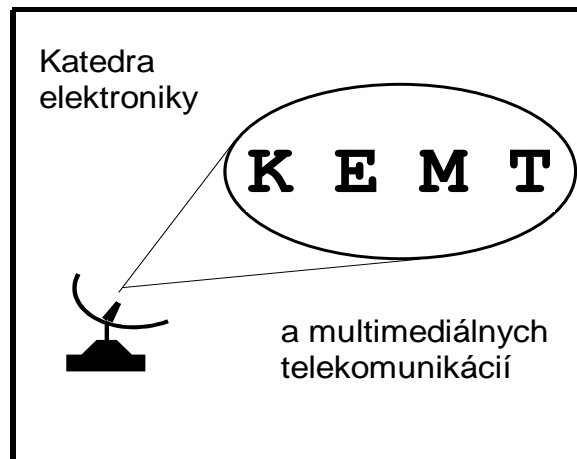

DEPARTMENT OF ELECTRONICS AND MULTIMEDIA TELECOMMUNICATIONS



Annual Report

2000

The Technical University of Košice
Faculty of Electrical Engineering and Informatics

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

DEPARTMENT OF ELECTRONICS AND
MULTIMEDIA TELECOMMUNICATIONS

ANNUAL REPORT 2000

Edited by Ľuboš Ovseník

Contents

1. BRIEF OVERVIEW	2
2. DEPARTMENT STAFF AND STRUCTURE.....	3
3. DIVISIONS OF THE DEPARTMENT	4
4. COURSES.....	6
Master Degree Course (title Ing.) – Electronics and Telecommunication Engineering	6
Ph.D. Degree Courses (title Ph.D.) – Electronics.....	6
Ph.D. Degree Courses (title Ph.D.) – Telecommunications.....	6
Ph.D. Degree Courses (title Ph.D.) – Measurement Techniques.....	6
5. LIST OF SUBJECTS TAUGHT	7
6. RESEARCH AND PROJECTS	10
7. EQUIPMENT.....	22
8. CO-OPERATION.....	23
Co-operation in Slovakia.....	23
International Co-operation.....	23
9. FACULTY ESSAYS	24
10. Ph.D. STUDENTS	27
11. MEMBERS.....	28
12. PUBLICATION ACTIVITY OF THE DEPARTMENT	29

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 modeling.

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, Linus Michaeli, Ján Mihalík, Ján Turán

- ◆ Assoc. Professors: Ľubomír Doboš, Miloš Drutarovský, Dušan Kocur, Jozef Juhár, Stanislav Marchevský

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

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

- ◆ Ph.D. students:
Internal form: Martin Bača, Martin Benča, Stanislav Benčo, Václav Čarnogurský, Pavel Farkaš, Roland Holzer, Rastislav Hovančák, Robert Hudec, Martin Kollár, Slavomír Lihan, Rastislav Lukáč, Milan Marcinek, Peter Marenčák, Viktor Michalčin, Peter Radoczi, Dana Šiškovičová, Rudolf Zetík

External form: Jalal Mahmood Abdulghafoor, Marek Čandík, Pavol Drab, Alena Galajdová, Mária Gamcová, Jozef Goril, Peter Chochol, Ľudovít Hintoš, Ľubomír Horniak, Martin Kapinos, Stanislav Matis, Pavol Mikulík, Marcel Pavlík, Vladimír Settey, Marek Šurin, Miroslav Žirko

3. DIVISIONS OF THE DEPARTMENT

◆ Laboratory of Multimedia Communications

Head: prof. Prof.Ing. Dušan Levický, CSc., Member of the IEEE

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fax: +421-95-636323989

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e-mail: cizmara@tuke.sk

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Assist. prof. Ing. Zita Klenovičová, CSc.

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Assist. prof. Ing. Emil Matúš , PhD.

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e-mail: matus@tuke.sk

Research Assistant:

Dr. Ing. Ingrid Hroncová

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◆ Laboratory of Digital Signal Processing and Satellite Communications

Head: Assoc. prof. Doc.Ing. Stanislav Marchevský, CSc.

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Researcher Ing. Ľudmila Maceková

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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.

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
Signal Recording	3/2	Juhár
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

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 Processing and Transmission of Audio Signal	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

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,
 - ◆ simple test-bed spread spectrum communication systems development.

Title of the Project: *Continuous speech recognition over the telephone*

Funding: COST 249

Collaboration with: 23 research institutions, 5 operators, 1 industry institution from European Countries

Duration: 1994-2000

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

Group members: L. Doboš, J. Juhár, B. Jelínek, M. Marcinek, J. Tlučák

Scientific goals/research targets:

- ◆ System configuration of continuous speech recognizers.
- ◆ Linguistic speech processing.
- ◆ Phonetic decoding.
- ◆ Acoustic signal processing.

Results Achieved:

- ◆ To initiate systematic approach of Slovak language analysis for the purpose of Slovak spoken speech database creation. As the first step to propose Slovak phonetic transcription comparable to existing standards, predominantly to SAMPA transcription.
- ◆ Acoustic modeling of speech based on Hidden Markov Models (HMM), Artificial Neural Networks (ANN) as well as hybrid HMM/ANN approach with primary focusing on continuous spoken Slovak speech recognition over the telephone line.
- ◆ To study robust methods for speech recognition in adverse conditions with concentration on noise robust features extraction techniques, noise immune auditory features and noise-removal preprocessing techniques.

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

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.

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 Čižmár, CSc.

Group members: Jozef Juhár, Ľubomír Doboš, Dušan Levický, Anton 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

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 Čižmár, CSc.

Group members: Jozef Juhár, Ľubomír Doboš, Dušan Levický, Zdenek 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

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: Jozef Juhár, Ľubomír Doboš, Dušan Levický, Milan Marcinek, Ľubomír 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.

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

Institutional grant

Duration: 2000-2002Co-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. StupákScientific goals/research targets:

- ◆ Design of new methods for digital watermarks implementation in multimedia.
- ◆ Innovation of speech data base for Slovak language for speech recognition.
- ◆ Analysis of spread spectrum method for wireless and mobile systems.
- ◆ Analysis of methods for digital image filtration based on neural networks.

Results Achieved:

- ◆ Implementation of DCT method for digital watermarks implementation in grey level image.
- ◆ The new method for digital watermarks by fractal image coding.
- ◆ Implementation of feed forward neural network for speech recognition.
- ◆ Design of distributed speech recognition systems.
- ◆ Utilization of the impulse detectors in Greyscale image filtering.

Title of the Project: *Digital Signal Processing in Multimedia Communications*Funding: VEGA 1/5241/98Duration: 1998-2000Co-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,
I. Hendel, R. Stanko, R. Palitefka, B. Jelínek, Cs. Stupák, R. ZetíkScientific goals/research targets:

- ◆ Design and verification of the new methods for multimedia data coding and transmission in telecommunication network by using ATM.
- ◆ Design and analysis of methods for speech coding and transmission in mobile communications.
- ◆ Design and verification of intelligent method for image filtering by using neural network.

Results Achieved:

- ◆ New modification of motion estimation for image sequences coding.
- ◆ Verification of new methods for fractal image coding based on the Reast-squares approximations method with trigonometric polynomials.
- ◆ Design of fractal image coding methods for colour image coding.
- ◆ Wireless ATM physical layer simulation.
- ◆ Design of new methods for speech pre-processing for AAR systems.
- ◆ Design of new methods for speech modelling on the base HMM.
- ◆ Study of aspects of UMTS and B-ISDN/ATM integration.
- ◆ Verification of the Grayscale image sequences filtering by neural networks.
- ◆ Design of impulse detectors based on neural networks.
- ◆ Design of stack filters and fuzzy filters by genetic algorithm.
- ◆ Design of impulse detectors based on LUM smother.
- ◆ Verification of time-frequency signal representations based on Wigner distribution in ultra wideband radar signals processing.

Title of the Project: *TEMPUS TELEEDUCA*

Funding: IB – JEP – 13004 - 98

Collaboration with:

- ◆ Slovak Technical University in Bratislava (STU Bratislava) – coordinator 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.
- ◆ Anew efficient method of resampling of image by block-base interpolation or decimation with compensation.
- ◆ Decreasing of bit rate of lattice vector quantizers by rushing entropy coding.
- ◆ Design of QMF filter banks in time domain satisfying perfect reconstruction property.

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 stochastic 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

Scientific goals/research targets:

- ◆ Modeling digital optical fibre communication systems.
- ◆ Modeling 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 and Optoelectronics 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

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: *Facilities for Communication Terminals*

Funding: COST 254

Collaboration with: France, Italy, Norway, Hungary, Spain (Project coordinator: Prof. A.R.Figueiras-Vidal, EPS - Universidad Carlos III, Madrid), Slovenia, Poland, Portugal, Ireland, Greece, Belgium, Switzerland.

Duration: 1996 – 2000

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 telecommunication terminals.

Results Achieved:

- ◆ The project represents a theoretical base for the emergent new telecommunication terminals. The work is done in Working Groups:
 - *WG.1G:* Emerging Techniques for Terminal Hardware and Software.
 - *WG.2G:* Distributing Intelligence (Terminal to Terminal, Terminal versus Network).

- *WG.3A*: Integrating Transmission, Computing, Processing, and User Needs at Terminals for Specific Applications.
- ◆ Our research group will focus on special applications, such as 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 measurement system
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

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
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, neural networks, data compression and digital communications.

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, nonlinear 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 the application of various signals processing methods in pitch detection and tracking algorithms for speech and audio.

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 and adaptive linear and non-linear filters, polyspectral signal analysis.

Levický Dušan

Full professor

His main interests and activities are in the digital signal processing, microprocessors and picture processing and transmission.

Maceková Ľudmila

Research assistant

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

Marchevský Stanislav

Associated 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 hardware implementation of the neural networks for measuring systems.

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 neural networks in charge of an amplitude shape pulse detector, 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		
Martin Bača	Kocur	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
Marek Šurin (df.)	Levický	Electronics
Second year of study		
Stanislav Benčo	Marchevský	Telecommunications
Václav Čarnogurský	Kocur	Electronics
Pavel Farkaš	Turán	Electronics
Roland Holcer	Michaeli	Measurement technique
Peter Radoczi	Levický	Telecommunications
Jalal Mahmood Abdulghafoor (df.)	Levický	Telecommunications
Pavol Drab (df.)	Mihalík	Telecommunications
Ľubomír Horniak (df.)	Michaeli	Measurement technique
Third year of study		
Martin Benča	Turán	Electronics
Robert Hudec	Kocur	Telecommunications
Rastislav Lukáč	Marchevský	Telecommunications
Milan Marcinek	Juhár	Telecommunications
Peter Marenčák	Turán	Electronics
Rudolf Zetík	Kocur	Electronics
Mária Gamcová (df.)	Marchevský	Telecommunications
Ľudovít Hintoš (df.)	Čižmár	Telecommunications
Martin Kapinos (df.)	Mihalík	Telecommunications
Fourth year of study		
Marek Čandík (df.)	Levický	Telecommunications
Alena Galajdová (df.)	Michaeli	Measurement technique
Miroslav Žirko (df.)	Čižmár	Telecommunications
Fifth year of study		
Pavol Mikulík (df.)	Michaeli	Measurement technique

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

Journal Papers:

- [1] Čandík,M.-Levický, D.-Klenovičová,Z.: Fractal Image Coding with Digital Watermarks. Radioengineering, Vol. 9, No.4, Dec. 2000, 22-26.
- [2] Daponte,P.-Grimaldi,D.-Michaeli,L.: Neural Network and DSP Based Decoder for DTMF Signals. IEE Proceedings-S/F-Science, Measurement and Technology, Vol.147, No.1, January 2000, 34-40.
- [3] Galajda,P.-Galajda,P.-junior: The Combination of the Graphical and Numerical Solutions of Linear and Nonlinear Boundary value problems in differential equations. International Journal of Applied Mathematics, IJAM, Vol.2, No.3, 2000, 381-387.
- [4] Kocur,D.-Marchevský,S.-Galajda,P.-Mihalčík,L.: Exploitation of Psychacoustic Values of Stationary Signals From Gear-Boxes. Journal of Electrical Engineering, Vol.51, No. , 2000, 154-155.
- [5] Kocur,D.-Hudec,R.-Marchevský,S.: Suppression of Mixed Noise in the Similar Images by Using Adaptive LMS L-Filters. Radioengineering, Vol. 9, No.4, Dec. 2000, 15-21.
- [6] Levický,D.-Petrušák,P.-Radoczi,P.-Šurin,-M.: Hybrid Coding of Image Sequences by Using Wavelet Transform. Radioengineering, Vol. 9, No.1, April 2000, 37-40.
- [7] Lukáč,R.-Marchevský,S.: Threshold Impulse Detector Based on LUM Smoother (LUMsm Detector). Journal of Electrical Engineering, Vol.51, No.1-2, 2000, 44-47.
- [8] Lukáč,R.-Marchevský,S.: Adaptive LUM Smoother Controlled by Adaptive Threshold System. Journal of Electrical Engineering, Vol.51, No. 3-4, 2000, 100-104.
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- [10] Lukáč,R.-Marchevský,S.: A Neural LUM Smoother. Radioengineering, Vol.9, No.3, September 2000, 5-7.
- [11] Lukáč,R.-Stupák,Cs.-Marchevský,S.-Maceková,L.: Order-Statistic Filters in Dynamic Image Sequences. Radioengineering, Vol.9, No.3, September 2000, 22-28.
- [12] Mihalík,J.-Labovský,R.: Neural Network Approaches for Predictive Vector Quantization of an Image. Neural Network World, Vol.10, No.6, 2000.
- [13] Michaeli,L.-Grimaldi,D.-Palumbo,A.: Automatic and Accurate Evaluation of the Parameters of a Magnetic Hysteresis Model. IEEE Transactions on Instrumentation and Measurement, Vol.49, No.1, February 2000, 154-160.
- [14] Radoczi,P.-Levický,D.: Pixel Decimation in Block Matching Techniques. Radioengineering, Vol. 9, No.4, Dec. 2000, 27-31.

- [15] Stupák,Cs.-Lukáč,R.-Marchevský,S.: Processor for Impulsive Noise Suppression in Telecommunication Channels. Communications (Scientific Letters of the University of Žilina), No 2, June 2000, 64-70.
- [16] Stupák,Cs.-Lukáč,R.-Marchevský,S.: Utilization of the Impulse Detectors In Grayscale Image Filtering. Journal of Electrical Engineering, Vol.51, No.7-8, 2000, 173-181.
- [17] Zavacký,J.-Mihalík,J.-Kapos, M.: Resembling of an Image by Block-Based Interpolation or Decimation with Compensation. Radioengineering Vol.9, No. , June 2000, 18-24.
- [18] Zetík,R.-Kocur,D.: Dual L-Class of Time-Frequency Distributions. Electronics Letters, Vol.36, No.20, 2000, 1741-1742.
- [19] Zetík,R.: Dual Version of Modified Pseudo-Wigner Distribution. Journal of Electrical Engineering, Vol.51, No.3-4, 2000, 81-88.

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- [2] Čižmár,A.-Doboš,L.-Juhár,J.: Possibilities of the offering Telemedical Services to Mobile Users. International symposium on Telemedicine and Teleeducation in Practice. ISTEP 2000, Košice, Slovak Republic, 22-24 March, 2000, 67-72.
- [3] Čižmár,A.-Doboš,L.-Juhár,J.: Network Architectures for Mobility of Multimedia Tele-Medicine and Tele-Education Services. International Symposium on Telemedicine and Teleeducation in Practice. Košice, Slovak Republic, 22-24 March, 2000, 61-66.
- [4] Čižmár,A.-Hintoš,L.: Niektoré trendy rozvoja informačného a telekomunikačného priemyslu a ich možný vplyv na Slovenské Telekomunikácie. Symposium on Data Networks and Services in Praxis of Slovak Telecom, SYDANET 2000, Banská Bystrica, Slovak Republic, February 22-23, 2000, 15-16.
- [5] Doboš,L.-Juhár,J.-Gamcová,M.: Some Aspects Of UMTS And B-ISDN/ATM Integration. International Symposium on Telemedicine and Teleeducation in Practice. Košice, Slovak Republic, 22-24 March, 2000, 94-97.
- [6] Doboš,L.-Palitefka,R.-Juhár,J.-Čižmár,A.: Wireless ATM Physical Layer Simulation. Technology Users Symposium with International Participation. Symposium Proceedings, Košice, Slovak Republic, 13-15 September, 2000, 160-164.
- [7] Drutarovský,M.-Galajda,P.: Spread Spectrum Approach to Stenography. COST 262, The 6th Management Committee Meeting, TU Hamburg, Germany, July 6-7, 2000, 1-7.
- [8] Drutarovský,M.: Research Report: ANOVIS FSK Demodulator : Implementation of Half Band Decimation and Interpolation Filter Banks. Research report for MEDAV GmbH, Košice, Slovakia, January 2000, 1-19.

- [9] Galajda,P.-Drutarovský,M.-Kocur,D.-Marchevský,S.: Chaos Application in Spread Spectrum Communication Systems. COST 262, The 6th Management Committee Meeting, TU Hamburg, Germany, July 6-7, 2000, 1-12.
- [10] Galajda,P.-Čandík,M.-Marchevský,S.: Teleeduca – Information Systems in Local Public Office. International TEMPUS Telecomnet Workshop ITTW'2000, UPC Barcelona, Spain, July 2-14, 2000, 1-2.
- [11] Galajda,P.-Galajda,P.junior.: Graphical Solution of Optimal Programming Problems for Three and More Number of Variables. International Scientific Conference „Educations, Science and Economics at Universities on the Edge of the Millenium“. Vysoké Tatry, Slovakia, August 21-25, 2000, 28-31.
- [12] Galajda,P.-Galajda,P.junior.: The Graphical and Numerical Solutions of Linear and Non-Linear Boundary Value Problems in Differential Equations. Acta Oeconomica Cassoviensia No 4, Košice, Slovak Republic, May 2000, 102-111.
- [13] Gamec,J.-Doboš,L.-Čižmár,A.: Gprs in GSM Evolution. International Symposium on Telemedicine and Teleeducation in Practice. Košice, Slovak Republic, 22-24 March, 2000, 157-160.
- [14] Gamec,J.: Meranie množstva nasatého vzduchu u maloobjemového motora.XXXI. Medzinárodná konferencia katedier a pracovísk spaľovacích motorov českých a slovenských vysokých škôl, KOKA 2000, Žilina, Slovak Republic, September 13-14, 2000, 229-235.
- [15] Gladišová,I.-Mihalík,J.: Mriežkové vektorové kvantovanie s entropickým kódovaním. Vedecká konferencia s medzinárodnou účasťou, Vojenská akadémia Liptovský Mikuláš, KTERP, Liptovský Mikuláš, Slovak Republic, May 24-26, 2000, 355-360.
- [16] Holcer,R.: The Performance Test of the ad Converters Embedded on Some Microcontrollers. XVI. IMEKO World Congress IMEKO 2000, Proceedings VOL.X, EWADC'2000 5th Workshop on ADC Modelling and Testing, Vienna, Austria. September 25.-28, 2000, 165-169.
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- [18] Jelínek,B.-Juhár,J.-Čižmár,A.: An Experiment with Feed-Forward Neural Network for Speech Recognition. Proceedings of the European Symposium on Computational Intelligence held in Košice, Slovak Republic, August 30-September 1, 2000, 308-313.
- [19] Juhár,J.-Čižmár,A.-Doboš,L.: Distributed Systems of Automated Speech Recognition In ATM Networks. ATM Technology Users Symposium with International Participation. Symposium Proceedings, Košice, Slovak Republic, 13-15 September, 2000, 148-159.
- [20] Juhár,J.-Doboš,L.-Čižmár,A.: Distributed Speech Recognition Systems. International Symposium on Telemedicine and Teleeducation in Practice. Košice, Slovak Republic, 22-24 March, 2000, 284-285.

- [21] Labovský,R.-Mihalík,J.: Stavové vektorové kvantovanie obrazov pomocou neurónových sietí. Vedecká konferencia s medzinárodnou účasťou, Vojenská akadémia Liptovský Mikuláš, KTERP, Liptovský Mikuláš, Slovak Republic, May 24-26, 2000, 281-286.
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- [23] Lukáč,R.-Marchevský,S.: Modified Set Observations for Dynamic Image Sequences. Vedecká konferencia s medzinárodnou účasťou, Vojenská akadémia Liptovský Mikuláš, KTERP, Liptovský Mikuláš, Slovak Republic, May 24-26, 2000, 323-326.
- [24] Lukáč,R.: Processing of Noised Dynamic Image Sequences: Adaptive Boolean Smoother Based on Permutation Theory and Optimized by Genetic Algorithm. Proceedings of 6th International Conference of the Fund of Jozef Murgas for Telecommunications joined with competition in Bratislava, Slovakia, June 13-14, 2000, 49-53.
- [25] Lukáč,R.: Implementation of LUM Smoothers. Proceedings of 6th International Conference of the Fund of Jozef Murgas for Telecommunications joined with competition in Bratislava, Slovakia, June 13-14, 2000, 60-64.
- [26] Lukáč,R.-Marchevský,S.: Reduction of Permutation Group by the Colouring Information. Proceedings of the 4th International Scientific Conference "New Trends of Aviation Development", Košice, Slovakia, September 7-8, 2000, 175-178.
- [27] Marchevský,S.-Benčo,S.: Adaptive Detectors for CDMA Signals. International Symposium on Telemedicine and Teleeducation in Practice. Košice, Slovak Republic, 22-24 March, 2000, 281-283.
- [28] Michaeli,L.-Arpaia,P.-Daponte,P.-Šaliga,J.: Reduction of Systematic ADC Errors by Oversampling. XVI. IMEKO World Congress IMEKO 2000, Proceedings VOL.X, EWADC'2000 5th Workshop on ADC Modelling and Testing, Vienna, Austria. September 25.-28, 2000, 33-38.
- [29] Mikulík,P.-Arpaia,P.: Dynamic Error Correction of Integrating Analog-to-Digital Converters by Using Volterra Filtration. XVI. IMEKO World Congress IMEKO 2000, Proceedings VOL.X, EWADC'2000 5th Workshop on ADC Modelling and Testing, Vienna, Austria. September 25.-28, 2000, 39-44.
- [30] Radoczi,P.-Levický,D.: Evaluation of Efficiency Some New Algorithms for Block Matching. Czech and Slovak 10th International Scientific Conference „RADIOELEKTRONIKA 2000“, Bratislava, Slovak Republic, September 12-13, 2000, 52-55.
- [31] Radoczi,P.-Levický,D.: Comparison Function of Distortion for Block Matching Algorithms. Vedecká konferencia s medzinárodnou účasťou, Vojenská akadémia Liptovský Mikuláš, KTERP, Liptovský Mikuláš, Slovak Republic, May 24-26, 2000, 147-152.

- [32] Radoczi,P.-Levický,D.: The New Approach to Reduction of Interframe Redundancy. Proceedings 6th International Scientific Conference of the Fund of Jozef Murgas for Telecommunications joined with competition, Bratislava, Slovakia, June 2-4, 2000, 61-64.
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- [35] Stupák,Cs.-: Impulse Detectors Based on Neural Network. Vedecká konferencia s medzinárodnou účasťou, Vojenská akadémia Liptovský Mikuláš, KTERP, Liptovský Mikuláš, Slovak Republic, May 24-26, 2000, 315-318.
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