The Technical University of Košice

Faculty of Electrical Engineering and Informatics

Annual Report 1994

Department of Radioelectronics

THE TECHNICAL UNIVERSITY OF KOŠICE

Faculty of Electrical Engineering and Informatics
(Slovak Republic)

DEPARTMENT OF RADIOELECTRONICS

ANNUAL REPORT 1994

Edited by Ľuboš Ovseník

Contents

1. INTRODUCTION

The department of Radioelectronics was founded in the year 1969.

The number of student studying in the Department is approximately 18O.

The basic research of the Department concentrates on digital signal processing mainly digital picture and speech processing and transmission, optoelectronics systems and optical communication, implementation of neural networks in digital processing and communication, digital filtering, ADC modeling and statistical sensors.

2. FACULTY

Head : Prof. Ing. Dušan Levický, CSc.

Assoc. Heads : Prof. RNDr. Ing. Ján Turán, DrSc.
Doc. Ing. Stanislav Marchevský, CSc.

Full professors : Prof. Ing. Dušan Levický, CSc.
Prof. RNDr. Ing. Ján Turán, DrSc.
Prof. Ing. Linus Michaeli, CSc.

Full professor Emeritus: Prof. Ing. Viktor Špány, DrSc.

Associated professors: Doc. Ing. Stanislav Marchevský, CSc.
Doc.Ing.Ján Mihalík,CSc., Doc.Ing. Dušan Kocur, CSc.,
Doc. Ing. Anton Čižmár, CSc., Dean of the Faculty of Electrical Engineering and Informatics

Assistant professors: Ing. Ľubomír Doboš, CSc., Ing. Miloš Drutarovský, CSc., Ing. Pavol Galajda, CSc., Ing. Ján Gamec, CSc., Ing. Milan Chudáčik, CSc., Ing. Jozef Juhár, CSc., Ing. Ján Šaliga, CSc., Ing. Jozef Zavacký, CSc.,

	Ing. Iveta Gladišová, Ing. Zita Klenovičová, Ing. Ľudmila Maceková, Ing. Emil Matúš
Research Staff :	Ing. Ľuboš Ovseník
Ph.D. Students :	Ing. Ingrid Hroncová, Ing. Ľuboš Balužinský, Ing. Peter Kalakaj, Ing. Tomáš Frič, Ing. Igor Kuba, Ing. Róbert Probstner, Ing. Viliam Segeďa, Ing. Peter Böhmann, Ing. Rastislav Labovský, Ing. Peter Balco, Ing. Ladislav Kövesi, Ing. Mikuláš Kövesi, Ing. Miroslav Jacko, Ing. Jozef Hámorský, Ing. Jozef Raček, Ing.Štefan Orosz, Ing. Peter Král, Ing. Andrej Šak, Ing. Jozef Dzivý, Ing. Milan Guzan

3. COURSES GIVEN IN 1995

Subjects	Winter semester	Summer semester	Lecturer
2nd year of study			
Electronic Components	X		Marchevský
3rd year of study			
Digital Electronics		X	Levický
Acoustics		X	Juhár
Electronics and Transmission of Information	X		Doboš,Čižmár
Linear Analog Circuits	X		Kocur
Non-Linear Analog Circuits		X	Michaeli
Signals and Systems		X	Mihalík
Design of Electronic Devices	X		Doboš
Microwave Technology		X	Turán
4th year of study			
Microprocessors in Electronic systems	X		Levický
VLSI Processors		X	Levický
Communication Systems		X	Čižmár
Digital Filtering		X	Kocur
Radioelectronic Measurements	X		Michaeli
Analog & Digital Interfaces Michaeli,Šaliga		X	Čižmár
Digital Signal Processing	X		Mihalík
TV Systems		X	Marchevský
Statistical Sensors		X	Špány
Integrated Function Blocks		X	Špány
Optoelectronics	X		Turán
Optoelectronic Systems		X	Turán
Signal Recording		X	Juhár
5th year of study			
Digital Voice Communication Systems	X		Čižmár
Telematic Systems	X		Levický
Radioelectronic Systems	X		Doboš
Sensor Systems	X		Michaeli
Digital Image Communication Systems	X		Mihalík
Medical Electronics	X		Michaeli
Photonics	X		Turán
HDTV&Cable TV Systems	X		Marchevský

4. Research Laboratories

4.1.Laboratory of Digital and Communications Systems

Staff

Head: Full prof. **Prof.Ing. Dušan Levický, CSc.,** Member of the IEEE
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Ing. Peter Böhmann
Ing. Peter Král
Ing. Ľuboš Balužinský
Ing. Peter Chromek (distance form)

Research activities:

Research project No.41141

Digital Methods for Signal Preprocessing and Transmission

Research project No. 1/284/92

Signal Preprocessing in Digital Communication

Supervised by Prof.Ing. D.Levický, CSc.

The projects are oriented towards to digital signal processing in field digital picture processing, digital speech processing and digital filtration.

Progressive image compression

Scientific staff: D.Levický, M.Fedor, Z.Klenovičová

Progressive image compression is very important technique in image processing. In this special mode of image processing is image encoded in multiple scan and receiver built up progressively better approximation of original images. Progressive encoding has applications in the three main areas. One application is in image databases serving output devices with widely differing resolution capability. Storing the database images in progressive form only that information in the compressed image required for reconstruction to the resolution of the display is transmitted and decoded. A second application for progressive image coding is in image browsing over medium rate communication channels. A low resolution image can be rapidly transmitted and displayed and then followed by as much resolution enhancement as is desired. Each stage of resolution enhancement builds on the previous stage. A third application for progressive coding is in packet networks where packets can or must be classified as droppable or non-droppable. Priority classification is being considered for broadband ISDN.

In the field of progressive image compression a new method of the gray scale image compression was proposed. In this method a gray scale image is decomposed into a set of bit planes and then any method for binary images coding can be used for bit planes coding. We proposed a new

modification of a method for quadtree encoding of bit planes by means of DF expression. The proposed method is very simple and suitable for telebrowsing and progressive image compression.

Intelligence Signal Processing in Communication

Scientific staff: D.Levický, E.Matúš, P.Král

Image compression methods perform two main operations: removal of statistical redundancy and reduction of (visual) irrelevancy to achieve a low-bit rate. These operations are conceptually orthogonal, but some coding techniques combine both approaches.

The image coding methods based on computational models of visual information processing have been termed as second generation methods. Indeed, it is very interesting to derive the image coding algorithms from the models of biological visual processing. Visual pattern image coding (VPIC) is the image coding technique offering high compression at low complexity. In this technique a set of visual patterns is defined, based on a simple viewing geometry model. The patterns used in VPIC are defined independent of the images to be coded and produce good image quality according to perception. Furthermore, to improve of a compression efficiency vector quantization is may exploited in some of these methods. Artificial neural networks (ANNs) inspired from neural networks of live organisms can enhance the adaptability of a coding systems and have the possible feasibility of real-time operation by a massively parallel implementation. In this field a new modification of visual pattern image coding was proposed. Proposed modification is based on using neural networks for visual patterns and vector classification. The Hamming neural network and a modification of Kohonen's unsupervised LVQ algorithm are used.

For the image transmission are very interesting the hybrid image techniques. We proposed a new idea of a two layer hybrid image coder

based on visual pattern image coding of original image and residual image by means of the wavelet transform. At first the contours are extracted from the original image. As a contour extractor a VPIC coder is used. In the second, the residual image is computed and coded by wavelet transform. In the decoder side the sum of contours and residual (texture) image parts is made to obtain the reconstructed image. For the simulation the picture LENA was used. The proposed coding technique is well suitable for image coding and progressive image transmission.

Speech and channel coding

Scientific staff: A.Čižmár, I.Hroncová, J.Hámorský

Applications of speech coding today have become very numerous. A few examples are listed here: mobile satellite communications, cellular mobile radio, voice/data multiplexers for public and private networks, rural telephone radio carrier systems audio for videophones or video teleconferencing systems.

Variable rate speech coding could be very attractive in all those applications where a common resource is shared by many users, for example, in mobile radio systems, where speech coders have to provide good quality and to be robust against transmission errors. Variable rate coding allows dynamic control of bit-rates assigned to speech and error protection. Thus, a flexible and adaptive communication system should be built to satisfy the need for bit rate reduction of speech signal as well as unequal error protection.

Transform-based models have been used for speech and waveform coding. Most of these models achieve data compression by encoding a set of orthogonal components derived from orthogonal transforms. Then, speech is characterized by a subset of transform components which are obtained by constraining the basis of an orthogonal transform.

We have proposed joint speech-and-channel coding system. The main idea of this system is splitting input speech signal into its integer and fractional part and their different processing using discrete Fourier transform (DFT) and Walsh-Hadamard transform (WHT), Discrete-cosine transform (DCT) and Hartley transform (HT), respectively, to achieve a data compression using only a constrained number of coefficients for signal reconstruction. For unequal error protection the use of rate compatible punctured convolutional (RCPC) codes has been suggested. Some experiments have been done with Turbo Codes as a new class of convolutional codes.

Neural Networks in Communications

Scientific staff: A.Čižmár

Neural networks, because of their massively parallel and adaptive nature, can adapt to changes in data and learn the characteristics of an input signal. Furthermore, because of their nonlinear nature, neural networks can perform functional approximation and signal filtering operations which are beyond optimal linear techniques. Neural networks can be used in pattern classification by defining nonlinear regions in the feature space.

High-speed data transmission over channels with amplitude and delay distortion has become a common practice due to the development of adaptive equalization techniques based on the linear finite impulse response channel model. Channel equalization is, however, an inherently non-linear problem and it is desired to incorporate some non-linearity in the equalizer structure. By contrast, channel equalization can also be viewed as a classification problem where an equalizer is constructed as a decision-making device to reconstruct the transmitted symbol sequence as accurately as possible decision making. The ability of multi-layer perceptrons to realize a wide variety of classification mapping provides the basis for their use as

adaptive equalizers we have investigate a the ability of changing the MLP decision region by controlling the threshold-level of the hard-limiting quantizer which follows the output of MLP and which is used to produce a binary output. Carpenter-Grossberg neural network model has been investigated in the area of speech waveform clustering to produce a codebook for bit-rate-reduction.

Continuous Speech Recognition Over the Telephone

Research project: COST 249
Supervised by Doc.Ing. A.Čižmár, CSc.
Scientific staff: S.Marchevský, D.Kocur, I.Hroncová, M.Drutarovský

This research project is proposed as a 4-year action, and the work packages can be described in terms of the concepts or the kind of processing being addressed:

Working Group 1: Concept Establishment

Working Group 2: Linguistic Processing

Working Group 3: Phonetic Decoding

Working Group 4: Acoustic Signal Processing

COST 249 is common project of teams at universities and private firms from foreign countries as follows: Belgium, Czech republic, Denmark, France, Germany, Hungary, Ireland, Italy, Lithuania, The Netherlands, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

We are involved in the Working group 4 - Acoustic Signal Processing.

The quality and intelligibility of speech is often degraded by background noise, by coding noise, by noise due to transmission over a channel with non-linear intersymbol interference, and by the presence of speakers other than the desired speaker. The aim of speech enhancement, noise suppression, and transmission-line equalization techniques is to process the degraded speech such that its intelligibility and quality are improved.

The research of the group is oriented towards the fields:

a) speech enhancement and noise suppression technique

- time/frequency domain adaptive filtering
- linear adaptive filtering
- nonlinear (Volterra) adaptive filtering
- neural networks based noise reduction
- frequency domain adaptive postfiltering

b) transmission-line equalization techniques:

- equalization of channels with non-linear intersymbol interference by multi-layer perceptron.

As fields of possible applications are defined:

- presence of background noise in an automatic recognition systems
- crosstalk and echo noise in telephone systems
- co-channel noise in a cellular mobile telecommunications systems, etc.

In the COST 249 project is involved a staff of Department of Cybernetics and Artificial Intelligence.

Power voltage harmonic analyzer

Research project HZ 16/93
Supervisor: D.Levický
Research staff: M.Drutarovský, P.Galajda, D.Kocur, S.Marchevský

This project presents one possible approach to harmonic analyzer of power voltage 220V/50Hz by method of digital signal processing. This approach was used in the equipment HARAN 30 developed on the basis of a contract for East-Slovak Power Company.

Main features:

- digital signal processing method application
- correlation analysis (determining of a fundamental harmonic component period)

- window function application (Hamming, Blackman, Bartlett window)
- DFT, Goertzel's algorithm
- 16 bit sigma-delta A/D converter application (Motorola DSP 565 ADC16, sampling frequency 7912,5 Hz)
- single chip microcontroller implementation (Philips 80C552)

Basic properties:

- harmonic analysis of power voltage 220V/50Hz up to the 30th harmonic component in monitoring mode
- measurement interval in monitoring mode: 1-15 minutes (optional)
- recording of analysis results for 672 measurements (one week, measurement interval 15 minutes)
- recording of time and date of each measurement
- recording of time and date of voltage drop-out
- harmonic analysis of power voltage 220V/50Hz up to the 50th harmonic component in a single measurement mode
- data obtained by measurements can be transmitted into PC computer using RS232 interface for the further processing (software for measurement results evaluation is also available)
- measuring accuracy: +0.1%

Integrated Services Metropolitan Area Network ISMAN
COPERNICUS Project: COP 587
Supervisor: A. Čižmár
Preparatory stage with partners:

LORACOM, University of Nancy, France

University of Mining and Metallurgy, Dept. of Telecommunications, Poland

University of Catania, Italy

Com Arch Co.Ltd., Poland

Krakow Voivodship Office, Poland

Award

Doc.Ing.Čižmár Anton, CSc., honorary title "Associate professor of Technical University, Oradea, Romania", received September, 21st 1994.

Members

Prof. Ing.Levický Dušan, CSc., member of the editorial board "Radioengineering".

Doc.Ing.Čižmár Anton, CSc., member of Technical Standardization Commission No.41 for Telecommunications in Slovakia.

PUBLICATIONS

Journal Papers

Levický,D.-Fedor,M.: Progressive Image Compression by Quadtree Encoding of the Bit Planes. Elektrotech. časopis, 45, No.8, 1994, pp. 293-299.

Levický,D.-Matúš,E.-Král,P.: A Two Layer Hybrid Image Coder. Radioengineering, Vol.4, No.1, 1995. (in press)

Levický,D.-Král,P.: Neural Networks in Visual Pattern Image Coding. Neural Network World 1995. (in press)

Kluch,K.-Levický,D.: Elektronické prístroje pre energetiku. (Electronic Devices for Power Engineering.) Technická revue, č.2, 1994, pp. 6-8.

Čižmár,A.: Niektoré zvláštnosti rečového signálu. (Some Special Features of Speech Signal.) Technická revue 5/94, pp. 10-12.

Čižmár,A.: Škola a prax v priemysle. (University and practice in industry - relationship.) Technická revue 3/94, pp.28-29.

Čižmár,A.: COST 249 - Continuous Speech Recognition Over the Telephone. Draft Minutes of the 1st Management Committee Meeting. Held in Brussels, Belgium, Sept.12th 1994, pp. 57-59.

Conference Papers

Levický,D.-Král,P.: Kódovanie obrazov vizuálnymi obrazcami s využitím neurónovej siete. (Image Coding by Visual Patterns Using Neural Network.) Proc. of Scient. Conf. on "New Trends in Signal Processing", Lipt. Mikuláš, Slovakia, May 1994, pp.99-102.

Levický,D.-Král,P.: Visual Pattern Image Coding Using Neural Network. Proc. of Scien. Conf., Košice, Slovakia, Sept. 1994, pp.28-32.

Levický,D.-Matúš,E.-Král,P.: Hybrid Image Coder Based on Visual Pattern Image Coder and Wavelet Transform of Residual Image. Proc. of Scien. Conf., Košice, Slovakia, Sept. 1994, pp.82-85.

Hámorský,J.:Influence of Using Different Subencoders on Performance of Turbo-Codes. Proc. of Scien. Conf., Košice, Slovakia, Sept.1994, pp.297-302.

Levický,D.- Drutarovský,M.- Galajda,P.- Marchevský,S.: Harmonický analyzátor sieťového napätia.(Power Voltage Harmonic Analyzer.) Proc. of Scient. Conf. "Rádioelektronika '94", April 1994, Brno, Czechia, pp.141-144.

Other Publications

Levický,D.: Telekomunikácie, história a súčasnosť. (Telecommunication: State of the Art.) Workshop “Light-Image-Sound-Graphics”, Košice, Slovakia, June 12th, 1994, (unpublished presentation).

Čižmár,A.: Generovanie, prenos a vnímanie reči. (Speech Production, Transmission and Perception.) Workshop “Light-Image-Sound-Graphics”, Košice, Slovakia, June 12th 1994, (unpublished presentation).

Čižmár,A.: COST 249 - Continuous Speech Recognition Over the Telephone. Presentation of the results at the 2nd Management Committee Meeting. Held in Amsterdam, The Netherlands, Nov. 14-15th 1994, (unpublished presentation).

4.2. Laboratory of Radioelectronic Systems

Staff

Head: Assoc. prof. **Doc.Ing. Stanislav Marchevský, CSc.**
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Ing.Peter Balco

Research activities:

Design and implementation of neural stack filters

Scientific staff: S.Marchevský, Ľ.Doboš, M.Drutarovský, P.Balco, J.Raček, Ľ.Maceková, V.Segeďa

The purpose of this project is to develop efficient algorithms for the design and implementation of nonlinear adaptive filters based on neural networks.

A new architecture of neural stack filters for vector valued signals was proposed. They use additional information about the signals in different components of vector valued signals. Experimental colour television signal RGB results from image enhancement of corresponded by impulsive noise and comparison with vector median filters and with component wise filtering by weighted order statistics filters were presented. The weighted order statistic filters were designed by using neural network and threshold decomposition.

Adaptive algorithms for finding the optimal neural stack filters (NSF) under the mean absolute and mean square error criterion produce coefficients (weights) of ONSF in floating point format. The basic principle of NSF allows the conversion of floating point coefficients to fixed point format, which is more convenient for implementation. Experimental results form image enhancement were provided to show the performance of NSF in the case of different word lengths for coefficient representation.

Pitch Detection Algorithms for Speech and Audio.

Scientific staff: J.Juhár

Speech and audio signals consists of alternating periodic and aperiodic intervals. Periodic of voiced intervals are characterized by waveform patterns called pitch periods, associated with the activity of the vocal cords. A pitch period is the waveform interval between successive glottal pulses in voiced

portions of speech. The location of a sequence of pitch periods in the waveform is called pitch tracking and represents an important part of many speech processing systems. The pitch contour of an utterance is useful for recognizing speakers, for speech instruction to the hearing impaired and is required in almost all speech analysis-synthesis systems.

Because of the importance of pitch detection, a wide variety of algorithms for pitch detection and tracking have been proposed. Our research in this field has been devoted to comparative performance study of various pitch detection algorithms. Our goal in the following period is studying new detection algorithms based on some modern signal analysis methods such as wavelet transform and time-frequency distributions (e.g. Wigner-Ville) as well as their real-time implementation with Motorola DSP 56000.

Nonlinear Volterra Digital Filters

Scientific staff: D.Kocur

The nonlinear Volterra digital filters (VF) belong to a group of nonlinear estimators and they are based on the approximation of nonlinear functionals by a truncated Volterra series. Under condition of non-Gaussian signal processing or in the case of nonlinear system identification they can be applied with advantage to noise canceling, echo canceling, nonlinear channel equalization, prediction of signals, pitch detection, speech intelligibility, enhancement, etc.

Our research in the field of Volterra filtering was devoted to the performance description of the well-known LMS adaptive VF (AVF) of the general order, to the design of new modifications of the RLS algorithms of adaptation of the AVF as well as to the design a new category of nonlinear digital filters so-called microstatistic VF.

Within our research intent on the LMS AVF we have examined the convergence in the mean and the misadjustment of the LMS AVF of the

general order. We have derived the stability condition of the LMS algorithm from the point of the step size selection as well as a formula for the LMS AVF misadjustment computation.

In the field of a design of new algorithms of adaptation of the AVF, three new modifications of the RLS algorithm called RLS-A, RLS-AN and FRLS-A algorithms have been proposed to improve the tracking capability of the conventional RLS and FRLS AVF. The proposed algorithms use the variable forgetting factor with unity zone as well as the modifications of this principle. They have very good tracking capabilities in the time-varying environment and good performance properties in steady-state.

In the field of a design of new categories of unconventional nonlinear filters we have proposed a new class so-called microstatistic VF (MVF). The MVF are based on the combination of the conventional microstatistic filters (CMF) and the Volterra filtering principle. The first experiences of ours in the field on the MVF have indicated that the MVF could provide higher quality of signal processing than the CMF or the VF.

Innovative Methods of Noise and Vibration Analysis on Reciprocating Machinery for the Purpose of Quality Control and Diagnostics.

Supervisor: Ing. Dušan Kocur, CSc.

Partners: MEDAV Digitale Signalverarbeitung GmbH, Germany

Technical University Ilmenau, Germany

Technical University Liberec, Czech Republic

LIAZ a.s. Jablonec n. Nisou, Czech Republic

ŠKODA a.s., Czech Republic

Technical Testing Institute Piešťany, Slovac Republic

Technical University Budapest, Hungary

Member

Ing. Jozef Juhár, CSc., Member of the Audio Engineering Society

Ing. Jozef Juhár, CSc., Member of Technical Standardization Commission No.55 for Electroacoustics and ultrasound in Slovakia.

PUBLICATIONS

Journal Papers

Drutarovský,M.-Marchevský,S.: The Methods of Design and Implementation of Stack Filters. Submitted for publication in Radioengineering 1/95.

Vaško,J.-Kocur,D.: Fast Tracking RLS Adaptation Algorithms of the Second-Order Volterra Digital Filters. (Submitted for publication to Radioengineering No.1, 1995)

Marchevský,S.-Drutarovský,M.-Galajda,P.-Kocur,D.: Brain Machines. Technická revue č.3, 1994, pp.14-15.

Conference Papers

Juhár,J.-Doboš,Ľ.: Numerické vlastnosti QRD algoritmov. (Numeric Properties of the QRD Algorithms). Proc. of Scien. Conf., section "Radioelektronika", FEI TU Košice, Slovakia, Sept. 1994, pp.260-265.

Juhár,J.-Doboš,Ľ.: Macintosh AV - inteligentná komunikačná centrála? (Macintosh AV - Smart Communication Exchange.) Proc. of Scien. Conf. COMPTEP '94, Prešov, Slovakia, June 1994.

Juhár,J.-Doboš,Ľ.: Moderné technické a programové prostriedky pre vývoj aplikácií číslicového spracovania signálov. (Modern Hardware and Software Tools for Digital Signal Processing Applications Development). Proc. of Scient. Conf. on "New Trends in Signal Processing", Lipt. Mikuláš, Slovakia, May 1994, pp.115-118.

Marchevský,S.: Moderné smery v televíznej technike.(Modern Trends in TV technology) Workshop “Light-Image-Sound-Graphics”, Dom techniky ZSVS - Katedra rádioelektroniky FEI TU, Jún 1994.

Drutarovský, M.: Hybrid Realization of Stack Filters. Proc. of Int. Conf. on "New Trends in Signal Processing", Lipt. Mikuláš, May 1994, pp.107-110.

Marchevský,S.-Drutarovský,M.- Galajda,P.- Kocur,D.: Application of Digital filters in Brain - Machine Apparatus. Proc. of the 12th Scient. Conf. "Biosignal '94", Brno, June 1994, pp.170-172.

Kocur,D.: Microstatistics Volterra Digital Filters (in Slovak). Proc. of Scient. Conf. on "New Trends in Signal Processing ", Vol.2, Lipt. Mikuláš, May 1994, pp.240-243.

Kocur,D.: Convergence in the Mean of Adaptive LMS Volterra Filters. Analele Universitatii Din Oradea (Proc. of Oradea University), 1994, pp.236-241.

Levický,D.- Drutarovský,M.- Galajda,P.- Marchevský,S.: Harmonický analyzátor sieťového napätia.(Power Voltage Harmonic Analyzer.) Proc. of Scient. Conf. "Rádioelektronika '94", April 1994, Brno, Czechia, pp.141-144.

Marchevský,S.-Drutarovský,M.: Scalar Filtering of Color Pictures by Weighted Order Statistic Filter.). Proc. of Scient. Conf. on "New Trends in Signal Processing", Pobočka SES pri VA SNP, L. Mikuláš, May 1994, pp.236-239.

Drutarovský,M.: Hybrid Realization of Stack Filters. Proc. of Scient. Conf. "New Trends in Signal Processing", L. Mikuláš, May 1994, pp.107-110.

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Courses:
Signals and Systems, Electronic Systems

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Ph.D. Students:

Ing. Igor Kuba

Ing. Rastislav Labovský

Ing. Jozef Dzivý

Research activities:

Digital Coding and Transmission of Images in Videotelephone and Videoconference Systems

Grant research project No.1707/94
Supervised by Doc.Ing. Ján Mihalík, CSc.
Scientific staff: J.Zavacký, I.Gladišová, R.Labovský, I.Kuba, J.Dzivý

Efficient image coding reduces a bit rate at the same quality of coded images and so there may be a decrease in channel capacity for transmission

or storage for record of digital images. The high data compression, complexity of hardware and noise immunity are important characteristics for a choice of efficient coding methods. At present, the well - known ones are prediction, transform and hybrid methods of image coding. The hybrid image coding is a combination of the transform and prediction ones. Its different modifications are divided from the modifications of the transform and prediction ones. Our research in regard to CCITT International standardization of image codecs for their application into videotelephone and videoconference systems is orientated above all to hybrid codecs with two dimensional DCT, vector quantization and interframe prediction by using motion compensation.

In the area of vector quantization we make research towards suboptimal vector quantizers, because the optimal (full search) one has a large computational complexity, which grows exponentially with dimension. The suboptimal vector quantizers with a structural code-book achieve lower performance compared to the full search on of the same dimension and bit rate. They can achieve higher performance one that of the full search for the same computational complexity, because they may have bigger dimensions at the same bit rate. The suboptimal ones are: the tree search, geometrical, contour - gain, multistage and hierarchical vector quantizers, which can be realized as fixed or adaptive ones.

The interframe prediction of videotelephone or videoconference images with high performance is carried out by using motion compensation. Our research of the motion estimation is orientated to words the difference methods by using the recursive or nonrecursive algorithms next to the correlation methods from which are known iterative, logarithmic and hierarchical ones.

The image spectrum is anizotropic therefore the efficient discrete representation of an image may be obtained by multidimensional sampling in

general by nonorthogonal lattice. The spline interpolators can carry out interpolation of the decoded images with high accuracy at low sampling frequency. In this area we concentrate towards searching for the optimal spline functions from the point of view precision as the advantageous technical realization and to the developing of hardware of spline interpolators on the basis of VLSI technology.

Digital Image Processing in Videocodecs

Institutional research project No.42143
Supervised by Doc.Ing. Ján Mihalík, CSc.
Scientific staff: J.Zavacký, I.Gladišová, R.Labovský, I.Kuba, J.Dzivý, P.Štefanko, D.Smolej

The specific methods of digital image processing in videocodecs increase the performance of coding and data compression. Our research in the area involves the statistical and structural analysis in the image space and transform domain. Multiresolution decomposition of images by using the bank of mirror filters and the wavelet transform. Next, the block matching and recursive methods of motion estimation and compensation in images on the basis of the hierarchical or Kalman algorithms. Finally, nonlinear interpolation and prediction of images by the spline functions and the neural networks. The results of the research are applied at the vector quantization, prediction, transform, hybrid and subband coding of images.

PUBLICATIONS

Journal Papers

Mihalík,J.: Scalar Vector Quantizers. Journal of Elect. Engineering, Vol.45, No.8, 1994, pp. 300-304.

Mihalík,J.-Zavacký,J.: Multichannel Spline Interpolation of Discrete Signals. Radioengineering, Vol.2, No.3, 1994, pp. 12-16.

Conference Papers

Mihalík,J.-Labovský,R.: Product Scalar Vector Quantizer. Proc. of Scien. Conf. "Radioelektronika'94", Vol.2, FEI VUT Brno, Czechia, Apr. 1994, pp. 217-221.

Mihalík,J.-Zavacký,J.-Kuba,I.:Interpolácia obrazu pomocou splajnových funkcií. (Image Interpolation Using Spline Functions.) Proc. of Scien. Conf. on "New Trends in Signal Processing", L. Mikuláš, Slovakia, May 1994, pp.119-122.

Mihalík,J.-Dzivý,J.: Spektrálny rozklad obrazu pomocou separovateľných zrkadlových filtrov. (Spectral Image decomposition by Separable Mirror Filters.) Proc. of Scient. Conf. on "New Trends in Signal Processing", Vol.1, Lipt. Mikuláš, Slovakia, May 1994, pp. 103-106.

Mihalík,J.-Gladišová,I.: Geometrický vektorový kvantizátor so sústredenými pyramídami. (Geometric Vector Quantizer with Concentrated Pyramids.) Proc. of Scient. Conf. on "New Trends in Signal Processing", Vol.1, Lipt. Mikuláš, Slovakia, May 1994, pp. 123-126.

Mihalík,J.-Kuba,I.-Labovský,R.: Vektorové kvantovanie obrazu.(Vector Image Quantization.) Proc. of Scien. Conf., section "Radioelektronika", FEI TU Košice, Slovakia, Sept. 1994, pp. 215-220.

Zavacký,J.-Mihalík,J.- Kuba,I.: Dvojrozmerná interpolácia obrazu. (2D Interpolation of Image.) Proc. of Scien. Conf., section "Radioelektronika", FEI TU Košice, Slovakia, Sept. 1994, pp. 227-232.

Gladišová,I.-Mihalík,J.: An Algorithm of the Weighted Vector Quantizer. Proc. of Scien. Conf., section "Radioelektronika", FEI TU Košice, Slovakia, Sept. 1994, pp. 221-226.ý

4.4. Laboratory of Optoelectronic Systems

Staff

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Ing. Marián Mihok (distance form) e-mail: mihokm@ccsun.tuke.sk

Ing. Július Tomèík (distance form)

Research activities:

Multidimensional digital signal processing and transmission

Fiber Optics

Simulation of Fibre Optic Communication and Sensory Systems
Financial support: Institutional grant project No.42144, FEI TU Košice
COST 229 Application of Digital Signal Processing to Communications
Supervised by Prof.RNDr.Ing. J. Turán, DrSc.
Scientific staff: ¼.Ovseník, M.Mihok, O.Tkáè, J.Tomèík, R.Probstner

Wavelength division multiplexing in optical fiber sensor and communication systems

Combining the sensing and signal transmitting (i.e. telemetry) capability of optical fibers provide the strongest driving force for fiber optic sensor network development in the coming years. This capability becomes increasingly attractive as fiber optical local area networks (LANs) are likely to be implemented in factories, buildings, offshore platforms and mobile systems.

In a sensor network, at least two sensors, which may be discretely or continuously distributed in space according to a suitable topological pattern (linear array, star, ladder, ring), are operated and controlled by a single central optoelectronic terminal or transceiver unit. This requires a scheme to provide unambiguous sensor addressing (or multiplexing) and interrogation (or demodulation). We will deal only with networks of sensors having spatial distribution that is discrete or quantized, i.e. point sensors. The intrinsic or extrinsic sources of optical information regarding the nonoptical measurand, and this information may be carried by the amplitude -intensity), phase, polarization, or spectral distribution of the optical carrier. In addition, the sensor information may be encoded in the frequency or time domain by means of the phase of an envelope modulation of the light. The topology of a

fiber optic sensor network is strongly determined by the desired method of sensor modulation and interrogation. The interrogation may be performed in the time (TDM), frequency (FDM), or wavelength domain (WDM). The WDM technique is feature unique to optical sensors, whereas the others are used for addressing conventional electrical sensors.

Wavelength division multiplexing offers a potentially powerful technique for use with in optical fibre sensor and communication systems. The work deals with short review of this technique with reference to systems of discrete optical fibre sensors. Potential network topologies for wavelength division multiplexing multiple sensor networks are analyzed, with description of their major features and implementation constraints. The program code for CAD system for WDM fiber optic sensor system projecting will be developed.

Fiber optics application in the microwave domain

The optical transmission and distribution of high speed, high frequency signals is among the fastest growing technologies in telecommunications. On the long term, there is the possibility of monolithic integration of optical and microwave components to produce self-contained devices and subsystems performing functions in communications, computer networks, process control, test procedures, and other areas. In the near future, hybrid microwave optoelectronic components presumably will lead to new applications such as low cost broad band, distribution networks of high definition television signals (HDTV), high speed chip to chip optical interconnects, microwave - optical links in commercial interconnects, microwave - optical links in commercial satellites, high speed subcarrier multiplexed optical local area networks and numerous other applications which cannot be achieved with present technologies. key, to these developments is the high speed optoelectronics.

As a rapidly expanding and maturing area, optoelectronics has many potential applications in the near future.

For enhanced transmission capacities there is an increasing interest in the interfaces of microwaves and lightwaves. This interest has been generated partially by the availability of new, high speed, electrooptic devices (diode lasers, modulators, switches, etc.) and partially by the development of more sophisticated microwave and millimeter wave circuits and system.

There is a strong trend to apply more and more monolithic microwave - photonic integrated circuits for communications. In the fields of optical transmission and distribution of high speed signals new modulation and detection methods are introduced. The recently developed low noise optical amplifiers extend the application field of the optical transmission of high speed, high frequency signals.

Optically powered sensor telemetry system

Optically powered sensor telemetry systems include advantages of electrical as well as fiber - optic sensors. The applications of the system include aerospace, aircraft, automobile instrumentation, process control, industry and medical test instruments, etc. The system is created by optical and electrical parts. The optical part is used for the transmission of energy to electrical sensor itself, i.e. for electrical sensor powering, as well as for transmission of the information from the sensor to the processing unit. The electrical part is composed of the coding circuit and the optical pulse transmitter. The main part of the coding circuit is the resistance-dependent generator. Signal from the generator is converted to series of pulses. The time distance between two pulses corresponds to the sensed quantity. The restrictions for the electrical parts are the minimum possible current consumption and very small supply voltage: A very important role plays the

opto-electrical converter and the laser source used for feeding the system. A single optically powered sensor telemetry system can by simply extended to the optically powered sensor network.

High speed optical communication system

Many commercial, scientific and educational environments face the communications bottleneck resulting from the limited transmission speed of to days interconnect technologies. Medical centers and hospitals would be able to transmit images form magnetic resonance scans to hundreds of work stations simultaneously. Universities, research centers and large corporations all need to link their mainframes, minicomputers, work stations and PC, to highs speed networks over campuses. In other areas, users do not need to share computing power, but they do need access to central mass storage in the form of large, redundant disk arrays. Potential network architectures are analyzed with the applications in multimedia communications electrical power industry and digital image transmission.

Hough and rapid transform

Transform Methods for Digital Multidimensional Signal Processing

Financial support :Grant project No. GAV 1680/94-9431 Ministry of Education and Science Slovak Republic, Bratislava
COST 229 Application of Digital Signal Processing to Communications
Supervised by Prof.RNDr.Ing.J. Turán, DrSc.
Scientific staff: M.Chudáèik, J.Gamec, J.Futő, J.Kövesi, M. Kövesi, M.Jacko, Z. Štiblár

Hough transform

Hough transform (HT) is an universal method of detecting parametric curves, non-parametric curves of other objects in noisy pictures. It is used in picture information processing in robotics, scene analysis, medical science, industry, military technology, etc. Through the detection properties of HT have been analyzed from different points of view, it is necessary to study the HT representation properties in connection with methodology of using HT

spectral region, based on the new results of digital or analog signal processing theory. The major problem with practical application of HT in industry is the need of fast, reliable and economic HT processor (HTP). The current HTP perform the computation of HT spectrum in the electrical or optical area. A disadvantage of electronic digital HTP is that it is necessary to implement a great number of multiplications and additions which usually results in the low speed of computation and increasing the complexity of device. Though the current optical HTP make it possible to speed up the HT spectrum computation, they require spatial, very exacting, and thus also very expensive optical components. They are also very sensitive to the surrounding effects due to the volume optics components used. Diversification in HT applications shows its remarkable adaptability in solving new picture processing problems.

Based on the our new inventions this will be a development and implementation of new electronic fast HTP, working in real time in on-line with previous development our original Digital Image Preprocessing System (CSPO-III). We also continue further evaluation of use of HT for feature extraction in pattern recognition with study of new methods of HT spectral domain processing.

Rapid transform and its inversion

Rapid transform (RT) and others fast translation invariant transforms (CT) are very attractive for many digital image classifications 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 realization. Although the RT is a non-linear and thus non-invertible, adding to the RT transform process a binary coding process (t.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-l, new fast translation invariant transform NT and new methods for they 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 -l in image sequence coding.

In TV picture sequence there is a high degree of correlation between successive frames, and interframe coding makes use of this redundancy to reduce the information which has 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-l 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 analyzed in the time - invariant RT transform domain and compared wit reference patterns stored in memory. The application of fast shift - invariant RT in signal classification increase the capability of the system to distinguish and identify different objects.

International cooperation

Project: **"Crowd Evaluation by Digital Image Processing"**
King’s College, University of London, U.K.

TU Budapest, Dept. of Microwave telecommunication, Hungary
COST 229, COPERNICUS 1529

University of Ljubljana, Dept. of Electrical and Computer Eng., Slovenia
COPERNICUS 1529

University of Delft, Dept. of Electrical Eng., Laboratory for Telecommunications and Image Processing, Netherlands
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Technical University of Cluj-Napoca, Dept. of Electrical Eng., Romania
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University of Firenze, Dept. of Electrical Eng., Italy
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PUBLICATIONS

Journal Papers

Turán,J.: Recognition of Printed Berber Characters Using Modified Rapid Transform. Journal of Communications, Vol. XLV, July-August 1994.

Turán,J.-Kövesi,L.- Kövesi,M.: CAD System for Pattern Recognition and DSP with Use of Fast Translation Invariant Transforms. Journal of Communications, Vol. XLV, July-August 1994, pp. 85-89.

Conference Papers

Tomèík, J.: Optimizing of Fibre Optics Network. Proc. of Scient. Conf., Her¾any 94, Košice 1994, pp.62-67.

Turán,J. et al.: Programme Code CT-CAD. Proc. of Scient. Conf., Her¾any 94, Košice 1994, pp.86-91.

Turán,J.-Probstner,R.: The CAD System for Projecting in WDM Fiber Optic Sensor Networks. Proc. of Sc. Conf., Her¾any 94, Košice 1994, pp.92-98.

Turán,J.-Mihok,M.: The Sensor Part of an Optimally Powered Sensor System. Proc. of Scient. Conf., Her¾any 94, Košice 1994, pp.99-103.

Turán,J.-Ovseník,¼.: Optical Fiber Sensor of High Frequency Magnetic Field. Proc. of Scient. Conf., Her¾any 94, Košice 1994, pp.104-109.

Turán,J.-Ovseník,¼.: Optical Fiber Sensor of High Frequency Magnetic Field. Proc. of Conf. "Sensors and Sensor Systems '94", Prešov, Slovakia, December 1994.

Turán,J.: Selection Invariant Features Using Modified Rapid Transform. Proc. of Scient. Conf. on "New Trends in Signal Processing", Lipt. Mikuláš, May 1994, pp.107-110.

Turán,J.-Probstner,R.: Planning WDM Fiber Optic Sensor Networks. 6th Int. Network Planning Symposium "Networks 94", Budapest, Hungary Sept. 4-9th, 1994.

Gamec,J.-Turán,J.-Mlèoch,M.: Motion Estimation with Use of 2D Inverse Rapid Transform. Proc. of the 4th COST 229 Workshop, Ljubljana, Slovenia, April 1994, pp.203-207.

Turán,J.: Modified Rapid Transform Fast Shape Descriptor. Proc. of the 4th COST 229 Workshop, Ljubljana, Slovenia, April 1994 pp. 209-212.

Turán,J.: Wavelength Division Multiplex in Subscribers Networks. Scient. Conf. "Úèastnícke siete", Žilina, Slovakia, Nov. 1994.

Turán,J.-Ovseník,¼.: Optical Fiber Sensor of High Frequency Magnetic Field. Proc. of Scien. Conf. "Radioelektronika 94", Vol.2, Brno 1994, pp.338-341.

Tomèík,J.-Turán,J.: Projecting Fibre Optic Backbone for Energetics. Proc. of Scient. Conf. "Radioelektronika 94", Vol.2, Brno 1994, pp.379-382.

Turán,J.-Mihok,M.: Optically Powered Sensor System. Proc. of Scient. Conf. "Radioelektronika 94", Vol.2, Brno 1994, pp.375-378.

Gamec,J.-Turán,J.: Inverse Rapid Transform and Motion Analysis. Proc. of Workshop COST 229, Bayona-Vigo, Spain, Oct. 1994.

4.5.Laboratory of Electronic Circuits & Measurement

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Research activities:

Fuzzy logical structure modeling presented by the artificial neural networks, multilevel logic and statistical sensors.

Financial support: Grant project GAN No. 1683/94
Ministry of Education and Science, Bratislava, Slovak Republic
Supervised by Prof.Ing. Linus Michaeli, CSc.

Scientific staff: V.Špány, J.Šaliga, P.Galajda, M.Guzan, P.Kalakaj, A.Šak, T.Friè

Collaborating part time scientific staff: V.Pirè, Dept. of Mathematics, FEI TU Košice, J.Pivka-Computer Center TU Košice

Neural based multiparametrical quantizers

Systems based on the fuzzy logic are realized in form of computer programs in the present time. The fuzzy logic electronic structures are rarely used. It is more surprising because fuzzy logic have been developed from real biological systems. The response from the sense organs as well as the conectionistic procedure of the information processing in the human brain utilizes similar decision rules. Artificial neural networks, statistical sensors and multilevel logic are samples of this structure.

Tank-Hopfield artificial neural networks enable to find the best fitting estimation of the finite time input pulse by using linear combination of the basic functions. The weighting coefficients of the function components determine the probability of their occurrence and they are from the interval (0,1). The coefficient values are determined by the output signal from the neuron. The orthogonality of the base function is not necessary. The values of the neural networks are determined in the training phase from the condition of the energetic function minima. The spurious solutions corresponding to the local minima have been studied using the Ljapunov´s stability criteria. In the present, many producers are declaring the production of the Electrically Trainable Artificial Neural Networks (ETANN). Design of the

neural based multiparametrical quantizers implemented on these circuits is a final aim.

The digital methods of systematic error correction in the processing circuits of intelligent measuring systems is another research objective of this scientific group. In the framework of this tasks the methods of A/D converters testing with using the FFT of the harmonic test signal are being studied. The stress is given to the dependence between the number of testing samples and the accuracy of resulting correction function. The dynamic properties of the above mentioned methods are studied simultaneously.

Statistical sensors

The statistical sensor has been the next component which measured information is represented by the probability of the one binary state occurrence in the output signal. Its advantage is small dimension, sensitivity on the wide scale of the physical quantities and possibility to create the field of sensors.

The simple principle of an information conversion and transmission designate the sensors for the application in the smart sensors. There is possible to realize diagnostic and autocalibration very simple. That is a necessary condition for the special applications in the sensing of the nonelectrical quantities with high grade of the reliability (nuclear energetic and traffic systems).

Multilevel memory elements

The multilevel memory cell has been another component of the fuzzy logic structure. The goal of the study of its dynamic behavior is to find out the influence of the control pulse parameters on the memory cell ability to rewrite or damage the written information. The response of the multilevel memory cell on the control pulse has been advantageous to study using a computer

simulation. The present state of the computer technology enables us to suppose the computer simulation to be equivalent of the physical verification. This is especially advantageous in the cases when the studied cell is a part of the integrated circuits structure with tiny geometrically dimensions.

International cooperation

Research area: **Neural based AD converters**
University of Calabria, Rende (CS), Italy, Dept. of Electronics, Informatics and Systems Theory.
EC Tempus project preparation, Ph.D. students exchange

Research area: **Chaos in Nonlinear Circuits**
Long-term study stay L. Pivka
Cal Tech, Berkeley, California, USA, Dept. of Electronics and Computer Science.

Member

Michaeli Linus, Head of Slovak IMEKO Technical Committee TC-4 "Measurement of Electrical Quantities".
Michaeli Linus, Member of Technical Standardization Commission No. 55 for Electroacoustics and Ultrasound in Slovakia.

PUBLICATIONS

Journal Papers

Marchevský,S.-Drutarovský,M.-Galajda.P.: Brain Machines, Technická Revue 3/94, Košice, pp.12-13.

Daponte,P.-Grimaldi,D.-Michaeli,L.: Gray Code ADC Based on an Analogue Neural Circuit. Submitted for publication in Radioengineering, No.1./95

Michaeli,L.-Somora,M.-Kalakaj,P.-Šak,P.:Auswertesystem für Mechanische Deformation. (Preprocessing System for the Mechanical Forces Instrumentation.) Accepted for publication in the monography

"Multisensorik Praxis", Editor Dr.-Ing.habil.H.Ahlers, Springer Verlag Berlin, 1995.

Pivka,L.-Zeleznyak,A.L.-Chaiwah,W.-Chua,L.O.: Arnold's Tongues, Devil's Staircase and Self/Similarity in the Driven Chua's Circuit. Accepted for publication in the Int. Journal of Bifurcation and Chaos, 1995.Conference Papers

Michaeli,L.-Pirč,V.-Šaliga,J.-Frič,T.: Rýchla metóda vyšetrovania charakteristík dvojparametrického kvantizátora na báze analógových neurónových sietí. (Fast Method for the Characteristic Determination of Two-Parametrical Neural Based Quantizer.) Scient. Conf. TU Košice Sept. 1994, pp.185-190.

Daponte,P.-Grimaldi,D.-Loizzo,E.-Michaeli,L.-Caputo,L.: A New Approach of Analogue Neural Networks Design for Analogue-Digital Converter. Proc. of EDS´94, VUT Brno, Czech Republic, November 22-23, 1994.

Špány,V.-Pivka,L.-Galajda,P.-Guzan,M.-Kalakaj,P.-Šak,A.: The Calculation of Symetrizing Voltage in Flip-Flop Sensors. Scient. Conf. TU Košice Sept. 1994, pp.22-27.

Guzan,M.:Tvorba softwaru pre symetrické štruktúry preklápacích senzorov v kontexte s ekvivalentným napätím a skúmaním jeho citlivosti na zmenu obvodových parametrov. (The Software Design for the Symmetrical Switching Sensors with the Relation to the Equivalent Voltage and the Circuit Parameter Sensitivity.) Sc.Conf. TU Košice, Sept. 1994, pp.22-27.

Marchevský,S.-Drutarovský,M.-Galajda,P.-Kocur,D.: Application of Digital Filters in Brain - Machine Apparatus. Proc. of the 12th Scient. Conf. "Biosignal'94", Brno, Czech Republic pp.170-172.

Levický,D.- Drutarovský,M.- Galajda,P.- Marchevský,S.: Harmonický analyzátor sie□ ového napätia.(Power Voltage Harmonic Analyzer.) Proc.

of Sc. Conf. "Rádioelektronika '94", Apr.1994, Brno, Czechia, pp.141-144.

Michaeli,L.-Kalakaj,P.: Obvod spracovania signálu z tenzometrického mostíka s vysokou citlivosťou. (Preprocessing Circuit for Strain Gauge Bridge with High Sensitivity.) Proc. of 32nd Conf. EAN, VŠST Liberec, Czech Republic, May 1994, pp.131-134.

5. FACULTY ESSAYS

Chudáèik Milan
Assistant professor
His research interests are in digital signal and image processing, Hough transform and Hough transform processors.

Èižmár Anton
Associated professor
His research interests include speech processing, neural networks, data compression and digital communications.

Doboš ¼ubomír
Assistant professor
His current interests are in the linear adaptive digital filters, least Mean Square algorithms and QR decomposition.

Drutarovský Miloš
Assistant professor
His research interests include neural networks, nonlinear digital filters for image processing, digital signal processors and microcontrollers.

Fedor Michal
Assistant professor
His main research interests are microprocessors, digital picture processing.

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

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.

Juhár Jozef
Assistant professor
His research interests are in the application of various signal processing methods in pitch detection and tracking algorithms for speech and audio.

Klenovièová Zita
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Her research interests include digital circuits and digital picture processing.

Kocur Dušan
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His present fields of interest are digital signal processing particularly time-invariant linear digital filters, adaptive linear and nonlinear (Volterra) digital filters as well as speech enhancement.

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

Maceková ¼udmila
Assistant professor
Her general research interest includes design and implementation algorithms for two and three dimensional median 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
Research assistant
His research interest include digital picture processing.

Michaeli Linus
Full professor
His research interests are in the preprocessing systems in the instrumentation, simulation of the AD converters and modeling of their systematic error models.

Mihalík Ján
Associated 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 ¼uboš
Research assistant
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, system sand methods.

Špány Viktor
Full professor
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.

6. Ph.D. Programme

Name	Supervisor	Field
Fourth year of study		
Ing.Gabriel Hanko	prof. Michaeli	ADC converter
Ing. Martin Dulina	doc. Mihalík	digital picture coding
Ing. Juraj Futó	prof. Turán	optical communication
Second year of study		
Ing.Friè Tomáš	prof.Michaeli	neural networks
Ing.Jacko Miroslav	prof.Turán	Hough transform, DIP
Ing.Kövesi Mikuláš	prof.Turán	Rapid transform, DIP
Ing.Raèek Jozef	doc.Marchevský	Kalman's filters, DIP
Ing.Orosz Štefan	prof.Michaeli	AD converters
Ing.Segeïa Viliam	doc.Marchevský	neural digital filters
Third year of study		
Ing.Böhmann Peter	prof.Levický	picture sequence processing
Ing.Dzivý Jozef	doc.Mihalík	digital signal processing
Ing.Kövesi Ladislav	prof.Turán	rapid transform, DIP
Ing.Král Peter	prof.Levický	digital picture coding
Ing.Probstner Róbert	prof.Turán	fibre optical sensors
Ing.Šak Andrej	prof.Špány	small signal quantities measur.
Ing.Štiblár Zoltán (dist. form)	prof.Turán	Rapid transform
Fourth year of study		
Ing.Balco Peter	doc.Marchevský	digital filtration
Ing.Guzan Milan	prof.Špány	smart sensors
Ing.Hámorský Jozef	doc.Èižmár	digital speech processing
Ing.Chromek Peter (dist. form)	prof.Levický	mathematic morphology
Ing.Kalakaj Peter	prof.Špány	oscillator sensors
Ing.Kuba Igor	doc.Mihalík	digital image processing
Ing.Labovský Ladislav	doc.Mihalík	digital signal processing
Ing.Mihok Marián (dist. form)	prof.Turán	optically powered sensors
Ing.Oleg Tkáè (dist. form)	prof. Turán	optical communications

7. OTHER ACTIVITIES

7.I. Conferences Seminars and meetings

Organization of the Scientific conference with international participation in Her¾any, September 1994.

7.2. Study tours

Ing. Jozef Hámorský
University Erlangen-Nůrmberk, FRG

Prof.RNDr.Ing. Ján Turán, DrSc.
6 month visiting prof. stay at University of London, King's College, Dept. of El. Eng. supported by Masaryk research fellowship, October 1994 - March 1995.

Ing. Milan Chudáèik
University of Ljubljana, Slovenia, November, 20-25th 1994

Ing. Mikuláš Kövesi, Ing. Ladislav Kövesi
BME Budapest, Hungary, November, 7-18th 1994

Prof.Ing. Linus Michaeli, CSc.
14 weeks visiting prof. stay at the University of Calabria, Rende (CS), Italy, Dept. of Electronic, Informatics and System Theory, April, June, Nov.-Dec. 1994.

7.3. Visitors and visits

Dr. Horst Jonuscheit (MEDAV Digitale Signalverarbeitung GmbH, Germany, vice-president)

Prof. Reiner Thomä (Technische Universität Ilmenau, Germany)

Prof. Dr. A.C.Davies, University of London, King's College, Dept. of Electrical Eng., U.K., August 1994

Prof. R.Rougny, Doc. R.Fouket, ISTASE Saint Etienne, France, October, 13-15th 1994

Dr. Zenon Ulman, Polytechnika Gdanska, Dept. of Informatics, Poland, Sept., 12-14th 1994

Èižmár, A., Technical University Miskolc, Hungary, February, 10th 1994

Èižmár, A., Delft University of Technology, The Netherlands, November, 14th 1994

Èižmár, A., Technical University Csestochova, Poland, Faculty of Electrical Engineering, December, 1-3rd 1994

Èižmár, A., Brussels, Belgium, September, 12th 1994, 1st Management Committee Meeting of the Action COST 249.

Èižmár, A., Amsterdam, The Netherlands, November, 14-15th 1994, The 2nd Management Committee Meeting of the Action COST 249.

7.4. External lectures

Courses given for technicians :

1. Introduction to microprocessors systems (5 days)
2. Application of microprocessors systems (5 days)
3. Programming of microprocessors systems (5 days)
4. Introduction to digital circuits (6 days)
5. Introduction to C language (5 days)
6. C language, advanced course (5 days)
7. Computer and MS DOS (5 days)
8. EXCEL 4.0 (5 days)
9. Operational amplifier - characteristics and applications (5 days)
10. Introduction to microprocessor systems (5 days)
11. Analog&Digital signal processing using personal computers (5 days)
12. Introduction to impulse power sources (5 days)

13. New trends in measuring technology - methods and devices (5 days)

Courses given for engineers with technical education.

1. Signal processors (5 days)
2. Optoelectronics (5 day)
3. Optoelectronics systems (5 day)
4. Microprocessors systems on 8O48 (5 days)
5. Microprocessors systems on 8O51 (5 days)
6. Digital Filters for Speech and Image Processing (1 semester)

For further information :

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