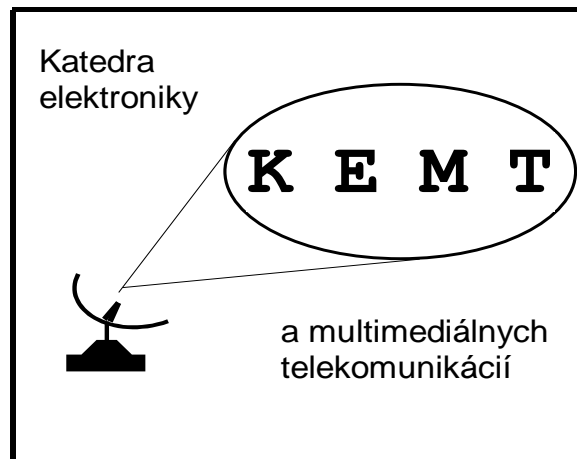

DEPARTMENT OF ELECTRONICS AND MULTIMEDIA TELECOMMUNICATIONS



Annual Report

2001

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 2001

Edited by Ľuboš Ovseník

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1. 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 changed 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 changed 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.

2. DEPARTMENT STAFF AND STRUCTURE

Total number of staff members is 26.

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

- ◆ Associated Professors: Ľubomír Doboš, Miloš Drutarovský, Dušan Kocur, Jozef Juhár

- ◆ Assistant Professors: Pavol Galajda, Ján Gamec, Mária Gamcová, Iveta Gladišová, Zita Klenovičová, Emil Matúš, Ľuboš Ovseník, Ján Šaliga, Jozef Zavacký

- ◆ Research Assistant: Ingrid Hroncová, Ľudmila Maceková

- ◆ Support staff: František Botta, Pavlina Chocholová, Božena Marchevská, Jozef Lenárt, Viera Šumáková

- ◆ Ph.D. students: **Internal form:** Martin Bača, Martin Benča, Jana Čížová, Pavel Farkaš, Roland Holzer, Rastislav Hovančák, Martin Kollár, Slavomír Lihan, Viktor Michalčín, Matúš Pleva, Peter Radoczi, Dana Šiškovičová, Radoslav Štefanišin, Stanislav Šurin

External form: Jalal Mahmood Abdulghafoor, Stanislav Benčo, Alena Galajdová, Mária Gamcová, Gyongyike Gebeová, Jozef Goriľ, Peter Chochol, Ľudovít Hintoš, Ľubomír Horniak, Miloš Kováč, Marián Krivda, Leoš Longauer, Stanislav Matis, Ali Omer Mohamoud, Jozef Novikmec, Ján Papaj, Marcel Pavlík, Anastázia Pavlíková, Slavomír Pillár, Vladimír Settey, Richard Strelák, Pavol Švač, Anton Vlasatý, Miroslav Žirko

3. DIVISIONS OF THE DEPARTMENT

◆ Laboratory of Multimedia Communications

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Research Assistant:

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◆ Laboratory of Digital Signal Processing and Satellite Communications

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

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

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

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◆ **Laboratory of Optoelectronic Communications**

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◆ **Laboratory of Electronic Circuits & Measurement**

Head: prof. Prof. Ing. Linus Michaeli, CSc.

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4. COURSES

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.

Bachelor Degree Course (title BcC.) – 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.

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.

5. LIST OF SUBJECTS TAUGHT

Master Degree Course (Ing.)

<i>Subjects</i>	<i>Hours/Week Lecture/Seminar</i>	<i>Lectures</i>
2nd year of study:		
Electronic Devices and Systems	3/2	Galajda
Electronic Devices	3/3	Galajda
3rd year of study:		
Transmission of Information in Electroenergetics	2/2	Čižmár
Analog Electronic Systems	2/2	Zavacký
Electronic Systems	3/2	Galajda
Linear Analog Circuits	4/3	Kocur
Microwave Technology	3/2	Gamec
Digital Electronics	3/2	Levický
Electronic Devices	3/3	Gamec
Digital Communication Systems	3/3	Levický
Non-Linear Analog Circuits	4/3	Michaeli
Signals and Systems	3/3	Zavacký
Design of Electronic Equipment	3/2	Doboš
Acoustics	3/2	Juhár
4th year of study:		
Radioelectronic Measurement	3/3	Šaliga
Electronics Systems with Microprocessors	3/2	Matúš
Digital Signal Processing	3/3	Mihalík
Optoelectronics	3/2	Turán
Switching Systems	3/2	Marchevský
Coding and Modulation	2/2	Čižmár
Semestral Projects	0/2	Marchevský
Digital Transmission Systems	3/2	Čižmár
Signals Processors in Telecommunication	3/2	Drutarovský
TV Systems	3/2	Marchevský
Analog & Digital Interfaces	3/2	Michaeli, Šaliga
Optoelectronic Communications Systems	3/2	Turán
Digital Filtering	3/2	Kocur
Applied Cryptography	2/2	Levický
Digital Audio Processing and Transmission	3/2	Juhár
Programmable Integrated Circuits	2/2	Galajda, Drutarovský
5th year of study:		
Photonics	3/2	Turán
Medical Electronics	3/2	Michaeli
Sensor Systems	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

Undergraduate Study (Bc.)

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	Zavacký
Digital Electronics	3/2	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	Marchevský
Measurement in Telecommunications	3/2	Šaliga
Optoelectronic Communications Systems	3/2	Turán
Videocommunications	3/2	Mihalík
Telecommunications Services	3/2	Čižmár
Management of Telecom. 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

<i>Subjects</i>	<i>Hours/Week Lecture/Seminar</i>	<i>Lectures</i>
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
Adaptive Signal Processing	3/2	Kocur
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 Audio Processing and Transmission	3/2	Juhár
Distributed Virtual Instrumentation	3/2	Michaeli
Photonics	3/2	Turán
Semestral Projects	0/5	Marchevský

6. RESEARCH AND PROJECTS

Title of the Project: *Spread-Spectrum Systems and Techniques in Wireless and Wired Communications*

Funding: COST 262

Collaboration with: 18 research and industrial institutions from European countries

Duration: 1999-2002

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

Group members: D. Kocur, M. Drutarovský, P. Galajda, S. Marchevský, S. Benčo, V. Čarnorgurský, J. Čížová, R. Zetík

Scientific goals/research targets:

◆ General Goal:

- ◆ to increase the knowledge of spread-spectrum techniques and applications for any wireless and wired system and to propose common products and methods for a variety of possible applications

◆ Partial Goals:

- ◆ Investigation of any spread-spectrum application, a classification and registration of common features and differences. A tutorial on existing techniques and standards will be given as a result of this activity.
- ◆ Spread-Spectrum systems architectures and modulation concepts (direct-sequence spread-spectrum, frequency-hopping, time hopping, hybrid spread-spectrum methods).
- ◆ Receiver implementation for spread-spectrum communication systems.
- ◆ Equalisation and interference rejection in spread-spectrum communication systems.

Results Achieved:

- ◆ Preparation of a review of basic spread-spectrum systems architectures and modulation concepts is being in progress with stress on:
 - ◆ non-linear adaptive CDMA receivers,
 - ◆ chaos application in spread spectrum communication systems,
 - ◆ analysis of spread spectrum method applications in steganography,

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, M. Marcinek, M. Pleva, S. Matis

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 apply 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.
- ◆ Creation an experimental automatic voice service "Departmental telephone numbers directory" based on VoiceXML and through IP/H323 network.

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, CSc.

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

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:

Robust non-linear methods 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, CSc.

Group members: L. Doboš, A. Čižmár, S. Lihan, M. Pleva, M. Kováč

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: *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: *Mobile computing for telematic services***Funding:** INCO/COPERNICUS PL 961 114**Collaboration with:**

- ◆ LORACOM Institute - University of Nancy, France
- ◆ Department of Telecommunications - University of Mining and Metallurgy Krakow, Poland
- ◆ Department of Communication System - University of Catania, Italy
- ◆ Department Electronics and Multimedia Communication, Technical University of Košice
- ◆ Foundation for Progressing Telecommunications - Krakow, Poland

Duration: 1998-2000

- ◆ Project was successfully finished with presentation in Brussels in 2001.

Co-ordinator: Prof. Ing. Anton Čižmár, CSc.**Group members:** D. Levický, L. Doboš, J. Juhár, R. Palitefka**Scientific goals/research targets:**

- ◆ Evaluation of the possibility of data and multimedia services provision in cellular and ATM radio network.
- ◆ Evaluation of the possibility of isochronous and multimedia services provision in cellular and ATM radio network.
- ◆ Study of management and control mechanism which are targeted to ensure provision of telematic services at highest possible QoS through simulation and analytical modelling.
- ◆ Selection and specification services offered in wireless network.
- ◆ Specification of field trials in term of users services, application and infrastructure.
- ◆ Development of telematic services for health and education.
- ◆ Testing of telematic services in field trials.

Results Achieved:

- ◆ To evaluate the possibility of provision of isochronous and multimedia services in wireless LANs including IEEE 802.11, HIPERLAN.
- ◆ To evaluate the possibility of provision of data and multimedia services in digital cellular radio networks (GSM, DCS).
- ◆ To evaluate the possibility of provision of data and multimedia services in wireless ATM networks.
- ◆ Project was successfully finished with presentation in Brussels.

Title of the Project: TELEHUMAN - Human Resource Support for Managing Modern Telecommunications Broadband Networks

Funding: Leonardo da Vinci No: SK/98/2/06420/PI/II.1.1.c/CONT

Collaboration with: ELFA - Košice, DEMOS – Paris, ZEUS – Brussels, INFO CONSULT – Klagenfurt, IDEC – Piraeus, SOL – Sion

Duration: 1999 – 2001

Project manager: Prof. Ing. Anton Čížmár, CSc.

Group members: J. Juhár, Ľ. Doboš, D. Levický, A. Lavrin

Scientific goals/research targets:

- ◆ The project represents vocational training in the managing broadband telecommunications networks

Results Achieved:

- ◆ The preparation of the modules:
 - ◆ Improvement of Quality and Quality Management of Telecommunications Services
 - ◆ Communication Network Planning and Restoration
 - ◆ Broadband Network Services
- ◆ Project successfully finished.

Title of the Project: DEPSIS – Distance Education Programme for Staff

Funding: Leonardo da Vinci No: SK/99/2/07003/PI/II.1.1.c/FPC

Collaboration with: ELFA - Košice, INFO CONSULT – Klagenfurt, IDEC – Piraeus, FerUni – Hagen, ICT TU - Košice

Duration: 1999 – 2000

Project manager: Prof. Ing Anton Čížmár, CSc.

Group members: J. Juhár, Ľ. Doboš, D. Levický, Z. Havlice

Scientific goals/research targets:

- ◆ The project represents vocational training in the managing of complex IS in broadband telecommunications networks

Results Achieved:

- ◆ The preparation of the modules:
 - ◆ Information projects in practise,
 - ◆ Information system development,
- ◆ Project successfully finished.

Title of the Project: JOINT – Joint International Training Module on Communications Techniques

Funding: Leonardo da Vinci No: PL/99/2/09015/PI/II.1.1.c/FPC

Collaboration with: AGH – Cracow, Loracom – Nancy, CEPS - Luxembourg

Duration: 2000 – 2001

Project manager: Prof, Ing Anton Čižmár, CSc.

Group members: J. Juhár, Ľ. Doboš, D. Levický, M. Marcinek, S. Lihan

Scientific goals/research targets:

- ◆ The main aim of the project is to develop and propose set of courses targeted towards dissemination of basic and contemporary knowledge on information and telecommunication structure for SMEs.
- ◆ Project successfully finished.

Title of the Project: *Multimedia processing, transmission and watermarking* Funding:

Institutional grant

Duration: 2000-2002

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

Group members: A. Čižmár, E. Matúš, S. Marchevský, D. Kocur, M. Drutarovský, J. Juhár, L. Doboš, Z. Klenovičová, M. Gamcová, Ľ. Maceková, M. Čandík, R. Hudec, R. Lukáč, P. Radoczi, Cs. Stupák

Scientific goals/research targets:

- ◆ Design of new methods for digital watermarks implementation in multimedia.
- ◆ Innovation of speech data base for Slovak language for speech recognition.
- ◆ Applications of spread spectrum principle for wireless and mobile systems.

- ◆ Analysis of methods for digital image filtering based on neural networks.

Results Achieved:

- ◆ Implementation of digital watermarking into digital images bit planes.
- ◆ Design of the new method for block matching motion estimation in digital image sequence coding.
- ◆ Analysis of method for mobile internet access over UMTS.
- ◆ Simulation of Frame Relay Networks.
- ◆ Design of adaptive order-statistic LMS filters.
- ◆ Application of Volterra filter in DS-SS techniques.

Title of the Project: *Digital Signal Processing and Watermarking in Multimedia Communications*

Funding: VEGA 1/8130/01

Duration: 2001-2003

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

Group members: A. Čižmár, E. Matúš, S. Marchevský, D. Kocur, M. Drutarovský, J. Juhár, Ľ. Doboš, Z. Klenovičová, M. Gamcová, Ľ. Maceková, M. Čandík, P. Radoczi, M. Marcinek, R. Lukáč, R. Hudec

Scientific goals/research targets:

- ◆ Design of the new methods for image coding and digital image watermarking in information technologies for multimedia communications.
- ◆ Design of the new method for speech coding, speech recognition and audio watermarking.
- ◆ Design of the new methods for digital image filtration from point of view digital image processing and watermarking.

Results Achieved:

- ◆ Design and verification of digital watermarking in wavelet transform domain.
- ◆ Analysis of influence of noise corruption to image watermarking in DCT domain.
- ◆ Design of method for digital watermarks in colour images.
- ◆ Design of the automatic recognition system Slovak speech database by using phoneme based ASR.
- ◆ Design of LUM smoothers for digital image filtration and for impulse detector.
- ◆ Design of center – weighted median filters.

- ◆ Non-linear Volterra filter application in spread spectrum communication.
- ◆ Chaos application in spread spectrum communication systems.

Title of the Project: *TEMPUS TELEEDUCA*

Funding: IB – JEP – 13004 - 98

Collaboration with:

- ◆ Slovak Technical University in Bratislava (STU Bratislava) – co-ordinator and contractor
- ◆ Technical University in Košice (TU Košice)
- ◆ University of Transport and Communication in Žilina (UTC Žilina)
- ◆ Universitat Politecnica de Catalunya in Barcelona (UPC Barcelona)
- ◆ Universitat Oberta de Catalunya in Barcelona (UOC Barcelona)
- ◆ Politecnico di Torino
- ◆ Slovak Telecom Bratislava
- ◆ Ministry of Transport, Post and Telecommunications of Slovak Republic
- ◆ Ministry of Interior of Slovak Republic
- ◆ Siemens Nixdorf Information Systems & Siemens Software House Bratislava
- ◆ Siemens Vienna
- ◆ Alcatel SEL A.G. Stuttgart
- ◆ Alcatel SEL TLH Liptovský Hrádok
- ◆ Telenor Slovakia
- ◆ Ericsson Slovakia

Duration: 1999 - 2001

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

Scientific goals/research targets:

- ◆ The built up network of project partners as an Institution for Distance Education and Teleteaching.
- ◆ Development and provide courses for Distance Education and Teleteaching focused on training of civil servants of state administration offices and staff of state institutions.

Results Achieved:

- ◆ Development of the following courses MULTIMEDIA (Technologies, Networks, European Standards, Recommendations and Rules and Process of their Implementation into the Slovak Information Infrastructure).

- ◆ Development of the following courses INFORMATION SYSTEMS (Applications in State Administration).

Title of the Project: *The Methods of Digital Image Processing for Videocodecs with Very Low Bit Rate.*

Funding: VEGA, 1/7387/20

Duration: 2000-2002

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

Group members: J. Zavacký, I. Gladišová, M. Dulina, R. Labovský, I. Kuba, M. Kapinos, P. Drább, V. Michalčín

Scientific goals/research targets:

- ◆ New methods of digital image processing for applications in videocodecs with very low bit rate.

Results Achieved:

- ◆ Neural network architectures for vector prediction and vector quantization of images.
- ◆ A new efficient method of resampling of image by block-base interpolation or decimation with compensation.
- ◆ Decreasing of bit rate of lattice vector quantizers by using entropy coding.
- ◆ Design of QMF filter banks in time domain satisfying perfect reconstruction property.
- ◆ Interframe prediction of video by using motion compensation.

Title of the Project : *Hardware implementation of unconventional analogue-to-digital interfaces and their error corrections*

Funding: VEGA, 1/3207/96

Duration: 1999 – 2001

Co-ordinator: Prof. Ing Linus Michaeli, CSc.

Group members: V. Pirč, V. Špány, J. Šaliga, P. Galajda, V. Sedlák, P. Mikulík, A. Galajdová, R. Holzer

Research activity of the group is concentrated on:

The effort of the research performed is focused on the following representatives :

- ◆ ADC and DAC as a quantisator of one analogue input parameter.
- ◆ Classifier of measuring signals carrying more parameters based upon hardware implemented neural networks.

- ◆ Flip-flop switching sensor as the direct converters of physical quantity to digit.
- ◆ Application of neural networks in instrumentation.

Scientific goals/research targets:

The common objective is the study of methods how to increase accuracy and reliability AD and DA converting systems. The proposed methods is oriented on the digital signal processing for error correction under different working condition. The single tasks are:

- ◆ The research in the field of neural networks is oriented on its utilisation for signal processing with help of its high grade of parallelism and for multiparametrical quantisation in the measurement applications.
- ◆ The area of the statistical sensor research. is the study of the impact of the measured physical quantity on the equivalent voltage. The importance is given on the statistical sensor with feedback where the sensor's behaviours are studied by the developed algorithm and the waving separatrix.
- ◆ The common error criteria and the mathematical description are established in order to settled a converter error model giving possibility to utilise results from the testing in the reduced number of significant points. The error values from mentioned points together with known model allow to approximate the error function over the whole working range.
- ◆ Another task is the research of different testing methods, preferably those, which reduce the performing time. The outcome of this stage is preparation of new standards for assessment of all kinds of neural and classical converters.

Results Achieved:

- ◆ Enhancement of dynamic range by oversampling and successive low pass filtering causes arising of the parasitic effects generated by systematic errors of the range below few LSB of integral nonlinearity INL(k). The outcomes of the research allows to achieve systematic error reduction by changes in the oversampling flux according to known probabilistic model of the corrected SAR ADC.
- ◆ Study of histogram testing method using small amplitude sine or triangular waves superimposed with variable DC level.
- ◆ Neural networks allow distinguish patterns represented by combination of two frequencies according to CCITT recommendation. Neural networks were software simulated and later implemented on customized both analog and digital neural chip (ETANN 80170NX by Intel and DSP TMS 320C30 by Texas Instruments).

- ◆ Another research outcome related to neural network is new programming method of deterministic mathematical operation. This application was aimed on reduction of parasitic quantity impact on the sensor system using redundant output information. This application was tested by customer designed analog neural structure.
- ◆ The stochastical sensors are based on the probability evaluation of chosen stable state for flip-flop circuit occurrence under repetitive connection to the supply source. The improvement of this idea by autocompensative system allows to linearise the transfer characteristic with better resistance against parasitic electromagnetic interference.

Title of the Project: *Fibre Optic Communication and Sensory Systems*

Funding: Institutional grant, G - 4119

Duration: 2000-2002

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

Group members: L. Ovseník, P. Marenčák, M. Benča, P. Farkaš, D. Šiškovičová

Collaboration with:

- ◆ Prof. E.F. Carome, John Carrol University, Cleveland, USA
- ◆ Prof. F. Mohr, University Pforzheim, Germany

Scientific goals/research targets:

- ◆ Modelling digital optical fibre communication systems.
- ◆ Modelling optical fibre sensor systems.

Results Achieved:

- ◆ Potential fiber optic networks architectures are analyzed and modeled with the applications in multimedia communications, electrical power industry and digital image transmission in private networks.
- ◆ A software package for fiber optics communication networks design was developed.
- ◆ Multimedia courseware: Optical Communications, Optoelectronics and Photonics were developed.
- ◆ Designed and extensively tested an innovative fiber optic index of refraction sensory system based on fiber optic technology was developed. Two variants: portable device and laboratory PC controlled device were developed.
- ◆ Optically powered fiber optic sensory system with very low power consumption was developed.

Title of the Project: *Invariant Transformational Systems for Visual Signal Processing.*

Funding: VEGA 1/74444/20

Duration: 2000-2002

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

Group members: Ľ. Ovseník, P. Marenčák, M. Benča, P. Farkaš, D. Šiškovičová

Collaboration with:

- ◆ Prof. K. Fazekas, TUB, Budapest, Hungary
- ◆ Prof. A. Figueras, University Carlos III, Madrid, Spain
- ◆ Prof. J. Tasic, TU Ljubljana, Slovenia
- ◆ Prof. P. P. L. Regtien, University of Twente, Netherlands
- ◆ Prof. M. Nojima, University Bordeaux, France
- ◆ Prof. K. Skala, University Zagreb, Croatia
- ◆ Prof. M. Ansorge, University Neuchâtel, Switzerland

Scientific goals/research targets:

- ◆ New systematic approach to multimedia communication graphical user interface (GUI) design and its application to teleeducation.
- ◆ New methods for image processing based on non-linear DSP, fast translation invariant transform (CT – Certain Transforms) and neural networks (NNs).
- ◆ Development, implementation and experimental verification of new invariant systems for image recognition based on the hybridisation CT with Radon and Mellin transform.

Results Achieved:

- ◆ Rapid transform (RT) and others fast translation invariant transforms (CT) are very attractive for many digital image classification problems. They belong to a special class of non-linear transforms with a fast computing graph. As a consequence the transforms have a very simple and fast hardware realisation. Although the RT is a non-linear and thus non-invertible, adding to the RT transform process a binary coding process (i.e. computing so called coding matrix (CM)) one may obtain the original signal (one, or two-dimensional) from its RT spectrum coefficients.
- ◆ Our research group has a long time, more than 10 years, history of research into RT or CT. We discovered RT-I, new fast translation invariant transform NT and new methods for their evaluation, computation and theoretical analysis. We have one patent on a very fast RT processor (RTP). It is intended that the result of this study will be new

methods of effective signal (picture) coding and the use of RT and RT -I in image sequence coding.

- ◆ In TV picture sequence there is a high degree of correlation between successive frames, and interframe coding makes use of the redundancy to reduce the information to be transmitted. The motion compensation can be used to overcome the difficulty of significant movement. For motion estimation will be studied the application of RT-I and other transform methods.
- ◆ New 3D-object recognition system studied in this project is based on the analysis of acoustic waves reflected by the objects. The reflected signals are analysed in the time - invariant RT transform domain and compared with reference patterns stored in memory. The applications of fast shift - invariant RT in signal classification increase the capability of the system to distinguish and identify different objects.

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 Ljubljana), Greece, Switzerland, Croatia, Czech republic, Portugal.

Duration: 2000-2003

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

Group members: J. Gamec, L. Ovseník, P. Marenčák, M. Benča, P. Farkaš, D. Šiškovičová

Scientific goals/research targets:

- ◆ The project represents a theoretical base for the emergent new method for *Information and Knowledge Management for Integrated Media Communication.*

Results Achieved:

- ◆ The work is ongoing in Working Groups:
 - ◆ *WG.1:* Multimedia, Data, Information and Knowledge Management.
 - ◆ *WG.2:* Communications Intelligent Agents.
 - ◆ *WG.3:* Personalisation of Information and Interfaces for Telecommunications.
 - ◆ *WG.4:* Advanced Signal, Audio and Video Processing.

- ◆ Our research group will focus advanced methods for image processing based on the use of fast, linear and non-linear selected transforms (CT, RT, NT, Hough, Radon, Trace Transform) and interface design for teleworking and teleeducation terminals.

7.EQUIPMENT

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	Exchange development tools for signal processor Motorola DSP5600X
Laboratory of Measurement	Special precise measurement system for ADC testing
Laboratory of Microcontrollers and VLSI Processors	Development tools for single chip microcomputers 8051, PIC
Laboratory of Optoelectronics	Development tools for optical fibre communications training systems and optical desk with He-Ne laser
Laboratory of TV System	Special TV system for teaching
Laboratory of Microwave Technology	Development tools for microwave training systems
Laboratory of Speech Techno- logy for Telecommunications	Development tools for automatic speech recognition systems and automatic voice services in telecommunications and Internet

8.CO-OPERATION

Co-operation in Slovakia

<i>Institution</i>	<i>Type of activity</i>
Slovak Telecom Bratislava	Rsearch, TEMPUS
Alcatel SEL Liptovský Hrádok	TEMPUS
Siemens Software House Bratislava	TEMPUS
Ericsson Slovakia	TEMPUS
Telenor Slovakia	TEMPUS
Acatel Bussiness System Bratislava	TEMPUS

International Co-operation

<i>Institution</i>	<i>Type of activity</i>
Alcatel SEL Stuttgart	TEMPUS
Siemens Viena	TEMPUS
UPC Barcelona	TEMPUS
Politechnico di Torino	TEMPUS
Loracom France Nancy	INCO/COPERNICUS
University of Catania Italy	INCO/COPERNICUS
University of Mining and Mettalogy 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 Clju-Napoca	COST
University of Firenze Italy	COST
University of Gent	COST
University of Sannio Italy	TEMPUS / SOCRATES
University of Calabria Italy	TEMPUS / SOCRATES
University of Mediteranea Italy	SOCRATES

9. FACULTY ESSAYS

Čižmár Anton

Full professor

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

Doboš Ľubomír

Associated professor

His current interests are in the linear adaptive digital filters, least Mean Square algorithms, QR decomposition and wireless communication systems (GSM, UMTS), wireless ATM and wireless LAN.

Drutarovský Miloš

Associated professor

His research interests include neural networks, non-linear digital filters for image processing, digital signal processors and microcontrollers.

Galajda Pavol

Assistant professor

His present fields of interest are multiple - valued logic systems and its application, VLSI multiple - valued memory design and smart sensors, dynamic properties of a multiple-valued sequential circuit.

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 includes 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.

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 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*Associated professor*

His research interest is in digital signal processing, spread spectrum communication systems, CDMA systems, adaptive linear and non-linear filters, polyspectral signal analysis.

Levický Dušan*Full professor*

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

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.

Matúš Emil*Assistant professor*

His research interest include digital picture processing.

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, digital image processing (including effective coding, restoration, enhancement and statistical filtering), digital image communication.

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*Assistant 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.

10. Ph.D. STUDENTS

Name	Supervisor	Degree Course
First year of study		
Jana Čížová	Kocur	Electronics
Matúš Pleva	Čižmár	Telecommunications
Radoslav Štefanišin	Mihalík	Telecommunications
Stanislav Šurin	Levický	Telecommunications
Gyongyike Gebeová (df.)	Čižmár	Telecommunications
Miloš Kováč (df.)	Juhár	Telecommunications
Marián Krivda (df.)	Levický	Electronics
Leoš Longauer (df.)	Marchevský	Telecommunications
Ali Omer Mohamoud (df.)	Doboš	Telecommunications
Jozef Novikmec (df.)	Doboš	Telecommunications
Ján Papaj (df.)	Čižmár	Telecommunications
Anastázia Pavlíková, (df.)	Kocur	Electronics
Slavomír Pillár (df.)	Marchevský	Telecommunications
Richard Strelák (df.)	Doboš	Telecommunications
Pavol Švač (df.)	Kocur	Electronics
Anton Vlasatý (df.)	Juhár	Telecommunications
Second year of study		
Martin Bača	Drutarovský	Electronics
Rastislav Hovančák	Levický	Telecommunications
Martin Kollár	Michaeli	Measurement technique
Slavomír Lihan	Juhár	Telecommunications
Viktor Michalčín	Mihalík	Telecommunications
Dana Šiškovičová	Turán	Electronics
Jozef Goril' (df.)	Doboš	Telecommunications
Peter Chochol (df.)	Marchevský	Telecommunications
Stanislav Matis (df.)	Juhár	Telecommunications
Marcel Pavlík (df.)	Kocur	Electronics
Vladimír Settey (df.)	Čižmár	Telecommunications
Third year of study		
Martin Benča	Turán	Electronics
Pavel Farkaš	Turán	Electronics
Roland Holcer	Michaeli	Measurement technique
Peter Radoczi	Levický	Telecommunications
Jalal Mahmood Abdulghafoor (df.)	Levický	Telecommunications
Stanislav Benčo (df.)	Marchevský	Telecommunications
Ľubomír Horniak (df.)	Michaeli	Measurement technique
Fourth year of study		
Mária Gamcová (df.)	Marchevský	Telecommunications
Ľudovít Hintoš (df.)	Čižmár	Telecommunications
Fifth year of study		
Alena Galajdová (df.)	Michaeli	Measurement technique
Miroslav Žirko (df.)	Čižmár	Telecommunications

11. MEMBERS

- Čižmár Anton**, Member of Technical Standardization Commission No.41 for Telecommunications in Slovakia.
- 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 in Slovakia.
- Juhár Jozef**, Member of the Audio Engineering Society, New York, I.D. 44164
- Juhár Jozef**, Member of Technical Standardization Commission No.55 for Electroacoustics and ultrasound in Slovakia.
- Levický Dušan**, Member of the editorial board "Radioengineering".
- Levický Dušan**, Member of the IEEE.
- Levický Dušan**, Member of Czech and Slovak Radioelectronics Society.
- Levický Dušan**, Slovak Government Commission for Accreditation.
- Levický Dušan**, Scientific Grant Agency of Slovak Republic.
- Marchevský Stanislav**, Member of the Scientific Board Military Academy, Lipt. Mikuláš.
- Marchevský Stanislav**, Member of Technical Standardization Commission No. 60, Sound, Image and Audiovideo Equipment and Systems in Slovakia.
- Michaeli Linus**, Head of Slovak IMEKO Technical Committee TC-4 "Measurement of Electrical Quantities".
- Michaeli Linus**, Slovak Metrological Institute, Member of the Scientific Board.
- 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**, Member of the Scientific Board University of Transport and Communication, Žilina, Slovakia.
- Michaeli Linus**, Co-ordinator of IMEKO Working Group “AD and DA metrology”.
- Michaeli Linus**, Member of the IEEE, Instrumentation & Measurement Society.
- Šaliga Ján**, Member of Slovak IMEKO Technical Committee TC-4 "Measurement of Electrical Quantities".
- 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 Editorial Board of the journal Radioengineering.

12. PUBLICATION ACTIVITY OF THE DEPARTMENT

Books:

- [1] Čižmár,A.-Comerlatti,M.-Derkacz,J.-Doboš,L.-Juhár,J.-deLanchy,G.-Loziak,K.-
Poussing,N.-Sikora,M.-Wajda,K.: Technical Telecommunication Handbook for SME:
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- [2] Galajda, P. – Lukáč, R.: Elektronické prvky. Mercury-Smékal Publishing House, Košice
2001. ISBN, pp. 1-212.
- [3] Kocur,D.: Adaptívne Volterrovo číslicové filtre. Elfa s.r.o., ISBN 80-89066-00-3, Košice,
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- [4] Mihalík,J.: Kódovanie obrazu vo videokomunikáciách. Vydavateľstvo Mercury-Smékal,
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- [5] Michaeli,L.: Modelovanie analógovo číslicových rozhraní. Vydavateľstvo Mercury-
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- [7] Repčík, D. - Lukáč, R.: Multimediálne telekomunikácie, Pobočka SES pri Vojenskej
akadémii v Liptovskom Mikuláši, Liptovský Mikuláš 2001, ISBN 80-968185-3-8, pp. 1-
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- [8] Repčík, D. - Lukáč, R. - Marchevský, S.: Cvičenia z telekomunikačných systémov,
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ISBN 80-968185-4-6, pp. 1-98.
- [9] Rozinaj,G.-Kubiš,L.-Šafařík,Jiří,Hronec,R.-Marchevský,S.-Škvarek,O.-Mikuš,L.-
Galajda,P.-Doboš,L.-Levický,D.: Informačné technológie, Vydavateľstvo STU
v Bratislave, obálku vydalo vydavateľstvo FABER, ISBN 80-227-1519-0. February
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Journal Papers:

- [1] Čandík,M.: Trigonometric Approximation in Fractal Image Coding. Radioengineering,
Vol.10, No.1, April 2001, pp. 33-36.
- [2] Čandík,M.-Matuš,E.-Levický,D.: Digital Watermarking in Wavelet Transform Domain.
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- [3] Holcer,R.-Michaeli,L.-Šaliga,S.: The Test of The Ad Converters Embedded On Two Microcontrollers. Measurement Science Review, Volume 1, Number 1, 2001, pp. 55-58.
- [4] Hudec,R.-Marchevský,S.: Adaptive Order-Statistic LMS Filters. Radioengineering, Vol.10, No.1, April 2001, pp. 20-24.
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- [15] Lukáč, R.: Fast Convergence to Root Signals Provided by Vector LUM FTC Smoother. Híradástechnika, Vol.LVI, No., December 2001, pp.
- [16] Lukáč, R.: The Use of Autocorrelation Matrix in the Design of Optimal Weighted Median Filters. Electronic Horizon, submitted, (in Slovak).
- [17] Lukáč, R. - Marchevský, S.: Impulse Detection in Noised Color Images. Journal of Electrical Engineering, Vol.52, No.11-12, 2001, pp.
- [18] Lukáč, R. – Lizák, J.: Optimised Permutation Filter. Acta Electrotechnica at Informatica, Vol.1, No.1, 2001, pp.
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- [22] Stupák, Cs.: Filtering of the Colour Images by Impulse Noise. Radioengineering, Vol.10, No.3, September 2001, pp. 21-27.
- [23] Turán, J.-Farkaš, P.: Line Fitting Using Hough-Like Procedure. Radioengineering, Vol.10, No.1, April 2001, pp. 25-30.

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