

STU
FEI

SLOVENSKÁ TECHNICKÁ
UNIVERZITA V BRATISLAVE
FAKULTA ELEKTROTECHNIKY
A INFORMATIKY

2011



INSTITUTE OF ELECTRICAL ENGINEERING

ANNUAL REPORT
SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA

INSTITUTE OF ELECTRICAL ENGINEERING

www.ue.fei.stuba.sk



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General Information

The Institute of Electrical Engineering FEI STU is a direct successor of the Institute of Theory and Experimentation in Electrical Engineering at the Slovak Technical University (SVŠT). This Institute was the first establishment of the Department of Electrical Engineering at the Faculty of Mechanical and Electrical Engineering of SVŠT in Bratislava and hence, it became the foundation institution for education of electrical engineers in Slovakia. This institute was constituted together with the Faculty in 1941 and thus its 70th anniversary was celebrated last year. The founder of the Institute was Prof. Dr. Ing. Ľudovít Kneppo, DrSc., who was also appointed the first Dean of the Faculty of Electrical Engineering at SVŠT, after that it gained its autonomy. Right from the beginning, the Institute addressed all theoretical and engineering aspects of electro-technology including measuring methods which were an integral part of the branch. Due to the broad scope of its scientific profile, several departments and working groups were formed within the institute.

These later on, because of further development of the specific scientific disciplines, separated. In the 1950s the Institute was renamed to Department of Theory and Experimentation in Electrical Engineering (KTEE) and as such it existed until 2011.

Besides the group of Electric Measurement (headed by Assoc. Prof. J. Gyárfáš, PhD.) there was also the group of Theory and Measurement of Electric Machines (headed by Assoc. Prof. Ing. I. Mayer, PhD.) at the Department. The Test-room of Electric Machines which the group built right off, was rather unique in Slovakia at the time. It was in operation until 1986 when after the Faculty moved to new premises in Mlynská dolina, it ceased to exist. Part of its machinery was relocated to the Department of Electric Machines and Devices as had been the related lectures some time ago. Another quickly developing group of Applied Magnetism (headed by Prof. Ing. O. Benda, DrSc.) dealt with a wide spectrum of problems in the field of magnetism and magnetic materials, stretching from research into ferrite cores for then contemporary computer memories and magnetic-bub-

ble memories to microwave applications of magnetic phenomena. There was another thriving group of Power Electronics and Non-linear Electromagnetism (head Assoc. Prof. Ing. J. Oravec, PhD.) doing research into semiconductor switching high-power impulses, as well as generation, propagation and application of high-power electromagnetic pulses on non-linear lines. The youngest group formed at the Department was that of Optical Fibre-lines (headed by Prof. Ing. J. Jasenek, PhD.). Since 1978 it has been a pioneer in Slovakia in research of the emerging branch of electromagnetic waves propagation in optical frequency band, and in information transport in linear and non-linear waveguides. The high level and progress of the KTEE department can be seen from the fact that a textbook published in the 1950s brought a method designed for the numerical harmonic analysis of signals, later known as the "discrete Fourier transform" which became a springboard of many methods in developing the "Signal processing" branch in the 1970s.

The Department of Electric Measurement was gradually extending its profile. Apart from classic measurement it was dealing with telemetric problems, metrology and sensorics. A remarkable advance of this area went hand in hand with spreading of microprocessor applications and, in general, with a shift from analogue to numerical methods in measurement science, in which the group played a leading role not only at the Faculty but also in Slovakia. 1974 was the initial year of education in the area of Measurement Technology, branch of Technical Cybernetics. This was a natural result of the industry and research & development demands to grow experts in the field of electrical engineering with a solid expertise in technical cybernetics and computational techniques and at the same time with a deeper training in the theory and practice of measurement and measuring systems providing abilities to meet practical needs of measurement with the current computational means. Foundation of a new department dealing with measurement technology was backed by the fact that a number of research institutions and enterprises appearing at that time demanded new experts in this field. Due to the growing volume and extent of work both in teaching and research, the foundation of a separate Department of Measurement became inevitable. This happened by the split of KTEE in 1980, when the Department of Measurement (KMER) was established. Its first head was Assoc. Prof. Ing. Juraj Gyárfáš, PhD.

Research at the Department of Measurement was focused on three main directions. There were works in the field of pedagogical research (Prof. J. Bajcsy), further research into higher harmonic components influencing the measurement and determination of the basic electric quantities, such as voltage, current and power. This intent originated from the measurement group of the former KTEE department (Assoc. Prof. J. Gyárfáš, later Assoc. Prof. P. Kukuča). The third course which started to develop right after the department was established,

could be depicted as Automated Instrumentation (Prof. V. Smieško). In the forthcoming period the Department not only extended its work in the above three main areas, but it was also working on other tasks. For successful solution of these the group from the Department was awarded the National Prize of the Slovak Republic in 1988. Thanks to the achievements in research and development, the Department of Measurement started building a Laboratory of Unique Measuring Apparatuses in 1982. In 1986, the Production Laboratory (RELA) was established at EF SVŠT and it was supervised by the Department.

The characteristic feature of research at the Department of Measurement in the 1980s was that except several issues it was based on co-operation with industry. The largest number of solution results was of implementation kind, usually as an apparatus, or a fully automated workplace. In the early 1990s, due to the existing technical and personal infrastructure, the research at KMER was aimed at the field of metrological aspects of measurements, modern testing methods (diagnostics), visual systems and electromagnetic compatibility of electrical and electronic devices and appliances. For electromagnetic compatibility purposes of electronic devices, a shielding-chamber with efficiency more than 100 dB, in the frequency range 100 kHz to 8 GHz, sized 4,5 x 4,5 x 8,5 m was built. The Laboratory of Electromagnetic compatibility was provided with a special room for testing purposes in a framework of accredited Test-room FEI STU, to perform accredited measurements of radiation level of the high frequency disturbing electromagnetic emission and tests of the robustness with respect to different forms of electromagnetic disturbances.

Prof. Dr. Ing. L. Kneppo, DrSc. headed the KTEE till 1970. Prof. Ing. O. Benda, DrSc. headed the KTEE between 1970 and 1986. He was followed by Assoc. Prof. Ing. Ľ. Šumichrast, PhD. between 1986 and 1990, Assoc. Prof. Ing. P. Kaboš, PhD. from 1990 to 1991, Assoc. Prof. Ing. F. Viršik, PhD. 1991 – 1992, Prof. Ing. J. Sláma, PhD. 1992 - 1995, and again Assoc. Prof. Ing. Ľ. Šumichrast, PhD. 1995 – 2011.

KMER was headed by Assoc. Prof. Ing. J. Gyárfáš, PhD. from 1980 to 1986, Assoc. Prof. Ing. D. Kodaj, PhD. from 1986 to 1989, Prof. Ing. J. Bajcsy, PhD. from 1990 to 1994 and Assoc. Prof. Ing. P. Kukuča, PhD. from 1994 to 2000. Prof. Ing. V. Smieško, PhD. continued heading the Department between 2000 and 2011 when these two departments merged and gave rise to the Institute of Electrical Engineering on 1 May 2011 with Prof. Ing. Viktor Smieško, PhD. as the head, which concluded the evolution by returning to its roots after 31 years.

After foundation of the Institute of Electrical Engineering, the Department of Measuring Technology became a successor of the Department of Measurement in education and research. The Department members sponsor the undergraduate course Measurement and Information Technology, postgraduate course Meas-

urement Technology and partly also the Metrology course. The main area of research at the Department is problems of electromagnetic compatibility of electric appliances and providing the metrologic properties of pertinent measurements. The EMC laboratory, which is part of the Department, and due to its equipment and personal structure it belongs to high-tech laboratories at the Slovak University of Technology and at the same time it assures close cooperation between the Department and companies designing electrical appliances both in and outside Slovakia. The EMC laboratory team future targets concentrate on improvement of precision and reproducibility of the EMC tests of common and large systems.

Another important field is digital processing of pictures and analysis of methods for picture description by utilizing the means of artificial intelligence. The common goal is state recognition or quantification of object properties based on picture information. In the future, the group will be aiming at detection of position of significant points in a picture, as well as at calibration of non-metric cameras. Finally, the group members are involved in diagnostic systems and precise measurements in power engineering.

The working group, originally dealing with optical wave guides has become the basis of the newly established Department of High-frequency Technology and Optoelectronics of the Institute of Electrical Engineering. At present this Department is oriented namely towards theoretical research and applications of optic-fibre sensors with distributed parameters on the basis of standard and specific optical fibres, like polarisation optical fibres, structured fibres, or photonic crystals and fibres with implemented Bragg lattices.

The main current outcome of the research work of this group is a prototype of an optic fibre reflectometer built as a combination of PC OTDR (Photon-Counting - Optical Time-Domain Reflectometry) and „PO-OTDR“ (Polarization - Optical Time-Domain Reflectometry) as the basis for numerous fiber-optic sensor systems. In the future, the group will deal with numeric modelling of optical-fiber interaction with external physical quantities that are subject to sensoric scanning, being the fundamental demand for development, fabrication and application of the fiber-optic sensors with distributed parameters.

At present, the group of applied magnetism has become the fundamental part of the Department of Electromagnetic Theory at the Institute of Electrical Engineering. Following the long-term tradition that started in 1963 by systematic research and publication of original results. Research activities of the group were focused on several key issues, such as preparation of metal-oxides (Fe based ferrites) for a wide range of applications like transformer cores, high-capacity recording media, insulators, circulators, cores for suppressors, micro-electro-mechanical systems (MEMS), micro-actuators and

further modern elements have to be mentioned. Substituted ferrite powders with small cores (10-100 nm) prepared by the group can be used as fillers in composite materials to shield unwanted electromagnetic microwave fields. The application in targeted distribution of medicaments into tissue with pathologic changes seems to bring about promising outcomes.

Besides preparation of materials, attention is also paid to development of experimental techniques allowing study of magnetic properties of different kinds of hard and soft magnetic materials (ferrites, oriented and non-oriented electrical steels, amorphous and nanocrystalline materials, construction steels etc) in a variety of working conditions, e.g. automated experimental apparatuses were designed using analogue (hardware) and digital (software) feedback to measure magnetic characteristics under precisely defined conditions, such as frequency, amplitude and prescribed waveforms of magnetic intensity and/or magnetic induction.

One of the studied items is non-destructive testing, particularly a method based on the Barkhausen noise analysis (BNA) as a promising tool in Magnetic Adaptive Testing (MAT).

The activities in this area have led to establishing the Universal Network for Magnetic Non-Destructive Evaluation (UNMNDE) focused on materials used in nuclear plant vessels, continuous in-field testing, where the members of the group were among the founding members.

The high standard of the research activities is accentuated by the fact that the Department staff regularly attend conferences on applied magnetism and the results of their research are published in recognised journals leading to hundreds of citations. Department members sponsor the doctoral course Electromagnetic Theory.

Department of Modelling of Electromagnetic Structures and Systems as a newly constituted working group, intends to fill a vacancy in the development of modelling methods and electromagnetic field simulations. The Department mainly deals with the advancement in the beam-propagation methods (BPM), finite-difference time-domain method (FDTD), and the moment method (MoM) from the standpoint of modification of individual methods for various, non-standard solutions of electromagnetic tasks (varying electromagnetic environment, lossy environment, inhomogeneities, non-ideal properties of media, the curves approximations etc). The main targets for utilization of these methods are microwave applications, antennas and propagation of electromagnetic waves, as well as sensors of non-electric quantities based on a change of microwave electromagnetic field properties. The Department cooperates with the Slovak Academy of Sciences (SAV) in the field of modelling, simulation and application of MEMS, where unification of mechanical and high-frequency parts of these systems – measurement and transfer of forces, distances, pressures etc represent the essential problem.

DEPARTMENTS OF THE INSTITUTE:

Department of Measurement

Department Chair: Ing. Mikuláš Bittera, PhD.

Department of High-frequency Techniques and Optoelectronics

Department Chair: prof. Ing. Jozef Jasenek, PhD.

Department of Electromagnetic Theory

Department Chair: doc. Ing. Elemír Ušák, PhD.

Department of Electromagnetic Structures and Systems Modelling

Department Chair: doc. Ing. René Hartánský, PhD.

I. STAFF

Professors:

prof. Ing. Jozef Jasenek, PhD., prof. Ing. Viktor Smieško, PhD., professor emeritus Ing. Július Bajcsy, PhD., professor emeritus Ing. Jozef Sláma, PhD.

Associate Professors:

doc. Ing. Ivan Bojna, PhD., doc. Ing. Jan Bydžovský, PhD., doc. Ing. Rastislav Dosoudil, PhD., doc. Ing. René Hartánský, PhD., doc. Ing. Peter Jahn, PhD., doc. Ing. Vladimír Jančířik, PhD., doc. Ing. Karol Kováč, PhD., doc. Ing. Peter Kukuča, PhD., doc. Ing. Rudolf Ravas, PhD., doc. Ing. Lívia Syrová, PhD., doc. Ing. Ľubomír Šumichrast, PhD., doc. Ing. Elemír Ušák, PhD.

Assistant Professors:

Ing. Jozefa Červeňová, PhD., Ing. Oľga Čičáková, Ing. Jaroslav Franek, PhD., Mgr. Ján Gřman, PhD., Ing. Miroslav Kamenský, PhD., Ing. Mojmír Kollár, PhD., Ing. Eva Králiková, Ing. Pavol Krivošík, PhD., Ing. Iveta Ondrášová, PhD., Ing. Marian Štofka, PhD., Ing. Vladimír Olah, PhD.

Senior Scientists:

Ing. Ján Bezek, PhD., Ing. Vladimír Bilík, PhD., Ing. Mikuláš Bittera, PhD., Ing. Jozef Hallon, PhD., Ing. Anton Krammer, Ing. Jozef Pala, PhD., Ing. Imrich Szolík, Ing. Martin Šoka, PhD., Ing. Marianna Ušáková, PhD.

Technical Staff:

Mária Brunovská, Milan Brunovský, Marta Jančovičová, Ružena Nagyová, Alojz Vďačný

PhD. Students:

Ing. Miroslav Földi, Ing. Branislav Korenko, Anton Krammer, Ing. Lukáš Maršalka, Ing. Lukáš Šroba, Ing. Marek Šuplata, Ing. Gabriel Vályk



II. EQUIPMENT

II. 1 Teaching and Research Laboratories

- Electromagnetic Compatibility (EMC) Laboratory with a 4,5 x 4,5 x 8,5 m Semi-anechoic
- Shielded Chamber
- Laboratory of Distributed Measurement Systems
- Laboratory of Digital Signal Processing
- Laboratory of Electrical Measurements
- Laboratory of Nonelectrical Quantities Measurement
- Precise Measurement Laboratory
- Laboratory of Microprocessor Engineering
- Laboratory of Visual Systems
- Laboratory of Diagnostics Systems
- Laboratory of Power and Energy Measurement
- Laboratory of Electric Circuits
- Laboratory of Electromagnetic Field
- Laboratory of Optoelectronics
- Laboratory of Signal Processing
- Laboratory of Microwave Technology
- Laboratory of Pulse and Nonlinear Electrodynamics
- Laboratory of Electronics
- Laboratory of Applied Magnetism
- Laboratory of Magnetic Measurement
- Laboratory of Magnetic Materials Testing
- Laboratory of Magnetic Materials Technology
- Laboratory of Chemical Technology

II. 2 Special Measuring Instruments and Computers

- Calibrator DATRON 4700
- Digitizing Oscilloscopes up to 1 GHz, 5 GSa/s
- VXI System (VX 4236 Digital Multimeter, VX 5520 VXI Slot Resource Manager, VX 1500 VXI Mainframe, VX 4223 Counter/Timer)
- GPIB System (NI GPIB Interfaces, Agilent 34401A Multimeters, 33120A Generators, 53131A Counters, E364XA Programmable Power Sources)

- EMC Design & Development System (8591A Spectrum Analyzer and 11945A Close Field Probe Set)
- EMC Analyzer Agilent E7405A up to 26GHz
- RF Measuring Receivers 9 kHz - 7 GHz (R&S - ESPI7, ESHS10, ESVS10)
- Handheld Spectrum Analyzer R&S FSH 8 up to 8 GHz
- Time Domain EMI Measuring Receiver TDEMI 1G up to 1 GHz
- RF Network Analyzer Agilent E5071C-285 up to 8 GHz
- Impedance Measurement System Hioki 3522-50, DC - 100 kHz
- RF Signal Generators (Agilent E8257D up to 20 GHz and R&S SMH up to 2 GHz)
- RF Power Amplifiers (AG 1020 - 50 W 10 kHz-20MHz, AR 150W1000 - 150 W 80 MHz - 1 GHz, Prana AP32DT150 - 50 W 10 kHz - 1 GHz, Milmega AS0840-30/17 - 30 W 0.8 - 4 GHz, AR 154G11 - 1 W 4 - 10.6 GHz)
- Measuring Antenna Set (BiLog, Biconical, LPDA, Rod, Loop, Horn, Dipole) DC - 40 GHz
- Electromagnetic Field Intensity Meter (C.A. 42 DC - 400 kHz, HI6105 100 kHz - 6 GHz)
- Analyzers of Single Phase System HA1600 and 3-Phase System KEW6310;
- Programmable AC/DC Power Supply Chroma 61503 1500VA;
- Electrostatic Discharge Simulators up to 30 kV (Emtest ESD30N and Haefely PESD1600);
- Electric Fast Transient Simulators (Emtest EFT500N5 and Haefely PEFT);
- Surge Generator Emtest VSC500;
- Line Impedance Stabilization Networks (1-Phase ESH3-Z5 and 3-Phase NNLK8121);
- Reference Noise Generator CGE 01 up to 18 GHz;
- Set of Impedance Stabilization and Coupling/Decoupling Networks;
- EM Field Simulation Computer Station ThinkStation D20 with FEKO Solver;
- Measurement Software (LabView, R&S EMC32);
- Michelson Interferometer for Measurement of Chromatic Dispersion of Single Mode Optica
- Fibres;
- Apparatus for Generation of Second Harmonics in Optical Frequency Range;
- Apparatus for Back-Scattering Measurement in Optical Fibers Using Photon Counting Method;
- Correlator and Signal Analyzer, frequency range to 50 kHz;
- Microwave Power Meter HP-432 B;
- Spectral Analyser 10 MHz - 4 GHz;
- Precision Wattmeter 104B, 4mW - 60 kW, up to 200 kHz;
- VSM Magnetometer, Hm up to 0.8 MA/m, temperature range 77 K - 800 K
- Precision Gaussmeter, 1 μ T - 10 T at DC, up to 1 kHz AC
- Lock-In-Amplifier DSP SR 850 2nV to 1V;

- High Coercivity Measuring Apparatus;
- PC Controlled AC/DC Hysteresisgraph;
- Automated System for Magnetic Susceptibility Temperature Dependence Measurement Universal Counter HP53132A up to 12.4 GHz;
- Vibrator DERRITRON SC-3000 – mechanical resistance testing equipment;
- RF Impedance/Material Analyzer HP4191 A 1 MHz-1 GHz, 1 mOhm - 100 kOhm, APC-7 coaxial (50 Ohm) input, GPIB standard; spot, linear and logarithmic frequency sweep;
- HP4192A LF Gain Phase - Impedance Analyser, 5 Hz - 13 MHz, 1 mOhm - 1 MOhm, GPIB;
- Optical Fibre Reflectometer JDSU - MTS 6000L;
- Optical Fibre Polarimeter – POD-101D - General Electronics;
- Vector Network Analyzer Agilent 8714ET, 300 kHz - 3 GHz, GPIB interface;
- Vector Network Analyzer Agilent E5071C, frequency range 9 kHz - 6.5 GHz, S-parameter test set, 2 ports 50 Ohm without bias tees;
- Optical Fibre Spectral Analyzer „Ocean Optics“ NIRQuest 512
- Supercantal furnace 1016S CLASIC CZ, spol.s r.o.



III. TEACHING

III. 1 Undergraduate Study (Bc.)

Subject, semester, hours per week for lectures and for seminars or practical exercises, name of the lecturer

Introduction to Engineering	(1st sem., 2-2 h)	R. Ravas
Measuring Information Systems	(3rd sem., 2-2 h)	L. Syrová
Measurement	(4th sem., 2-3 h)	P. Kukuča
Diagnostics and Testing of Automobiles	(6th sem., 2-2 h)	K. Kováč
Microprocessor Engineering	(6th sem., 2-2 h)	R. Ravas
Technical Diagnostics	(6th sem., 3-2 h)	K. Kováč
Measurement Technology	(3rd sem., 2-3 h)	V. Smieško

Measurement Technology
(4th sem., 2-3 h) V. Smieško

Computer Architecture
(2nd sem., 3-2 h) R. Ravas

Measurement in Information Technology
(5th sem., 2-2 h) R. Hartánský

Methodology of Measurement
(5th sem., 2-1h) L. Syrová

Electric Circuits I
(2nd+3rd sem., 3-2 h) V. Jančárik, R. Dosoudil

Electrotechnology I
(2nd+3rd sem., 3-2 h) J. Červeňová, M. Kollár

Electric Circuits II
(3rd+4th sem., 3-2 h) E. Ušák, R. Dosoudil

Electrotechnology II
(2nd+3rd sem., 3-2 h) L. Šumichrast, M. Kollár

Electromagnetic Field
(4th+5th sem., 3-2 h) J. Jasenek

Basics of Electrical Engineering
(FIIT 3rd sem., 3-2 h) V. Jančárik

Electronics
(FIIT 4th sem., 3-2 h) E. Ušák

III. 2 Graduate Study (Ing.)

Electromagnetic Compatibility
(2nd sem., 3-2 h) R. Hartánský

Electromagnetic Compatibility
(1st sem., 3-2 h) R. Hartánský

Visual Systems
(3rd sem., 2-3 h) R. Ravas

Telemetry and Information Transmission
(3rd sem., 3-2 h) P. Kukuča

Telemetry and Information Transmission
(4th sem., 3-2 h) P. Kukuča

Theory of Measuring Systems
(2nd sem., 3-2 h) R. Ravas, L. Syrová

Digital Signal Processing
(2nd sem., 3-2 h) K. Kováč

Digital Signal Processing
(3rd sem., 3-2 h) K. Kováč

Distributed Measurement Systems
(1st sem., 2-3 h) V. Smieško

Distributed Measurement Systems
(3rd sem., 2-3 h) V. Smieško

Digital Image Processing
(1st. sem., 2-3 h) R. Ravas

Diagnostic Systems
(1st. sem., 3-2 h) K. Kováč

Diagnostic Systems
(3rd sem., 3-2 h) K. Kováč

Designing of Information Systems
(1st sem., 2-3 h) R. Ravas

Methods and Tools of Artificial Intelligence
(2nd sem., 2-3 h) R. Ravas

Methods and Tools of Artificial Intelligence
(4th sem., 2-3 h) R. Ravas

Metrology, Testing and Quality Control
(2nd sem., 3-2 h) P. Kukuča, R. Hartánský

Diagnostics and Electromagnetic Compatibility
(2nd sem., 3-2 h) K. Kováč

Telemetry and Distributed Measurement in Automobiles
(4th sem. 2-2 h) V. Smieško

Electromagnetism
(SvF 1st sem., 2-2 h) L. Šumichrast

Modelling of Fields
(1st sem., 2-2 h) L. Šumichrast

Numeric methods in Electromagnetism
(SvF 1st sem., 2-2 h) L. Šumichrast

Safety of Electric Equipment
(2nd sem., 2-1h) I. Bojna

Optical Waveguides
(3rd sem., 2-1h) J. Jasenek

III. 3 Distance Study (Bc.)

Measurement Technology
(6th sem.) V. Smieško

Measuring Information Systems
(5th sem.) R. Hartánský

Methodology of Measurement
(7th sem.) L. Syrová

Technical Diagnostics
(8th sem.) K. Kováč

Computer Architecture
(2nd sem.) R. Ravas

Electrotechnology
(2nd+3rd sem., 3-2 h) J. Sláma, E. Ušák,

Theory of Electricity I
(2nd+3rd sem., 3-2 h) J. Bydžovský, M. Kollár

Theory of Electricity II
(2nd+3rd sem., 3-2 h) P. Jahn, M. Kollár

Theory of Electricity II
(2nd+3rd sem., 3-2 h) I. Bojna, J. Franek, J. Sláma

III. 4 Distance Study (Ing.)

Methods and Tools of Artificial Intelligence
(2nd sem.) R. Ravas

Visual Systems
(3rd. sem.) R. Ravas

Electromagnetic Compatibility
(2nd sem.) K. Kováč

III. 5 Undergraduate Study for Foreign Students (in English Language)

Measurement Technology
(3rd sem.) V. Smieško, L. Syrová

Electronic Measurement
(4th sem.) P. Kukuča

Microprocessor Systems
(7th sem.) K. Kováč

Methodology and Measurement
(5th sem.) L. Syrová

III. 6 Graduate Study (Ing.) for Foreign Students (in English Language)

Electromagnetic Interference and Compatibility
(1st sem.) K. Kováč



IV. RESEARCH PROJECTS

IV. 1 National Scientific Projects

- Electromagnetic Compatibility of Large Systems, VEGA 1/0551/09 Duration: 2009–2011 (completed) (V. Smieško)
- Research and Preparation of Prospective Magnetic Nanomagnetic and Hybrid Composite Materials for New Applications in Electrotechnology, Electronics, and Car Production, VEGA 1/0575/09 Duration: 2009–2011 (completed) (J. Sláma)
- Optical Fibre Sensors and their Application, VEGA 1/0617/09 Duration: 2009–2011 (completed) (J. Jasenek)
- Diagnostics of Electrical Steels and Construction Ferromagnetic Materials by Means of Novel Magnetic Defectoscopy Methods, VEGA 1/0747/09, Duration: 2009–2011 (completed) (E. Ušák)
- The Use of Image Information in the Measurement and Diagnostics, VEGA, 1/0490/10 Duration: 2010–2011 (completed) (R. Ravas)
- Selected Effects of High-Frequency Electrodynamics - Methods and Algorithms of Computer Simulation with Applications, VEGA 1/0377/10 Duration: 2010–2011 (completed) (L. Šumichrast)
- Research and Synthesis of Electronic Composites and Magnetic Dielectrics, VEGA 1/0529/10 Duration: 2010–2011 (completed) (R. Dosoudil)
- Construction and Control of Micro-electro-mechanical Elements and Devices, VEGA, 2/0006/10 Duration: 2010–2012 (completed) (R. Harňanský)
- Support of Research and Development Infrastructure from the Point of View of Electromagnetic
- Compatibility Requirements, State Research and Development Program, 338/2003 Duration: 2003–2011 (completed) (K. Kováč)

IV. 2 International Scientific Projects

- Applied Research and Development of Innovative Bore Technique for Ultra Deep Geothermal Drillings, Directed by - Geothermal Anywhere, s.r.o. (ITMS: 26240220042) (Challenge: OPVaV-2009/4.2/03-SORO) Duration: 2010–2012 (continued) (J. Jasenek, E. Ušák)
- Effective Control of Production and Consumption of Energy from Renewable Resources, ENERGOZ 26240220028, Operational Programme Research and Development, European Regional Development Fund Duration: 2010–2013 (continued) (V. Smieško, M. Bittera, R. Hartanský)
- Increase of Power Safety of the Slovak Republic (ITMS: 26220220077), Operational Programme Research & Development, European Regional Development Fund Duration: 2011–2013 (continued) (K. Kováč)
- Center of competency for new materials, advanced technologies and power engineering (ITMS 26240220073) Duration: 2011–2014 (continued) (P. Kukuča)
- Universal Network for Magnetic Non-Destructive Evaluation” (UNMNDE) Duration: from 2005–(continued) (J. Bydžovský, E. Ušák, J. Paľa)
- ELLEIEC (Enhancing Lifelong Learning in Electrical and Information Engineering), 142814-LLP-1-2008-FR-ERASMUS-ENW, project funded by the European Commission, SOCRATES Thematic Network Duration: from 2008 – (continued) (J. Jasenek)



V. COOPERATION

V. 1 Cooperation in Slovakia

- Institute of Measurement Science, Slovak Academy of Sciences, Bratislava
- Slovak Institute of Metrology, Bratislava
- Nuclear Power Plants Research Institute, jsc., Trnava
- Slovak Institute of Technical Standardization, Bratislava
- Office for Standardization, Metrology and Testing of Slovak Republic, Bratislava
- National Security Authority, Bratislava
- Slovak Power Plants, jsc., Bratislava
- University of Žilina, Žilina
- Trenčín University, Trenčín

- Volkswagen Slovakia, jsc., Bratislava
- Slovak Electric Transmission System, jsc., Bratislava
- West Slovakia Power Systems, jsc., (Západoslovenská energetika, a.s.), Bratislava
- Middle Slovakia Power Systems, jsc., (Stredoslovenská energetika, a.s.), Žilina
- Elektrovod Holding, jsc., Bratislava
- Institute of Informatics, Slovak Academy of Sciences, Detached branches Banská Bystrica
- Continental Matador, Itc., Púchov
- Military Academy of Slovak National Uprising (Vojenská akadémia Slovenského národného povstania), L. Mikuláš
- Institute of Electrical Engineering of Slovak Academy of Sciences, Bratislava
- Institute of Physics of Slovak Academy of Sciences, Bratislava
- Integrity a Safe of Steel Constructions, jsc., Bratislava (IBOK)
- Reasearch and Project Institute of Electrotechnology Nová Dubnica, jsc., (EVPU a.s.)
- Technical University in Košice
- Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava

V. 2 International Cooperation

- Katholieke Hogeschool Brugge - Oostende, Oostende, Belgium
- University of York, York, England
- European Organization for Nuclear Research CERN, Geneve, Switzerland
- Institute of Logistics and Warehousing (ILIM), Poznań, Poland
- Austrian Research Centre, Seibersdorf, Austria
- Izhevsk State Technical University, Russian Federation
- School of Physics and Electronic Systems Engineering, University of South Australia, Pooraka
- TU Budapest, Hungary
- Doshisa University, Japan
- Nuclear Engineering Research Laboratory, University of Tokyo, Japan
- Department of Physics Colorado State University Fort Collins, USA
- Istituto Nazionale di Ricerca Metrologica
- TU Ilmenau, Germany
- Cardiff University, Wolfson Centre for Magnetic Technology, United Kingdom
- VEV Elektrotechnish Vakondernus Nijkjer, The Netherlands
- TU of Czenstochowa, Poland
- Warsaw University of Technology
- Moscow Energy Institute, Russia
- Lublin Technical University, Poland
- Institute of Physics, Academy of Sciences of Czech Republic, Prague, Czech Republic
- Institute of Inorganic Chemistry, Academy of Sciences

- of Czech Republic, Prague, Czech Republic
- Czech Technical University, Prague, Czech Republic
- West Bohemian University, Pilsen, Czech Republic
- Technical University, Brno, Czech Republic
- CINVESTAV, Saltillo, Mexico
- Research Institute for Technical Physics and Materials Science, Hungarian Academy of Sciences, Budapest, Hungary
- Politehnika Zagreb, Chorvatsko
-
- Faculty of Engineering, Universidad Nacional Autonoma de Mexico (UNAM), Ciudad de Mexico

V. 3 Contract-based Business Activities

- V. Smieško et al.: EMC Testing and Consultancy. Contracts for Small and Medium Enterprises



VI. THESES

VI. 1 Master theses

The names of supervisors are in brackets:

- [1] Morvay T.: Knowledgebased Systems and Artificial Intelligence (J. Grman)
- [2] Fraňo P.: Digital Voltmeter for Automated Measurement (A. Krammer)
- [3] Foltín I.: EMI suppression in telecommunication systems (R. Dosoudil)
- [4] Chudovan J.: Application of polarization OTDR in senzorics (J. Červeňová)

VI. 2 Doctoral Theses

The names of supervisors are in brackets:

- [1] Páleník T.: Microsensors for Measurement of Parameters of Electromagnetic Field (V. Smieško)
- [2] Hlaváč M.: Optic fibre sensors with distributed parameters on the OTDR basis (J. Jasenek)
- [3] Šoka M.: Analysis of electromagnetic properties of selected magnetics for electronic applications (V. Jančárik)

VII. OTHER ACTIVITIES

Courses for Practical Engineers:

- Electromagnetic Compatibility for Electronic Equipment Designers, June 2011
- Cooperation with Encyclopaedic Institute of Slovak Academy of Sciences – Encyclopaedia Beliana, (J. Sláma, P. Jahn, J. Franek)

VIII. MEMBERSHIP IN INSTITUTIONS/ COMMITTEES

VIII. 1 Membership in National Institutions/Committees

- Members of the Scientific Committee of the Conference “Electrical Engineering and Information Technology” 2011, Trenčín (V. Smieško)
- Chairman of the Council of Universities of Slovak Republic (V. Smieško)
- Member of Slovak Republic Government Council for Science and Technology (V. Smieško)
- Member of Scientific Council of the Slovak Academy of Sciences (V. Smieško)
- Member of Scientific Council of Institute of Measurement Science in Slovak Academy of Sciences (V. Smieško)
- Member of Scientific Council of the FEI STU (V. Smieško)
- Chairman of Council for State Program of Ministry of Education SR (V. Smieško)
- Member of Chairmanship of Slovak Research and Development Agency (V. Smieško)
- Member of Accreditation Board for Research Institution in SR (V. Smieško)
- Membership in the Scientific Council of the Slovak Institute of Metrology (V. Smieško)
- Membership in the Slovak National Technical Standardization Committees (K. Kováč)
- Membership in the Chamber for State Policy and Harmonization in Technological Standardization in Slovak Republic (ÚNMS), (I. Bojna)
- Membership in the Technical Subcommittees of IMEKO (TC19 - K. Kováč)
- Membership in the Working Group of Accreditation Commission of the Government of Slovak Republic for the research field No. 15 “Electrical Engineering and Electrical Power Engineering (J. Jasenek)
- Membership in the Working Group for the implementation of the National Qualification Framework established by the Ministry of Education of the SR (J. Jasenek)

- Membership in the Life-Long-Learning Managing Committee, established by MS VVS SR (J. Jasenek)
- Membership in Commission for the Award of the title of Associate Professor in the study field Theoretical of Electromagnetic Engineering (5.2.10) (J. Jasenek)
- Membership in Commission for the PhD Degree Award in the study field Theoretical of Electromagnetic Engineering (5.2.10) (J. Jasenek, J. Bydžovský, J. Sláma, L. Šumichrast, R. Dosoudil, E Ušák)
- Membership in the Slovak Expertise Commission for Electronics (J. Jasenek)
- Expert No. 256 for Branch of Metrology at the Institute of Normalization, Measurement and Standards (ÚNMS) of Slovak Republic (J. Bydžovský)
- Membership in the Scientific Board of FEI STU (J. Jasenek, V. Jančárik)
- Membership in the Slovak Association for Physics (J. Sláma, M. Ušáková)
- 8th International Conference supported by IMEKO TC-7 MEASUREMENT 2011 (Members of the Scientific Committee V. Smieško, K. Kováč)

Membership in the Editorial Boards of Journals:

- Journal of Electrical Engineering (V. Smieško, M. Kollár)
- AT&P Journal (V. Smieško)
- EE - Journal of Electrical and Power Engineering (V. Smieško, P. Kukuča)
- Measurement Science Review – on-line edition (V. Smieško)
- Radioengineering Journal – reviewer (R. Hartánský)
- Auditor of Slovak National Accreditation Service (K. Kováč, M. Bittera, J. Hallon)

VIII. 2 Membership in International Institutions/Committees

- J. Bydžovský: Scientific Committee of International of Magnetic Measurement 2011
- R. Hartánský: IEEE - The Institute of Electrical and Electronics Engineers
- V. Jančárik: Scientific Committee of International of Magnetic Measurement 2011
- J. Jasenek: European Association for Education in Electrical and Information Engineering
- J. Jasenek: IEEE - Institute of Electrical and Electronics Engineers
- J. Jasenek: OSA – Optical Society of America
- J. Jasenek: IOC of the International Travelling Summer School on Microwaves and Lightwaves
- J. Jasenek: International Organizing Committee of EAEEIE Annual Conference 2011, Maribor, Slovenia
- P. Kukuča: IET - The Institution of Engineering and Technology
- P. Kukuča: Scientific Committee of International Conference Applied Electronics 2011, Plzeň
- M. Kollár: The Institution of Engineering and Technology - IET Slovak Centre

- M. Kollár: Scientific Committee of International of Magnetic Measurement 2011
- J. Sláma: The Institution of Engineering and Technology - IET Slovak Centre
- J. Sláma: SAES, European Physical Society
- J. Sláma: Scientific Committee of International of Magnetic Measurement 2011
- V. Smieško: The International Information Academy
- V. Smieško: The European Academy of Sciences and Arts
- V. Smieško: IEEE - The Institute of Electrical and Electronics Engineers
- V. Smieško: IET - The Institution of Engineering and Technology, Fellow
- V. Smieško: URSI – Scientific Commission for Electromagnetic Noise and Interference
- Ľ. Šumichrast: The Institute of Electrical and Electronics Engineers
- Ľ. Šumichrast: The Institution of Engineering and Technology - IET Slovak Centre
- Ľ. Šumichrast: European Physical Society
- Ľ. Šumichrast: Optical Society of America (OSA)
- Ľ. Šumichrast: President of the Slovak National Committee of the International Union of Radio Science (URSI)
- E. Ušák: Membership in the Scientific Committee of International of Magnetic Measurement 2011

IX. PUBLICATIONS

IX. 1 Journals

- [1] BOJNA, I.: Protective Equipotential Bonding against Static Electricity. In: EE časopis pre elektrotechniku a energetiku. - ISSN 1335-2547. - Vol. 17, No. 1 (2011), Suppl.Volt, p. 15. (in Slovak)
- [2] BOJNA, I.: High Buildings in Electrical Standards. In: EE časopis pre elektrotechniku a energetiku. - ISSN 1335-2547. - Vol. 17, No. 2 (2011), Suppl.Volt, p. 7. (in Slovak)
- [3] BOJNA, I.: Additional Protection: Residual Current Protective Devices and Supplementary Protective Equipotential Bonding. In: EE časopis pre elektrotechniku a energetiku. - ISSN 1335-2547. - Roč. 17, č. 6 (2011), Suppl.Volt, p. 3. (in Slovak)
- [4] BOJNA, I.: Periods of Regular Verifications in Premises Having Own Schedule of Preventive Maintenance. In: EE časopis pre elektrotechniku a energetiku. - ISSN 1335-2547. - Roč. 17, č. 6 (2011), Suppl.Volt, p. 3. (in Slovak)
- [5] BOJNA, I. - FRANEK, J.: Skin Effect and Proximity Effect in Time Variable Current Circuits. Part 1 - Electric Skin Effect. In: EE časopis pre elektrotechniku a energetiku. - ISSN 1335-2547. - Vol. 17, No. 2 (2011), Suppl. Volt, p. 2-3. (in Slovak)
- [6] BOJNA, I. - FRANEK, J.: Skin Effect and Proximity Effect in Time Variable Currents Circuits. Part 2. Proximity Effect. In: EE časopis pre elektrotechniku a energetiku. - ISSN 1335-2547. - Vol. 17, No. 1 (2011), Suppl.Volt, p. 2-5. (in Slovak)
- [7] BOJNA, I. - FRANEK, J.: Skin Effect and Proximity Effect in Time Variable Currents Circuits. Part 3. In: EE časopis pre elektrotechniku a energetiku. - ISSN 1335-2547. - Vol. 17, No. 3 (2011), Suppl. Volt, p. 2-3, 13. (in Slovak)
- [8] DOSOUDIL, R. - UŠÁKOVÁ, M. - SLÁMA, J.: Polymer-Based Composites for Minimization of EMI in Automobile Electronic Systems. In: Chemické listy. - ISSN 0009-2770. - Vol. 105 S (2011), p. 432-434. (in English)
- [9] FRANEK, J. - KOLLÁR, M. - MAKOVÍN, I.: Microwave Electromagnetic Field and Temperature Distribution in a Multilayered Wood-Cement Board. In: Journal of Electrical Engineering. - ISSN 1335-3632. - Vol. 62, No. 1 (2011), p. 25-30. (in English)
- [10] HALLON, J. - HARTÁNSKÝ, R. - KOVÁČ, K. - MARŠÁLKA, L. - KARAVAEV, Y.: Investigation of Cables Geometry Influence on Measurement Repeatability of Electromagnetic Compatibility Tests. In: Intelektuálne systémy v produkcii. - ISSN 1813-7911. - Vol. 18, No. 2 (2011), p. 194-199. (in Russian)
- [11] HALLON, J. - SMIEŠKO, V. - BITTERA, M. - KOVÁČ, K.: Laboratory of Electromagnetic Compatibility FEI STU in Bratislava. In: DPS. - ISSN 1804-4891. - No. 1 (2011), p. 58-59. (in Slovak)
- [12] KAMENSKÝ, M. - KOVÁČ, K.: Correction of ADC Errors by Additive Iterative Method with Dithering. In: Measurement Science Review. - ISSN 1335-8871. - Vol. 11, No. 1 (2011), p. 15-18. (in English)
- [13] KAMENSKÝ, M. - KOVÁČ, K. - KRAMMER, A.: Usage of Additive Iterative Method for Correction of ADC Errors in LSB Region. In: Intelektuálne systémy v produkcii. - ISSN 1813-7911. - Vol. 17, No. 1 (2011), p. 256-262. (in English)
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- [16] KRUŽELÁK, J. - HUDEC, I. - DOSOUDIL, R.: Elastomeric Composites Filled with Magnetic Hard Fillers. In: Elastomery. - ISSN PL 1427-3519. - Vol. 15, No. 1 (2011), p. 9-15. (in English)
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- [19] KRUŽELÁK, J. - HUDEC, I. - DOSOUDIL, R.: Properties of Elastomeric Composites with Magnetic Fillers. In: Gumárenské listy. - ISSN 1212-9704. - Vol. 15, No. 1 (2011), p. 7-14. (in Slovak)
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- [21] PÁLENÍK, T. - BITTERA, M. - SMIEŠKO, V.: Sub-Domain MoM Formulation for Circular and Non-Circular Loop Antenna Arrays. In: International Journal of Engineering Science and Technology. - ISSN 0975-5462. - Vol. 3, No. 5 (2011), p. 3686-3692. (in English)
- [22] REKOŠOVÁ, J. - HUDEC, I. - KRUŽELÁK, J. - DOSOUDIL, R.: Composite Materials with Magnetic Fillers and Elastomeric Matrix for Construction of Intelligent Tyres. In: Chemické listy. - ISSN 0009-2770. - Vol. 105 S (2011), p. 373-375. (in English)
- [23] SLÁMA, J. - ŠOKA, M. - GRUSKOVÁ, A. - GONZÁLEZ-ANGELES, A. - JANČÁRIK, V.: Hopkinson Effect Study in Spinel and Hexagonal Ferrites. In: Journal of Electrical Engineering. - ISSN 1335-3632. - Vol. 62, No. 4 (2011), p. 239-243. (in English)
- [24] SLÁMA, J.: 180 Years Since the Birth J. C. Maxwell. In: EE časopis pre elektrotechniku a energetiku. - ISSN 1335-2547. - Vol. 17, No. 6 (2011), p. 20-21. (in Slovak)
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- [29] ŠTOFKA, M.: Waveform Generator Minimizes Amplitude Dependency. In: EDN. - ISSN 0012-7515. - Vol. 56, Iss. 10 (2011), 52, 54. (in English)

IX. 2 Conference Proceedings

- [1] BILÍK, V. - KRAJČOVIČ, G.: Coaxial 2.45-GHz High Power Impedance Matching Device. In: Microwave and RF Power Applications : 13th International Conference AMPERE. Toulouse, France, 5-8 September 2011. - Toulouse : Cepadues, 2011. - ISBN 978-2-85428-978-7. - p. 119-122. (in English)
- [2] BITTERA, M. - SMIEŠKO, V.: Influence of Non-Destructive Shortening of Cables on EMI Measurement. In: EMD 2011. XXI. International Conference on Electromagnetic Disturbances : Bialystok, Poland, September 28-30, 2011. - Bialystok : University of Technology, 2011. - ISBN 978-83-62582-07-5. - p. 29-32. (in English)
- [3] BITTERA, M. - SMIEŠKO, V.: Relation between Receiving Antenna Characteristics and Measuring Distance and its Effect on EMI Measurement. In: EMD 2011. XXI. International Conference on Electromagnetic Disturbances : Bialystok, Poland, September 28-30, 2011. - Bialystok : University of Technology, 2011. - ISBN 978-83-62582-07-5. - p. 33-37. (in English)
- [4] BOJNA, I.: Major Changes Overview of STN-Standards and Legislation on Electrical Engineering in Years 2006-2011. In: Up-Dating Expert Course. Overview of Most Important Changes in STN and Juridical Regulations in 2006-2011. - Bratislava : Slovenský elektrotechnický zväz, 2011. - p. 61. (in Slovak)
- [5] BOJNA, I.: Major Changes Overview of STN-Standards in Years 2006-2011. In: Up-Dating Expert Course. Overview of Most Important Changes in STN and Juridical Regulations in 2006-2011. - Bratislava : Slovenský elektrotechnický zväz, 2011. - p. 3. (in Slovak)
- [6] BOJNA, I.: Actual Information of Technical Standardization and Legislation in Electrical Engineering Field. In: 34th Conference of Slovak Electrical Engineers : Bratislava, Slovak Republic, 23.-24.3.2011. - Bratislava : Slovenský elektrotechnický zväz, 2011. - p. 36-45. (in Slovak)
- [7] BOJNA, I.: Actual Information of Technical Standardization in Electrical Engineering Field. In: 35th Conference of Slovak Electrical Engineers : Poprad, Slovak Republic, 9.-10.11.2011. - Bratislava : Slovenský elektrotechnický zväz, 2011. - p. 69-78. (in Slovak)
- [8] BOJNA, I.: Some Useful Tasks and Problems of Electrical Engineering. In: 34th Conference of Slovak Electrical Engineers : Bratislava, Slovak Republic, 23.-24.3.2011. - Bratislava : Slovenský elektrotechnický zväz, 2011. - p. 46-57. (in Slovak)
- [9] BOJNA, I.: Some Useful Tasks and Problems of Electrical Engineering - Second Part. In: 35th Conference of Slovak Electrical Engineers : Poprad, Slovak Republic, 9.-10.11.2011. - Bratislava : Slovenský elektrotechnický zväz, 2011. - p. 79-89. (in Slovak)
- [10] ČIČÁKOVÁ, O. - JANÍK, J. - VESELÝ, M.: Computerized Measurements in Vacuum. In: IN-TECH 2011 : International Conference on Innovative Technologies. Bratislava, Slovak Republic, 1.9.-3.9.2011. - Jaroměř : Jan Kudláček, 2011. - ISBN 978-80-904502-6-4. - p. 422-425. (in English)

- [11] DIBALA, M. - RAVAS, R.: Detection of X-Corners in the Image with Chessboard Pattern. In: ŠVOČ 2011 : Proceedings of Selected Works. Bratislava, Slovak Republic, 4.5.2011. - Bratislava : FEI STU, 2011. - ISBN 978-80-227-3508-7. - p. 413-419. (in Slovak)
- [12] DOSOUDIL, R. - FRANEK, J. - SLÁMA, J. - UŠÁKOVÁ, M. - GRUSKOVÁ, A.: Electromagnetic Wave Absorption Performances of Metal Alloy/Spinel Ferrite/Polymer Composites. In: SMM 2011 : 20th International Conference on Soft Magnetic Materials. Athens, Greece, 19.-22.9.2011. - Arhens : X mpenou Publ. House, 2011. - ISBN 978-960-9534-14-7. - p. 259. (in English)
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- [15] HAJRO, L. - ČERVEŇOVÁ, J.: Transient Phenomena in Linear Electrical Circuits ? Electronic Lecture. In: ŠVOČ 2011 : Proceedings of Selected Works. Bratislava, Slovak Republic, 4.5.2011. - Bratislava : FEI STU, 2011. - ISBN 978-80-227-3508-7. - p. 186-190. (in Slovak)
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- [18] HANAJÍK, M. - RAVAS, R. - SMIEŠKO, V.: Interest Point Detection for Vision Based Mobile Robot Navigation. In: SAMI 2011 : 9th IEEE International Symposium on Applied Machine Intelligence and Informatics. January 27-29 2011, Smolenice, Slovak Republic. - IEEE, 2011. - ISBN 978-1-4244-7428-8. - p. 207-211. (in English)
- [19] HARŤANSKÝ, R. - MIKUŠ, P. - SLÍŽIK, J.: Crosstalk on Short Transmission Line Measurement. In: EE časopis pre elektrotechniku a energetiku. - ISSN 1335-2547. - Vol. 17, Special Issue: ELOSYS, Trenčín, 11.-14.10.2011, p. 122-124. (in Slovak)
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- [21] KAMENSKÝ, M. - KOVÁČ, K. - VÁLKY, G.: Analyses of Quantization Noise Spectrum for Multiresolution Quantization of Harmonic Signal. In: Measurement 2011 : 8th International Conference on Measurement. Smolenice, Slovak Republic, 27.-30.4.2011. - Bratislava : Slovak Academy of Sciences, 2011. - ISBN 978-80-969-672-4-7. - p. 42-45. (in English)
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- [30] MARŠALKA, L. - HARŤANSKÝ, R.: Electromagnetic Method for Distance Measurement on MEMS Structures. In: MM Science Journal. - ISSN 1803-1269. - Special Edition : 20th International Workshop on Robotics in Alpe-Adria-Danube Region (RAAD), October 5-7, 2011, Brno, Czech Republic, October 5-7, 2011. - p. 48-53. (in English)

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