Klenovičová, Slavomír Lihan, Ľuboš Ovseník, Jozef Zavacký

- ◆ Research Assistant: Jana Čížová, Ingrid Hroncová, Ľudmila Maceková, Ján Papaj, Matúš Pleva

- ◆ Support staff: Pavlina Chocholová, Božena Marcheviská, Viera Šumáková

- ◆ Ph.D. students:
Internal form: Ľubomír Čopjan, Peter Foriš, Renáta Gaňová, Marián Grega, Miroslav Kasár, Miroslav Katrák, Jozef Krajňák, Peter Michalko, Michal Mirilovič, Stanislav Ondáš, Henrieta Palubová, Peter Patlevič, Pavol Pavelka, Radovan Ridzoň, Lenka Sochová, Martin Šimka, Anton Štofa, Peter Varchol
External form: Miroslav Baboľ, Pavol Cabúk, Szabolcz Csernok, Sakhia Darjan, Marek Domaracký, Vladimír Frolek, Imrich Harčár, Viktor Homolya, Ľubomír Horniak, Daniela Kravecová, Štefan Lipovský, Martin Lukáč, Renáta Nováková, Ján Papaj, Milan Rusko, Péter Serfozo, Tomáš Straka, Jozef Študenc, Pavol Švač, Marián Zlacký, Peter Želinský

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COURSES

Bachelor Degree Course (title Bc.) – Telecommunications Engineering

The Bachelor degree course is orientated into the field 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.) – Electronics and Telecommunication Engineering

The Master degree course is orientated into the field of Electronics and Telecommunications. In the field of Electronics 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.

In the field Telecommunications the students have been achieve good skills in digital communication and transmission systems, mobile and satellite communications, optoelectronics communication systems and multimedia communication.

Master Degree Course (title Ing.) – Measurement Techniques

The Master degree course is orientated into the field of Measurement techniques. The degree course is the specialisation of the general programme Electronics. In the field of Mesurement techniques the students have been achieve good skills in electrical measurement, metrology, electronics components, linear and non-linear circuits, digital electronics, microprocessors and signal processors, digital signal processing targeted on enhancement of the metrological properties, virtual instrumentation using ICT, measurement in the biomedicine, measurement in the telecommunications, industrial measurement for process control and TQM.

Ph.D. Degree Courses (title Ph.D.) – Electronics

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.) – Measurement Techniques

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.

LIST OF SUBJECTS TAUGHT

Master Degree Course (Ing.) *Electronics and Telecommunications*

Subjects	Hours/Week Lecture/Seminar	Lectures
2nd year of study:		
Basic of electronics	3/2	Michaeli
3rd year of study:		
Linear Analog Circuits	4/3	Kocur
Microwave Technology	3/2	Gamec
Digital Electronics	3/3	Levický
Digital Communication Systems	3/2	Levický
Non-Linear Analog Circuits	3/2	Michaeli
Signals and Systems	3/3	Mihalík, Zavacký
Design of Electronic Equipment	3/2	Doboš
Electroacoustics	3/2	Juhár
Electronic Systems with FPGA Circuits	2/3	Galajda, Drutarovský
4th year of study:		
Radioelectronic Measurement	3/3	Šaliga
Electronic Systems with Microprocessors	3/2	Drutarovský
Digital Signal Processing	3/3	Mihalík
Optoelectronics	3/2	Turán
Switching Systems	3/2	Marchevský
Coding and Modulation	3/2	Drutarovský, Čižmár
Semestral Projects	0/2	Galajda
Digital Transmission Systems	3/2	Čižmár
Signal Processors in Telecommunications	3/2	Drutarovský
TV Systems	3/2	Marchevský
Analog & Digital Interfaces	3/2	Michaeli, Šaliga
Optoelectronic Communications Systems	3/2	Turán
Digital Filters	2/2	Kocur, Drutarovský
Applied Cryptography	3/2	Levický
Digital Proc. and Transmission of Speech and Audio	3/2	Juhár
Automotive Electronic Control Systems	3/2	Gamec
5th year of study:		
Photonics	3/2	Turán
Medical Electronics	3/2	Michaeli
Radioelectronic Systems	3/2	Doboš
Multimedia Communications	3/2	Levický
Satellite Communications	3/2	Marchevský
Digital Image Communication Systems	3/3	Mihalík
Mobile Communications Systems	3/2	Doboš
Spread Spectrum Communication Systems	3/2	Kocur
Diploma Projects	0/5	Galajda
Cars Electronic Diagnostic Systems	3/2	Marchevský, Dudrik
Choice Chapters from Elec. and Telecom. Tech.	4/0	Marchevský

Master Degree Course (Ing.) Measurement Techniques

Subjects	Hours/Week Lecture/Seminar	Lectures
4th year of study:		
Radioelectronic Measurement	3/3	Šaliga
Electronic Systems with Microprocessors	3/2	Drutarovský
Digital Signal Processing	3/3	Mihalík
Electromagnetic Compatibility	3/2	Marton
Sensor Systems	2/2	Mojžiš
Semestral Projects	0/2	Michaeli
Digital Transmission Systems	3/2	Čižmár
Signal Processors in Telecommunications	3/2	Drutarovský
Technical Diagnostic	3/2	Smrczek
Virtual instrumentation	3/2	Šaliga
Modelling and Measurement	3/2	Kováč
Measurement in High Voltage Technology	2/2	Kolcunova
Measurement in Electroenergetic	2/2	Leščinský
Digital Filters	2/2	Kocur,
Applied Cryptography	2/2	Levický
Measurement in Experimental Physics	2/2	Kudela
5th year of study:		
Signal Processing in Measurement	3/2	Michaeli
Medical Electronics	3/2	Michaeli
Measurement in Telecommunication	3/2	Šaliga
Diagnostic of Electrical Systems	2/2	Kolcunova
Technology of Sensors	2/3	Banský

Undergraduate Study (Bc.) Telecommunications

Subjects	Hours/Week Lecture/Seminar	Lectures
1st year of study:		
Electronic Devices	3/3	Gamec
2nd year of study:		
Linear Analog Circuits	4/3	Kocur
Microwave Technology	3/2	Gamec
Signals and Systems	3/2	Mihalík, Zavacký
Digital Electronics	3/3	Levický
Data Acquisition Systems	3/3	Michaeli, Šaliga
Optoelectronics	3/2	Turán
Digital Signal Processing	3/2	Mihalík
Basics of Telecommunication Systems	3/2	Levický
Circuits for Communications Systems	4/3	Michaeli
3rd year of study:		
Telecommunications Networks	3/2	Čižmár
Transmissions Systems	3/2	Čižmár
Switching Systems	3/2	Marchevský
Semestral Projects	0/2	Galajda
Measurement in Telecommunications	3/2	Šaliga
Optoelectronic Communications Systems	3/2	Turán
Videocommunications	3/2	Mihalík
Telecommunications Services	3/2	Čižmár
Management of Telecommunication Networks	3/2	Čižmár
Security of Communications Networks	3/2	Levický
Multimedia Communications	3/2	Levický
Satellite Communications	3/2	Marchevský
Mobile Communications Systems	3/2	Doboš

Undergraduate and Graduate Study for Foreign Students (in English Language)
Study plan for MSC degree in *Telecommunication technology*

Subjects	Hours/Week Lecture/Seminar	Lectures
1st year of study:		
Digital Signal Processing	3/3	Mihalík
Coding in Communication Systems	3/2	Levický
Optoelectronics	3/2	Turán
Digital Filtration in Communications	3/2	Marchevský
Microwave Technology	3/2	Turán
Telematic Systems	3/2	Levický
Digital Speech in Communication Systems	3/2	Marchevský
Optoelectronic Communications Systems	3/2	Turán
Image Coding	3/2	Mihalík
VLSI Processors in Telecommunications	3/2	Drutarovský
Digital Transmission Systems	3/2	Čižmár
Digital Filters	2/2	Kocur, Drutarovský
2nd year of study:		
Multimedial Communications	3/2	Levický
Satellite Communications	3/2	Marchevský
Mobile Communications	3/2	Doboš
Digital Image Communication Systems	3/3	Mihalík
Digital Proc. and Transmission of Speech and Audio	3/2	Juhár
Distributed Virtual Instrumentation	3/2	Michaeli
Photonics	3/2	Turán
Semestral Projects	0/5	Galajda

RESEARCH AND PROJECTS

Title of the Project: *Digital Signal Processing, Transmission, Recognition and Protection in Multimedia Communications*

Funding: VEGA 1/1057/04

Duration: 2004-2006

Co-ordinator: prof. Ing. Dušan Levický, CSc.

Group members: A. Čížmár, S. Marchevský, D. Kocur, M. Drutarovský, J. Juhár, Ľ. Doboš, Z. Klenovičová, M. Gamcová, Ľ. Maceková, R. Hovančák, R. Ridzoň, S. Lihan, P. Foriš, J. Čížová, J. Krajňák, M. Pleva, M. Šimka, S. Šurin, P. Varchol

Scientific goals/research targets:

- ◆ Design of the new methods for image coding and digital image watermarking in information technologies for multimedia communications as well as new methods for message transmission by using steganography
- ◆ Verification of robustness watermarks in proposed methods
- ◆ Design of the new method of speech recognition in voice interactive dialog systems.
- ◆ Design of new methods of digital signal transmission by using CDMA and multi-user detection.
- ◆ Design of the new methods for digital image filtration from point of view digital image processing and image quality enhancement.

Results Achieved:

- ◆ Design of new method for digital watermarking of color image by using DWT and DCT and methods for multiembedding watermarks.
- ◆ Analysis selected types of attacks on digital watermarks and robustness of watermark techniques.
- ◆ Design of new methods for building up subliminal channels in steganography.
- ◆ Design of new embedded cryptographic architectures based on FPGA.
- ◆ Design of new method of speech recognition and its implementation in interactive information system.
- ◆ Design new modifications of adaptive LMS filters for image filtering.
- ◆ Design procedure of microstatistic multi-user receivers for CDMA transmission systems.

Title of the Project: *Digital signal processing in secure communications and interactive telecommunication services***Funding:** Institutional grant**Duration:** 2003-2005**Co-ordinator:** prof.Ing. Dušan Levický,CSc.**Group members:** A. Čižmár, S. Marchevský, D. Kocur, M. Drutarovský, J. Juhár, L. Doboš, Z. Klenovičová, P. Foriš, M. Gamcová, Ľ. Maceková, J. Čížová, R. Hovančák, M. Grega, S. Lihan, M. Pleva, R. Ridzoň, M. Šimka, S. Šurin, P. Varchol**Scientific goals/research targets:**

- ◆ Design of new methods in steganography for conceals the existence of message transmission.
- ◆ Design of new methods and hardware for data encryption.
- ◆ Design of new methods for speech recognition in interactive telecommunication services.
- ◆ Application of new approaches of i–multi-user detection for communication systems based on CDMA.
- ◆ Design of new methods of digital watermarks implementation in multimedia.
- ◆ Design of new methods of digital image filtration.

Results Achieved:

- ◆ Designs of new methods for conceal the message existence in steganography by using CDMA.
- ◆ Design and verification of new type of random sequence generators for data encryption.
- ◆ Design of HVS models for digital image watermarking in transform domain.
- ◆ Design of new method of machine speech recognition for Slovak language based SpeechDat-Sk and analysis of proposed point of view implementation in interactive telecommunication services.
- ◆ The review of the state-of-art of multi-user receivers for MC-CDMA transmission systems.

Title of the Project: *ICT networks and services convergency in communication infrastructure of SR***Funding:** S000095 / National programme for R&D “Building of information society”**Collaboration with:** STU Bratislava, ŽU Žilina, VUS B. Bystrica

Duration: 2004-2005

Co-ordinator: doc. Ing. Ľubomír Doboš, CSc. (WP6)

prof. Ing. Dušan Levický, CSc. (WP4, WP13)

Group members: M. Drutarovský, P. Foriš, R. Hovančák, R. Ridzoň, M. Šimka, S. Šurin

Scientific goals/research targets:

- ◆ The main objective of the project is research and development of telecommunication network and services for NGN in public and private telecommunication networks of SR.
 - ◆ WP4 : Data security analysis in NGN
 - ◆ WP6: R&D of NGN conception for SR infrastructure from point of view data security
 - ◆ WP13: Implementation of data security in NGN environment

Results Achieved:

- ◆ Design of new methods for data security in NGN based on enciphering.
- ◆ Design of new method for ownerships protection by using digital watermarking in NGN.

Title of the Project: *Spoken Language Interaction in Telecommunication*

Funding: COST 278

Collaboration with: 29 academic and commercial research institutions from 18 European countries

Duration: 2001-2005

Co-ordinator: prof. Ing. Anton Čižmár, CSc.

Group members: L. Doboš, J. Juhár, S. Lihan, D. Levický, M. Baboľ, J. Papaj, M. Pleva

Scientific goals/research targets:

- ◆ To improve the knowledge of the issues and problems involved in general in spoken language interaction in telecommunication.
- ◆ To achieve knowledge of issues related to robustness and multi-linguality within spoken language processing.
- ◆ To achieve knowledge of spoken language interaction in the context of multi-modal communication.
- ◆ To achieve knowledge of human-computer dialogue theories, models and systems and associated tools for the establishment of such systems.
- ◆ To achieve knowledge of and evaluate telecommunication applications that applies spoken language as one out of more input or output modalities.

Results Achieved:

- ◆ Initiation of Slovak language analysis for the purpose of automatic spoken language interaction in telecommunication services.
- ◆ Developing a reference automatic speech recognition system based on hidden Markov modelling and SpeechDat-Slovak database.
- ◆ Developing a reference spoken language dialogue system based on Galaxy II hub architecture and VoiceXML dialogue management.
- ◆ Developing an experimental automatic voice service "Departmental telephone numbers directory" based on VoiceXML accessible through PSTN.

Title of the Project: *MOBILTEL - Mobile Multimodal Telecommunications Systems and Services***Funding:** APVT-20-029004**Duration:** 2005-2007**Co-ordinator:** prof. Ing. Anton Čižmár, CSc.**Group members:** Ľ. Doboš, J. Juhár, D. Levický, S. Lihan, M. Pleva, J. Papaj, M. Baboľ, S. Ondáš, M. Mirilovič**Scientific goals/research targets:**

The main goal of this project is the research and development in the area of mobile multimodal telecommunication systems, which allows access to information from different areas through mobile multimodal terminal and human - machine interaction with natural speech, with support of another mainly graphical modalities. The solution of the project is furthermore the goal of information exchange and acquisition of new knowledge from the area of the research, development and use of mobile telecommunication systems and services, automatic speech recognition, speech synthesis, automatic speech and multimodal dialog systems, network programming and other subjects according to the solving of the point of this project. The solution should have the following areas:

- ◆ In the area of speech pre-processing, analysis, synthesis and recognition it would be the exploring of new algorithms of extraction the features of the speech signal, which could lead us to more robust automatic speech recognition engines (ASR).
- ◆ In the area of multimodality and multimedia the research will be focused on possibilities of individual modalities implementation in to mobile multimedia devices and telecommunication terminals.

- ◆ In the area of multimodal dialog systems the research will be concentrated on dialog modelling and natural language processing (NLP) techniques, which are necessary for estimation of the natural Slovak language semantics and parsing.
- ◆ In the area of utilization of mobile telecommunication terminals, networks and their services research of possibilities of recent mobile infrastructures and their usability in task will be elaborated. Consideration will be focused to transfer rates and delays for individual solutions.
- ◆ In applications scope our work will be focused to implementation and evaluation of applications. Main goal will be activate mobile multimodal system in demonstrative mode, enabling communication with selected mobile terminal.

Title of the Project: *Towards Mobile Broadband Multimedia Networks*

Funding: COST 273

Collaboration with: academic and commercial research institutions and groups from 18 European countries

Duration: 2001-2005

Co-ordinator: doc. Ing. Ľubomír Doboš, CSc.

Group members: J. Juhár, A. Čižmár, M. Pleva, J. Goril, J. Novikmec

Scientific goals/research targets:

The main objective of the Action is to increase the knowledge on the radio aspects of mobile broadband multimedia networks, by exploring and developing new methods, models, techniques, strategies and tools towards the implementation of 4th generation mobile communication systems. It will consider frequencies ranging from the upper UHF up to millimetre waves, and data rates higher than 2 Mb/s (probably up to 155 Mb/s).

It is also expected that the Action will contribute to the deployment of systems that are very close to completion of their standardisation phase, in particular UMTS and HIPERLAN 2.

Results Achieved:

- ◆ Analysis Medium Access Control protocol for wireless ATM.
- ◆ Design and simulation of new Call Admission Control algorithm for wireless ATM networks.
- ◆ Analysis and simulation OFDM technique for high speed mobile communications.

Title of the Project: *Non-linear Speech Processing*

Funding: COST 277

Collaboration with: academic and commercial research institutions and groups from 15 European countries

Duration: 2001-2005

Co-ordinator: doc. Ing. Jozef Juhár, PhD.

Group members: D. Kocur, L. Doboš, A. Čižmár, S. Lihan, M. Lukáč, M. Pleva

Scientific goals/research targets:

- ◆ The ultimate objective of this Action is to improve the voice services in telecommunication systems through the development of new nonlinear speech processing techniques.
- ◆ The new technologies developed within the Action are to provide:
 - ◆ higher quality speech synthesis,
 - ◆ more efficient speech coding,
 - ◆ improved speech recognition, and
 - ◆ improved speaker identification and verification.
- ◆ The methods are expected:
 - ◆ to contribute significantly to the acceptance of voice interfaces for information systems such as the mobile Internet (by improved synthesis and recognition) and
 - ◆ to improve efficiency in future generations of speech coders used in wireless networks, including packet-based wireless networks.
- ◆ The Action intends to accomplish the stated goals by developing techniques based on nonlinear speech processing.

Results Achieved:

- ◆ A robust non-linear method for speech recognition in adverse environment has been studied with concentration on:
 - ◆ noise robust features extraction techniques,
 - ◆ noise immune auditory features and
 - ◆ noise-removal preprocessing techniques.

Title of the Project: *Biometrics-Based Recognition of People over the Internet*

Funding: COST 275

Collaboration with: academic and commercial research institutions and groups from 13 European countries

Duration: 2001-2005

Co-ordinator: doc. Ing. Jozef Juhár, PhD.

Group members: L. Doboš, A. Čižmár, S. Lihan, M. Pleva, M. Kováč, D. Levický, P. Varchol

Scientific goals/research targets:

- ◆ The main objective of the Action is to investigate effective methods for the recognition of people over the Internet based on voice and facial characteristics in order to facilitate, protect, and promote various financial and other services over this growing telecommunication medium.
- ◆ The main objectives can be specified as follows.
- ◆ To improve knowledge of the issues and problems involved.
- ◆ To study the current techniques for voice and face recognition and to evaluate their performance in the medium considered.
- ◆ To investigate methods for the fusion of the considered biometric data and the interpretation of the results.
- ◆ To analyse the implementation problems including user-interface issues and investigate effective solutions.
- ◆ To identify the potential applications and analyse the requirements of these.
- ◆ To develop standard methods and tools for the assessment of biometrics-based identification methods.

Results Achieved:

- ◆ Preparation of a review of biometrics-based recognition of people over the Internet is being in progress with stress on:
 - ◆ speaker recognition, verification and identification algorithms,
 - ◆ development tools and toolkits, that can be used and
 - ◆ Voice over IP transmission techniques and protocols.

Title of the Project: *Smart spoken language communication system*

Funding: S00034 / National programme for R&D "Building of information society"

Collaboration with: STU Bratislava, SAV Bratislava, ŽU Žilina

Duration: 2003-2006

Co-ordinator: doc. Ing. Jozef Juhár, PhD.

Group members: L. Doboš, A. Čížmár, D. Levický, S. Lihan, M. Pleva, M. Kováč, J. Papaj,
M. Baboľ, M. Lukáč, S. Ondáš, M. Mirilovič, P. Varchol, J. Gamec, I.
Gladišová

Scientific goals/research targets:

- ◆ The main objective of the project is research and development of a smart automated voice-interactive dialogue system, enabling the access to distributed information via conversational human-machine dialogue. The solution should have the the following main properties:
 - ◆ The dialogue system will enable spoken language interaction in Slovak.
 - ◆ Communication through PSTN, GSM and VoIP telecommunication network
 - ◆ The system will consists of I/O telephone unit, speech recognition unit, natural language understanding unit, dialogue management unit, natural language generation unit, speech synthesis module and module for communication with external database.
 - ◆ Open and modular architecture allowing further extensibility to other languages, modalities, and ability to modify them for different purposes.
 - ◆ The functionality of the system will be proved with minimal two pilot applications from two specific domains (e.g. telecommunications, traveling, ...).

Title of the Project: *Spectrum and Power Efficient Broadband Communications*

Funding: COST 289

Collaboration with: 15 partners from university, research and industrial institutions from 10 European countries

Duration: 2003-2007

Co-ordinator: prof. Ing. Dušan Kocur, CSc.

Group members: M. Drutarovský, P. Galajda, S. Marchevský, J. Čížová, J. Krajňák, L.
Longauer, L. Čopjan, P. Pavelka

Scientific goals/research targets:

- ◆ General Goal:
 - ◆ Design of new architectures of communication systems with intention to increase the capacity of communication systems within a specified transmission bandwidth with minimum available transmitter power, bearing in mind the cost effectiveness and the practical implementability of the system.
- ◆ Partial Goals:
 - ◆ Analysis of multiple access principles (e.g. CDMA, MC-CDMA, CC-CDMA, OFDM, etc.) with regard to design the 4G mobile communication systems and heterogeneous networks.
 - ◆ Design of sub-systems of the 4G mobile communication systems and heterogeneous networks, especially the multi-user receivers and interference canceller design.
 - ◆ Design of software defined radio architectures, mapping selected the software defined radio blocks into the high performance FPGAs.

Results Achieved:

- ◆ The analysis of the state of art of multi-user receivers for MC-CDMA transmission systems.
- ◆ The state of art of turbo blind multi-user receivers for CDMA transmission systems.
- ◆ Development of the detail design procedure of the microstatistic multi-user receivers for CDMA transmission systems.
- ◆ The analysis of the performance properties of the microstatic multi-user CDMA receiver under different communication scenario.
- ◆ The analysis of the state of art in the field of software defined radio.
- ◆ Theoretical description of relationships between a class of microstatistic filters and a class of piece-wise linear filters.

Title of the Project: Enginetest

Funding: industrial co-operation

Collaboration with: Medav GmbH (Germany)

Duration: 2004-2005

Co-ordinator: prof. Ing. Dušan Kocur, CSc.

Group members: M. Drutarovský,

Scientific goals/research targets:

- ◆ General Goal:
 - ◆ Development of methods for engine diagnostics based on advanced digital signal processing applications.

Results Achieved:

- ◆ Development of the knowledge database intent on engine diagnostics based on advanced digital signal processing applications.
- ◆ Development of the robust engine diagnostic methods based on the application of order analysis and non-linear digital signal processing.

Title of the Project: Packet-Oriented Service Delivery via Satellite**Funding:** COST 272**Collaboration with:** 16 research and industrial institutions from European countries**Duration:** 2001-2005**Co-ordinator:** prof. Ing. Stanislav Marchevský, CSc.**Group members:** D. Kocur, M. Drutarovský, P. Galajda, M. Gamcová, L. Maceková, S. Benčo, L. Longauer, M. Grega,**Scientific goals/research targets:**

- ◆ General Goal:
 - ◆ To contribute to the identification of key requirements, analysis, performance comparison, architectural design and protocol specification of future packet-oriented satellite communication systems, with a clear focus on Internet-type system concepts, applications and protocols/techniques on the various layers.
- ◆ Partial Goals:
 - ◆ the design of efficient receivers with low consumption for mobile terminals,
 - ◆ the design of low cost reconfigurable terminals
 - ◆ design and implementation multi-user detection receiver for CDMA signals from satellites,
 - ◆ to identify suitable models integrating Internet services and worldwide communication
 - ◆ to identify the tradeoffs between complexity and effectiveness for supporting QoS in multi-network environments using different media or networking technologies

Results Achieved:

- ◆ development of multi-user detection receivers for CDMA signals using FIR filters,
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- ◆ development of multi-user detection receivers for CDMA signals using blind adaptive filtering,
- ◆ development of detailed design procedure of optimum and sub-optimum microstatistic multi-user receivers for CDMA transmission systems,
- ◆ development of transport protocols for VoIP using satellite channels.

Title of the Project: Using *ICT technologies and new generation network platforms in education*

Funding: 2003 SP 20/028 01 04 / National programme for R&D “Building of information society”

Collaboration with: ŽU Žilina, STU Bratislava, SPU Nitra, UKF Nitra, ZCV Bratislava, SANET Bratislava, Asociácia projektu INFOVEK Bratislava, ELFA, s.r.o., Košice

Duration: 2003-2005

Co-ordinator: prof. Ing. Stanislav Marchevský, CSc. (WG3, WG7, WG10)
prof. Ing. Dušan Levický, CSc. (WG12)

Group members: V. Baláž, S. Benčo, Ľ. Čopjan, M. Drutarovský, P. Foriš, P. Galajda, A. Galajdová, M. Gamcová, J. Gamec, I. Gladišová, M. Grega, R. Hovančák, K. Harčarufková, P. Horovčák, Z. Klenovičová, D. Kocur, P. Košč, A. Lavrín, L. Michaeli, Ľ. Ovseník, R. Ridzoň, J. Šaliga, J. Turán

Scientific goals/research targets:

- ◆ Proposal of new pedagogical approaches and proposal of innovation methodology for e-learning, e-consulting and cooperative work based on effective and optimal using new generation ICT and converged telecommunication and IP networks (included proposal of necessary changes of Ministry of education, SR regulations).
- ◆ Proposal of conception of integrated virtual hardware platform for e-learning, e-consulting and cooperative work based on new generation ICT and converged telecommunication and IP networks and its pilot implementation.
- ◆ Proposal and development of software tools (environs) for management, administration and implementation of courses and application of e-learning, e-consulting and cooperative work in environment of designed integrated virtual platform.
- ◆ Proposal of security techniques for e-learning

Results Achieved:

- ◆ Design of new conceptions and structures of possible type architectures of hardware platforms and software platforms (configurations) for e-learning, e-consulting and e-

cooperative work implemented in converged technologies and NGN environment with taking account and using:

- Properties and capabilities of new generation technology and network platforms
- Variability from point of view of different type of technologies: fixed, mobile, and satellite

- ◆ Methods for network security in LMS in e-learning
- ◆ Development of methodology for authentication and autorification of education material based on digital watermarking
- ◆ Development and implementation of pilot platform for e-learning, e-consulting and cooperative work (HW, SW configuration, ICT infrastructure)

Title of the Project: *The algorithms of standard videocodecs H.263 and MPEG-4*

Funding: VEGA, 1/0384/03

Duration: 2003-2005

Co-ordinator: prof. Ing Ján Mihalík, Ph.D.

Group members: J. Zavacký, I. Gladišová, M. Dulina, V. Michalčín, R. Štefanišin, M. Kasár

Scientific goals/research targets:

The research of algorithms of standard videocodecs H.263 and MPEG-4 for purpose of implementation of videocommunications and multimedia services in heterogenous telecommunication networks with very low bit rates. There are supposed new algorithms of vector quantization of video and texture of videoobjects in domain of DCT or wavelet transform. Next, effective algorithms of arithmetic encoding of binary shapes of videoobjects also chain coding their contour representations. Then precise algorithms of motion estimation with variable block size and mesh based with bilinear or affine transformation. Further, modelling and animation of human head on the basis of algorithms of its calibration, deformation, estimation three-dimensional motion and animation parameters, also generation and projection of its texture on wireframe model. Going on in morphing of the texture by using of algorithms of scatter data spline interpolation. Finally shape generalized DCT and wavelet representations of the texture of videoobjects.

Title of the Project: *Metrological Quality Enhancement of the Analog to Digital Interfaces by the Digital Signal Processing Methods***Funding:** VEGA, 1/2180/05**Duration:** 2005-2007**Co-ordinator:** prof. Ing Linus Michaeli, DrSc.**Group members:** J. Šaliga, V. Pirč, P. Galajda, M. Drutarovský, M. Kollár, P. Michalko, Ľ. Horniak, Sz. Csernok, P. Cabúk, V. Frolek, P. Mikulík**Scientific goals/research targets:**

- ◆ The project objective is the improvement of the metrological properties of the measuring system converting analogue signal to its digital representation. The research will be focused on the following represent ants of the analog-to-digital converters.
- ◆ Low passes analog-to digital converters.
- ◆ Sigma-delta converters of the selected parameters modulated in the high frequency signal or converters of measured physical quantity to the number.
- ◆ The common effort is the study of the testing methods in the end-user laboratories and methods enhancing their accuracy. The main research effort is splitted into three research areas:
 - ◆ Fast ADC testing methods based on the known error model convenient for the testing of the DAQ boards and their traceability to the standardised approaches.
 - ◆ Digital signal processing methods for ADC error reduction. The proposed algorithm will be utilised time redundancy in the data flux and implementation of the appropriate filters for dynamic resolution enhancement.
 - ◆ Design of the methods for the band-pass sigma-delta ADC testing for demodulation of software radio signals and sigma delta structures for physical quantity sensors.

Title of the Project: *Summer school on "Data Acquisition systems"***Funding:** SOCRATES (EUR 15000)**Collaboration with:** Italy, Hungary, Czech Republic.**Duration:** 2005-2006**Project subcoordinator:** prof. Ing Linus Michaeli, DrSc.**Group members:** J. Šaliga,**Scientific goals/research targets:**

The IP course is aimed on the preparation graduates in the hardware and software design of the Data Acquisition Systems integrated with the computerized information environment.

It allows achieving the requirements of industrial partners for graduates skilled in the relevant field for the organisation according to TQM. The project meets needs of highly qualified graduates, able to work in multinational teams.

Results Achieved:

- ◆ Student's skills how to design Data Acquisition Systems using modern approaches from the area of information and communication technologies.
- ◆ Knowledge about metrological parameters of DAQ according to actual International standards and inform them about ambiguity of the interpretation among various producers.
- ◆ Student's skills in the simple testing methods for metrological parameter assessment coherent with ISO standards
- ◆ Production teaching materials for students and teacher related with Data Acquisition Systems.

Title of the Project: *Fibre Optic Sensors*

Funding: Institutional grant, G - 4442

Duration: 2003-2005

Co-ordinator: prof. RNDr. Ing Ján Turán, DrSc.

Group members: J. Gamec, R. Gaňová, P. Filo, P. Serfőző, L. Ovseník, J. Študenc

Collaboration with:

- ◆ prof. E.F. Carome, John Carrol University, Cleveland, USA

Scientific goals/research targets:

- ◆ Development *Fiber Optic Refractometer* remotely controlled through WWW.
- ◆ Development *Optically Powered Fiber Optic Sensor* with frequency output.
- ◆ *Multiplex* in optically powered fiber optic sensor.

Results Achieved:

- ◆ Fiber optic refractometer as:
 - ◆ laboratory equipment;
 - ◆ portable equipment;
 - ◆ monitoring equipment.
- ◆ GUI for refractometer control through WWW.
- ◆ Optically powered fiber optic sensory system with low power consumption.

Title of the Project: Transform Systems for Digital Image Processing

Funding: VEGA 1/0381/03

Duration: 2003-2005

Co-ordinator: prof. RNDr. Ing Ján Turán, DrSc.

Group members: J. Gamec, R. Gaňová, P. Filo, P. Serfőző, L. Ovseník, J. Študenc

Collaboration with:

- ◆ prof. K. Fazekas, TUB, Budapest, Hungary
- ◆ prof. A. Figuieras and Prof. J. Cid-Sueiro, University Carlos III, Madrid, Spain
- ◆ prof. J. Tasic, TU Ljubljana, Slovenia
- ◆ prof. T. Adam, Technical University, Miskolc, Hungary
- ◆ prof. M. Najim, University Bordeaux, France
- ◆ prof. K. Skala, University Zagreb, Croatia
- ◆ prof. M. Ansorge, University Neuchâtel, Switzerland

Scientific goals/research targets:

- ◆ Development new methods for invariant feature selection based on hybridisation of fast translation invariant transforms (CT, RT and NT) with Radon or Hough Transform.
- ◆ Development, implementation and experimental verification of new invariant image recognition systems based on feature selection-using hybridisation of CT with Radon or Hough Transform.
- ◆ Study properties of Trace Transform and int application to image processing.
- ◆ Study new applications of Hough Transform (robust system identification, metrology problems and signal processing).

Results Achieved:

- ◆ Development new methods for invariant feature extraction based on CT, RT, NT, Radon and Hough Transform.
- ◆ New Continuous Kernel Hough Transform (CKHT) and its application to feature extraction and system parameters estimation.
- ◆ System parameters estimation tool based on CKHT.
- ◆ Motion estimation based on inverse rapid transforms.
- ◆ Invariant associative memory based on STIR transforms.
- ◆ 3D-object recognition system based on using RT for reflected acoustic waves analysis.
- ◆ Invariant image recognition systems based on hybridisation of RT, NT with Hough and Radon transform.

Title of the Project: *Information and Knowledge Management for Integrated Media Communication***Funding:** COST 276**Collaboration with:** France, Italy, Norway, Hungary, Spain, Slovenia (Project coordinator: Prof. J. Tasic, University of Ljubljana), Greece, Switzerland, Croatia, Czech Republic, Portugal, Romania, Turkey, Ireland.**Duration:** 2001-2005**Co-ordinator:** prof. RNDr. Ing Ján Turán, DrSc.**Group members:** J. Gamec, R. Gaňová, P. Filo, P. Serfőző, Ľ. Ovseník, J. Študenc**Scientific goals/research targets:**

- ◆ Development advanced multimedia data and knowledge management technologies for personal systems and services, including specific signal processing and implementation techniques.

Results Achieved:

The work is ongoing in Working Groups:

- ◆ WG.1: Multimedia information, knowledge management and data management;
- ◆ WG.2: Agent architectures for agent communication and agent mobility;
- ◆ WG.3: Technologies for user interface personalisation;
- ◆ WG.4: Dedicated advanced methods for signal, video, speech and sound processing and coding.
- ◆ Our research group will focus on the development of advanced methods for image processing based on the use of fast, linear and non-linear selected transforms (CT, RT, Hough, Radon, Trace, Mojette Transform) and GUI design for teleworking and teleeducation applications.

Title of the Project: *Multimedia Signal Processing***Funding:** Bilaterally project Slovak Republic - Serbia and Monte Negro No.1/2004**Collaboration with:** prof. Dr. Zoran Bojkovic, University of Belgrade, Serbia and Monte Negro**Duration:** 2004-2005**Co-ordinator:** prof. RNDr. Ing Ján Turán, DrSc.**Group members:** Z. Bojkovic, Ľ. Ovseník, A. Samcovic**Scientific goals/research targets:**

- ◆ Development transform based digital image processing methods.
 - ◆ Development multimedia signal processing methods.
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Results Achieved:

- ◆ New multimedia signal processing methods for coding, streaming and watermarking.
- ◆ Algorithms for Video based surveillance systems.
- ◆ Signal processing with Hough and Trace Transform.
- ◆ Transform based invariant feature extraction.

Title of the Project: *Semantic Multimedia Analysis of Digital Media***Funding:** COST 292

Collaboration with: Hungary, United Kingdom (Project coordinator: prof. Dr. E. Izquierdo, Queen Mary College, University of London), Portugal, Spain, Italy, Serbia and Montenegro, Finland, Greece, Turkey, France, Germany, Belgium, Ireland, Norway, Austria, Croatia, Netherlands.

Duration: 2004-2008**Co-ordinator:** prof. RNDr. Ing Ján Turán, DrSc.

Group members: J. Gamec, I. Gladišová, P. Filo, J. Futó, Ľ. Maceková, S. Marchevský, Ľ. Ovseník, T. Straka, J. Študenc

Results Achieved:

The work is ongoing in Working Groups:

- ◆ WG.1: Common Testing Data and Framework.
- ◆ WG.2: Image and Video Segmentation, Shot Analysis and Key Frame Extraction, Efficient Extraction of Standardized Features.
- ◆ WG.3: Reduction of the Dimension of the Feature Space and Multimodal Feature Fusion.
- ◆ WG.4: Automatic Paradigms for Semantic Annotation.
- ◆ WG.5: Semi-automatic Paradigms for Semantic Annotation.
- ◆ WG.6: Applications.
- ◆ WG.7: JPSearch.
- ◆ Our research group will focus on the development of advanced methods for digital image and video signal processing based on extraction of Low-level invariant transform and colour features; applications: coding of enriched and smart content and visualization.

Title of the Project: *Orthographic and orthoepic transcription of car-speech database.*

Funding: industrial co-operation

Collaboration with: Škoda auto, a.s., Mladá Boleslav

Duration: 01 – 04. 2005

Co-ordinator: Ing. Slavomír Lihan, PhD.

Group members: J. Juhár, A. Čižmár, L. Doboš, M. Pleva, M. Mirilovič, P. Varchol, S. Ondáš, J. Pastírik

Scientific goals/research targets:

- ◆ The main objective was to identify and transcribe content of speech recordings collected in car. Transcribed recordings are aimed for training of speech recognition system used in car. Transcriptions were created and stored in separate text files, which contain an orthographical transcription with marked non-speech events caused by speaker or by external sources of noise. A lexicon file containing orthoepic (phonetic) transcription of all words in the examined speech database was created. A number of tasks had to be solved:
 - ◆ suppose way of identifying and transcribing all important information carried by speech signal, which is important for setup of speech recognition system
 - ◆ create tools for automatic generation of phonetic transcription

EQUIPMENTS

Teaching and Research Laboratories and Special Measuring Instruments and Equipment.

<i>Laboratory</i>	<i>Equipment</i>
ATM Laboratory	ATM Laboratory Network, ATM Switch.
DSP Laboratory	Hardware and software development tools (floating licenses) for Analog Devices fixed-point digital signal processors ADSP218x, ADSP219x and ADSP2153x, ADSP2156x Blackfin DSPs development boards, TAG emulators, video extenders. The laboratory is supported by the Analog Devices University program (www.kemt.fei.tuke.sk/adsp).
Laboratory of Measurement	Hardware and software development tools for Altera FPGAs, UP-1, UP-3, NIOS and Stratix DSP development boards. The laboratory is supported by the Altera University program (www.kemt.fei.tuke.sk/fpga).
Laboratory of Embedded Microcontrollers	Laboratory of Measurement (Special precise measurement system for dynamic ADC testing. Testing stand is equipped by calibrated Stanford Research DS 360, Data acquisition system with software tools based on LabWindows/CVI for ADC parameter estimation according to IEEE 1057, IEEE 1241 Std). Data Acquisition Systems controlled by LabVIEW for laboratory and industrial virtual measurement based on Allan Bardley HW components.
Laboratory of Optoelectronics	Development tools for single chip Analog Devices ADuC 83x MicroConverters (Intel 8052 compatible), Microchip PIC microcontrollers, Cypress PSOC mixed-signal array microcontrollers, embedded Altera RISC soft processor NIOS II.
Laboratory of TV System	Development tools for optical fibre communications training systems and optical desk with He-Ne laser.
Laboratory of Microwave Technology	Special TV system for teaching.
Laboratory of Speech Technology for Telecommunications	Development tools for microwave training systems.
Laboratory of Mobile Communication Technology	Development tools for automatic speech recognition systems and automatic voice services in telecommunications and Internet.
	CISCO Aironet 1310 Wireless Bridges, CISCO Aironet 1200 Access Points, CISCO Aironet 350 Wireless LAN Adapters

CO-OPERATION

Co-operation in Slovakia

<i>Institution</i>	<i>Type of activity</i>
Slovak Telecom Bratislava	Research, Leonardo
Alcatel SEL Liptovský Hrádok	Leonardo
Siemens Software House Bratislava	Leonardo
Ericsson Slovakia	Leonardo
Telenor Slovakia	Leonardo
Alcatel Business System Bratislava	Leonardo
VSE, Košice	Research
Volkswagen Slovakia a.s.	Development and education
Slovak Academy of Science	Research and development

International Co-operation

<i>Institution</i>	<i>Type of activity</i>
Alcatel SEL Stuttgart	Leonardo
Siemens Viena	Leonardo
UPC Barcelona	Leonardo
Politecnico di Torino	Leonardo
Loracom France Nancy	INCO/COPERNICUS
University of Catania Italy	INCO/COPERNICUS
University of Mining and Metallurgy Krakow	INCO/COPERNICUS, JOINT
MEDAV GmbH, Germany	Bilateral Contract
Technical University Ilmenau Germany	SOCRATES
Technical University Budapest	COST
Technical University of Ljubljana	COST
Technical University of Delft	COST
Technical University of Cluj-Napoca	COST
University of Firenze Italy	COST
University of Gent	COST
University of Maribor	COST
INESC Lisabon	COST
University of Sannio Italy	Leonardo / SOCRATES
University of Reggio Di Calabria Italy	Leonardo / SOCRATES
University of Mediteranea Italy	SOCRATES
Universite Jean Monnet-Saint-Etienne France	SOCRATES
ŠkodaAuto Mladá Boleslav, Czech Republic	Bilateral Contract

FACULTY ESSAYS

Čižmár Anton

Full professor

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

Čížová Jana

Research assistant

Her research interests include spread spectrum communication systems, CDMA systems, and multi-user detection receivers.

Doboš Ľubomír

Associated professor

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

Drutarovský Miloš

Associated professor

His research interests include applied cryptography, digital signal processing (digital filters and order spectral analysis), algorithms and architectures for embedded cryptographic architectures, digital signal processors, FPGAs and soft microcontrollers embedded into the FPGAs.

Galajda Pavol

Associated professor

His research interest is in nonlinear circuit's theory, CHAOS in spread spectrum communication systems, Software Defined Radio (SDR) and programmable logic devices-ALTERA and FPGA circuits.

Gamec Ján

Assistant 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.

Hovančák Rastislav*Assistant professor*

His research interests are in the digital watermarking, multimedia communications and cryptography.

Hroncová Ingrid*Research assistant*

Her professional area of interests is digital signal processing, digital speech processing, transform coding and metropolitan area networks.

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 transmission systems and digital signal processing.

Levický Dušan*Full professor*

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

Lihan Slavomír*Assistant professor*

His research interests are in digital speech processing and transmission, automatic speech/speaker recognition, speech synthesis, and application of speech technologies in automatic voice services in telecommunications..

Maceková Ľudmila*Research assistant*

Her general research interest includes design and implementation algorithms for two and three-dimensional filters for image processing.

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 converters and methods for correction of their uncertainties.

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 PSTN, mobile, ISDN, ATM telecommunication networks and Internet on the basis of the standards.

Ovseník Ľuboš*Assistant professor*

His general research interests include fiber optics, fiber optical sensors and the fiber optical application in the microwave domain.

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.

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.

Zavacký Jozef*Assistant professor*

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

Ph.D. STUDENTS

<i>Name</i>	<i>Supervisor</i>	<i>Degree Course</i>
First year of study		
<u>Internal form:</u>		
Ing. Miroslav Katrák	Juhár	Telecommunications
Ing. Henrieta Palubová	Galajda	Infoelectronics
Ing. Peter Patlevič	Doboš	Telecommunications
<u>External form:</u>		
Ing. Sakhia Darjan	Čižmár	Telecommunications
Ing. Ľubomír Horniak	Michaeli	Measurement technique
Ing. Renáta Nováková	Levický	Telecommunications
Ing. Milan Rusko	Juhár	Telecommunications
Ing. Tomáš Straka	Turán	Infoelectronics
Ing. Peter Želinský	Galajda	Infoelectronics
Second year of study		
<u>Internal form:</u>		
Ing. Ľubomír Čopjan	Marchevský	Telecommunications
Ing. Michel Mirilovič	Čižmár	Telecommunications
Ing. Stanislav Ondáš	Juhár	Telecommunications
Ing. Pavol Pavelka	Galajda	Electronics
Ing. Lenka Sochová	Michaeli	Measurement technique
Ing. Anton Štofa	Doboš	Telecommunications
Ing. Peter Varchol	Levický	Telecommunications
<u>External form:</u>		
Ing. Pavol Cabúk	Michaeli	Measurement technique
Ing. Marek Domaracký	Levický	Telecommunications
Ing. Imrich Harčár	Šaliga	Measurement technique
Ing. Štefan Lipovský	Doboš	Telecommunications
Third year of study		
<u>Internal form:</u>		
Ing. Renáta Gaňová	Turán	Electronics
Ing. Miroslav Kasár	Mihalík	Telecommunications
Ing. Jozef Krajňák	Kocur	Electronics
Ing. Radovan Ridzoň	Levický	Telecommunications
<u>External form:</u>		
Ing. Miroslav Baboľ	Čižmár	Telecommunications
Ing. Peter Chochol	Marchevský	Telecommunications
Ing. Slavomír Pillar	Marchevský	Telecommunications
Ing. Martin Lukáč	Juhár	Telecommunications
Ing. Péter Serfozo	Turán	Electronics
Ing. Jozef Študenc	Turán	Electronics
Fourth year of study		
<u>Internal form:</u>		
Ing. Peter Foriš	Levický	Telecommunications
Ing. Marián Grega	Marchevský	Telecommunications

Ing. Peter Michalko	Michaeli	Measurement technique
Ing. Martin Šimka	Drutarovský	Electronics
<u>External form:</u>		
Ing. Szabolcz Csernok	Šaliga	Measurement technique
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