Silesian University of Technology
Faculty of Automatic Control, Electronics
and Computer Science

Annual Review 2016

Institute of Electronics

Akademicka 16, 44-100 Gliwice, Poland
phone: (+48) 32 2371495, (+48) 32 2371529
fax: (+48) 32 2372225, e-mail: instytut.elektroniki@polsl.pl
http://iele.polsl.pl

Edited by
Zdzisław Filus and Edward Hrynkiewicz

Prepared for printing by
Natalia Waczyńska-Niemiec

Institute of Electronics, March 2017

FOREWORD

The Institute of Electronics is a part of the Faculty of Automatic Control, Electronics and Computer Science, one of the 13 faculties of the Silesian University of Technology, founded in 1945. The University is located in Gliwice and has about 22,000 students at present. The Faculty of Automatic Control was founded in 1964, and after a few reorganisations it changed its name to the Faculty of Automatic Control, Electronics and Computer Science. The total number of students is about 3,000 now. Since its creation in 1974 the Institute of Electronics has undergone a number of reorganisations. It has over 70 members of academic staff and consists of six units:

- ***Division of Electronics Fundamentals and Radio Engineering***
- ***Division of Digital and Microprocessor Systems***
- ***Division of Circuit and Signal Theory***
- ***Division of Telecommunication***
- ***Division of Biomedical Electronics***
- ***Group for Microelectronics and Nanotechnology***

The Institute specialises in such advanced fields of engineering as analogue and digital electronic systems, including biomedical systems, production of telecommunication and electronic systems etc. Research in these areas ranges from component to system level, encompassing practical and theoretical investigations with the application of both hardware and software techniques. Research groups are supported by a wide range of test and instrumentation equipment together with computer facilities, which can run with programming languages of all levels and offer various application software. Many of the Institute's research programmes are carried out in close co-operation with industry in order to satisfy the needs of the region, which is the main industrial centre of Poland.

The Institute offers 3.5-year courses leading to the degree of BSc in the general field of Electronics and Telecommunication and 1.5-year MSc courses in the following specialisations:

- Electronic Apparatus
- Biomedical Electronics
- Microelectronics
- Radio Engineering
- Telecommunication

Both degrees are obtained on the basis of a project and a report, presented during a final examination. In addition, the Institute participates in a joint macro-course in Automatic Control, Electronics and Computer Science, run by the Faculty, in which all teaching is in the English language. In the academic year 2013/2014 a completely new course in Information and Communication Technology was started together with the Institute of Informatics. The courses normally consist of lectures, laboratories, seminars and projects, and are followed by examinations. The curricula of the courses run by the

Institute are designed for people who want to achieve both theoretical knowledge and practical skills in electronics.

Other didactic activities include courses such as Printed Circuit Board Design (run in cooperation with Mentor Graphics), postgraduate courses, e.g. Programmable Electronic Circuits and Systems, and PhD studies in Electronics.

The following pages provide detailed information regarding the research carried out as well as the subjects taught in each division.

CONTENTS

DIRECTORS OF THE INSTITUTE

Director of the Institute:
Prof. Edward HRYNKIEWICZ

Vice Director of the Institute for Research:
Prof. Zdzisław FILUS

Vice Director of the Institute for Teaching:
Asst. Prof. Jacek KONOPACKI

DIVISION OF ELECTRONICS FUNDAMENTALS AND RADIO ENGINEERING

Head of Division: Prof. Zdzisław Filus, PhD, DSc

Research staff

Prof. Zdzisław FILUS, PhD, DSc

Prof. Andrzej KARWOWSKI, PhD, DSc
Prof. Zbigniew RYMARSKI, PhD, DSc
Krzysztof BERNACKI, PhD
Andrzej BŁONAROWICZ, PhD
Jacek CHĘCIŃSKI, PhD
Jerzy FIOŁKA, PhD
Zenon KIDOŃ, PhD
Adam KRISTOF, PhD
Sławomir LASOTA, PhD
Mirosław MAGNUSKI, PhD
Andrzej MALCHER, PhD
Artur NOGA, PhD
Wojciech OLIWA, PhD
Maciej SURMA, PhD
Tomasz TOPA, PhD
Grzegorz WIECZOREK, PhD
Dariusz WÓJCIK, PhD

PhD Students
Łukasz DYGA, MSc

Research fields

- Electronic circuits synthesis
- Symbolic methods of electronic circuits analysis
- Electronic circuits for automotive applications
- Power electronic circuits
- Microprocessor-based measurement systems
- Computational electromagnetics
- Numerical modelling of radiating and scattering wire objects
- Linear antenna theory
- Electromagnetic compatibility
- Optoelectronics, Fiberoptics

Courses

- Semiconductor Devices
- Analogue Electronic Circuits
- Analogue Circuits Design
- Fundamentals of Measurements
- Electronic Measurement Techniques
- Switching Circuits
- Special Semiconductor Devices and Circuits
- Materials Technology and Electronic Equipment Design
- Field and Wave Electromagnetics
- Introduction to Radiocommunication
- Radio Engineering Systems
- Fields, Waves and Antennas
- Wireless Computer Networks
- Design of Radio Electronic Devices
- High-Frequency Engineering Fundamentals
- Electromagnetic Compatibility
- Optoelectronics
- Optical Fiber Techniques

DIVISION OF DIGITAL AND MICROPROCESSOR SYSTEMS

Head of Division: Prof. Dariusz Kania, PhD, DSc

Research staff

Prof. Dariusz KANIA, PhD, DSc

Prof. Edward HRYNKIEWICZ, PhD, DSc
Mirosław CHMIEL, PhD
Robert CZERWIŃSKI, PhD
Tomasz GARBOLINO, PhD
Józef KULISZ, PhD
Adam MILIK, PhD
Adam PAWLAK, PhD
Tomasz RUDNICKI, PhD
Wojciech SAKOWSKI, PhD
Dariusz STACHAŃCZYK, PhD
Krzysztof TABOREK, PhD
Bernard WYRWOŁ, PhD
Dariusz POLOK, MSc

PhD Students

Jarosław WROTNIAK, MSc
Piotr CHODOROWSKI, MSc

Research fields

- Testing and testability of digital systems
  - Test and diagnostics of connections
  - Built-in self-test
  - Generation of test patterns and analysis of test responses
  - Specific linear registers
  - Design for testability
  - Digital systems compliant with IEEE 1149 and IEEE 1500 standards
  - On-line testing
- Design of systems with programmable devices and controllers
  - Design of support software
  - Logic synthesis
  - Technology mapping in CPLDs, FPGAs and pSoCs
  - Fast operating CPU structures of programmable controllers and methods of PLC programming
  - Distributed structures of PLCs
  - PLC applications

- Embedded control system design
- Frequency multipliers based on digital techniques
- Multiprocessor systems
  - Pipelining and parallel processing
  - Systems with global memory and arbitration
  - Statistical analysis of performance for pipelining processing
- ASIC design
  - High level design methodologies
  - System modelling and simulation (using VHDL and Verilog)
  - IP-core design
  - Distributed design methodologies based on the Internet
- Cyber-physical systems
- Field oriented control (FOC) dedicated for a permanent magnet synchronous motor (PMSM)

Courses

- Digital Systems Fundamentals
- Design of Digital Devices
- Microprocessors Fundamentals
- Microprocessor Systems
- Reliability and Testing of Electronic Devices
- Computer Aided Design of Integrated Circuits
- Programmable Logic Devices
- Programmable Controllers
- Hardware Description Languages

DIVISION OF CIRCUIT AND SIGNAL THEORY

Head of Division: Prof. Jerzy Rutkowski, PhD, DSc

Research staff

Prof. Jerzy RUTKOWSKI, PhD, DSc

Damian GRZECHCA, PhD, DSc
Jacek KONOPACKI, PhD, DSc
Andrzej PUŁKA, PhD, DSc
Łukasz CHRUSZCZYK, PhD
Tomasz GOLONEK, PhD
Andrzej KUKIEŁKA, PhD
Jan MACHNIEWSKI, PhD
Katarzyna MOŚCIŃSKA, PhD

PhD Students
Sebastian TEMICH, MSc

Research fields

- Computer-aided electronic circuits analysis and design
  - Test and diagnosis for analogue and mixed-signal electronic circuits
  - Application of sensitivity methods to the analysis and synthesis of electronic circuits
  - Modelling and simulation of digital and mixed analog-digital circuits in VHDL language
  - System level design in SystemC
  - Application of artificial intelligence methods and genetic algorithms to circuit theory and electronics
  - Common-sense reasoning modelling and application of AI techniques to circuits models generation and verification
- Digital signal processing focused on digital filters design and application
- Signal processing and basic research into neural networks (analysis, synthesis and optimisation) and their application to engineering practice
  - Application of neural networks to image processing and recognition, including texture images
  - Application of wavelet techniques to signal processing

- Technology Enhanced Learning (IC-TEL) Web based Education (WBE)
- Indoor location and navigation methods

Courses

- Circuit Theory
- Systems and Signals
- Fundamentals of Electrical Engineering
- Information Theory and Coding
- Computer-Aided Design of Electronic Circuits
- Digital Signal Processing
- Neural Networks
- LabView – Graphical Programming Language
- Computer-Based Measurements with NI LabView

DIVISION OF TELECOMMUNICATION

Head of Division: Asst. Prof. Jacek Izydorczyk, PhD, DSc

Research staff

Asst. Prof. Jacek IZYDORCZYK, PhD, DSc

Leszek DZICZKOWSKI, PhD, DSc
Piotr ZAWADZKI, PhD, DSc
Adam DUSTOR, PhD
Maria DZICZKOWSKA, PhD
Grzegorz DZIWOKI, PhD
Piotr KŁOSOWSKI, PhD
Marcin KUCHARCZYK, PhD
Wojciech SUŁEK, PhD
Jerzy WOJTUSZEK, PhD

Research fields

- Digital commutation in modern telecommunication systems
  - Construction of telephone exchanges
  - Supervisory software for telephone exchanges
  - Special services (e.g. teleconferences)
  - Implementation of digital networks with integrated services (ISDN, B-ISDN, ATM)
- Application of digital signal processing to telecommunication
  - Compression of speech signal with the application of DSPs
  - Speech synthesis
  - Speech and speaker recognition
  - Application of artificial neural networks to signal processing
  - Design, testing and implementation of error correcting and modulating codes
  - Design of modern local area networks
  - Implementation and testing of new services in the Internet
  - xDSL technology
  - Efficient hardware implementation of decoder of LDPC code.
- Modems

Courses

- Fundamentals of Analogue and Digital Communication
- Fundamentals of Commutation
- Switching Nodes and Exchanges
- Principles of Transmission
- Communication Systems
- Signal Theory
- Information Theory and Coding
- Digital Signal Processing
- Computer-Aided Analysis of Electronic Circuits
- Digital Signal Processors (DSP)
- Neural Networks
- Computer Networks
- Internet
- Modems
- Introduction to Cryptography

DIVISION OF BIOMEDICAL ELECTRONICS

Head of Division: Prof. Jacek Łęski, PhD, DSc

Research staff

Prof. Jacek ŁĘSKI, PhD, DSc

Prof. Jacek SZUBER, PhD, DSc
Marian KOTAS, PhD, DSc
Monika KWOKA, PhD, DSc
Tomasz PANDER, PhD, DSc
Ewa STRASZECKA, PhD, DSc
Robert CZABAŃSKI, PhD
Jerzy IHNATOWICZ, PhD
Michał JEŻEWSKI, PhD
Piotr KOŚCIELNIAK, PhD
Michał KOZIELSKI, PhD
Tomasz PRZYBYŁA, PhD

PhD Students

Tomasz MOROŃ, MSc
Sebastian PORĘBSKI, MSc

Research fields

- Biocybernetics and biomedical engineering - processing of information in medicine
  - Processing of biomedical signals
  - Image processing and analysis
  - Fuzzy sets and systems, neuro-fuzzy systems
  - Pattern recognition
  - Cybernetics
  - Computer assisted medical diagnosis
  - Hospital information systems
  - Picture archiving and communications systems
  - Medical information systems integration
  - Expert systems in medicine
  - Time-frequency analysis of biomedical signals
  - Multirate signal processing
  - Evolutionary computations
  - Artificial neural networks
  - Data mining
  - Artificial intelligence
- Design, construction and testing of electronic medical equipment

- Design and construction of amplifiers for biological signals and data acquisition systems co-operating with computers
- Testing of electromedical equipment
- Design of electronic devices for data acquisition

- Nanotechnology of transparent conductive oxides and organic semiconductors for application in photovoltaics and gas sensors

Courses

- Electromedical Metrology
- X-ray and Nuclear Imaging
- Medical Information Systems
- Cybernetics
- Artificial Intelligence
- Electromedical Equipment
- Pattern Recognition
- Principles of Knowledge Engineering
- Diagnostic Imaging Systems
- Biocybernetics
- Computers in Medicine
- Diagnostic Cardiological Systems
- Computer Aided Medical Diagnosis
- Probability Theory and Mathematical Statistics
- Optimization Methods
- Bionics
- Principles of Digital Signal Processing
- Numerical Methods
- Biomedical Information Processing
- Digital Signal Processing
- Artificial Intelligence in Engineering Applications
- Fundamentals of Physics
- Electronics for Environment

GROUP FOR MICROELECTRONICS AND NANOTECHNOLOGY

Head of Group: Krzysztof Waczyński, PhD, DSc

Research staff

Krzysztof WACZYŃSKI, PhD, DSc

Wojciech FILIPOWSKI, PhD
Weronika IZYDORCZYK, PhD
Piotr KOWALIK, PhD
Jerzy ULJANOW, PhD
Edyta WRÓBEL, PhD

Research fields

- Design of electronic devices for data acquisition
- Nanotechnology of transparent conductive oxides for application in photovoltaics and gas sensors
- Passivation of semiconductor surfaces for application in microelectronics
- Solar cells and photovoltaic systems
- Special hybrid circuits made in thick (thin) film technology
- Technology of doped semiconductor glasses based on organosilicon compounds
- Thin film resistive layers

Courses

- Design of Thick/Thin-Film Circuits
- Diagnostic Methods in Microelectronics and Nanotechnologies
- Electronic Devices, Semiconductor Structures and Circuits
- Fundamentals of Electrical Engineering, Measurements and Electronics
- Hybrid Circuit Technology
- Information Technologies
- Materials Science and Principles of Construction of Electronic Equipment
- Microelectronics
- Microelectronics Technology
- Modelling of Phenomena and Structures in Microelectronics and Nanotechnologies
- Nanotechnology in Microelectronics
- Photovoltaics
- Sensor Arrays
- Sensors and Actuators
- Solid State Electronics
- Thick-Film Technology
- Thin-Film Technology

SECRETARIAL AND TECHNICAL STAFF

Secretarial staff

Beata BIELAWNY, MBA
Agata CUDAK-TUTAJEWICZ, MSc
Tatiana NIEDZIELA, BBA

Technical staff

Andrzej CZYŻ, MSc
Dariusz KOLKA, MSc
Łucja LEWANDOWSKA
Szymon PARA, MSc
Tomasz SZYMAŃSKI, BSc
Natalia WACZYŃSKA–NIEMIEC, MSc
Jarosław WROTNIAK, MSc
Piotr ZAJĄC, BSc
Czesław ZIOBER

STATUTORY ACTIVITIES OF THE INSTITUTE OF ELECTRONICS

PhD DEGREES CONFERRED ON STAFF MEMBERS AND PhD STUDENTS OF THE INSTITUTE OF ELECTRONICS

1. **Łukasz Golly,** Concurrent modelling of time-predictable multitask electronic systems in SystemC language, PhD advisor: Asst. Prof. Andrzej Pułka, 25 January 2016
2. **Grzegorz Tytko,** Analytical mathematical models of eddy current coils with a core formed by a Truncated Region Eigenfunction Expansion method, PhD advisor: Asst. Prof. Leszek Dziczkowski, 20 May 2016 (with honours)
3. **Krzysztof Bernacki**, Dynamic properties of voltage source inverters with the low DC voltage, PhD advisor: Prof. Zbigniew Rymarski, 11 July 2016 (with honours)

RESEARCH GRANTS

Research activities of the Institute of Electronics are mainly financed by the Ministry of Science and Higher Education within the frames of a general research programme:

- ***Development of new research areas in electronics, telecommunication and signal processing***

Apart from this, each division of the Institute carries out its own research in the following general areas, which are further subdivided into individual research projects:

Division of Electronics Fundamentals and Radio Engineering:

- *Electronic components, circuits, systems and objects radiating and dissipating electromagnetic waves - development of measurement methods, analysis and synthesis*

Division of Digital and Microprocessor Systems:

- *Multiprocessor systems, application specific integrated circuits, programmable logic devices and systems - analysis, design and testing*

Division of Circuit and Signal Theory:

- *Computer-aided methods of analysis, synthesis and testing of electronic systems and technology enhanced teaching*

Division of Telecommunication:

- *Development of methods and applications of digital channel commutation and processing and transmission of digital signals*

Division of Biomedical Electronics:

- *Acquisition and processing of biomedical information*

Group for Microelectronics and Nanotechnology:

- *Advanced technology in microelectronics and nanoelectronics*

In total, forty individual research projects were completed in 2016.

GRANTS AWARDED BY THE COMMISSION OF EUROPEAN COMMUNITIES OR OTHER INTERNATIONAL SOURCES

1. Dependable Cyber-Physical Systems. Project DAAD (Deutscher Akademischer Austausch Dienst) No. 56268155
Coordination: A. Pawlak, PhD
Collaboration with Brandenburg University of Technology in Cottbus (Prof. H.T. Vierhaus) is realised in a frame of the DCPS (Dependable Cyber Physical Systems) project. DCPS is a network project of the German DAAD-Program „Strategic Partnerships and Thematic Networks" (2013-2016). The project supports organisation of doctoral workshops and exchange of PhD students and professors doing research in the area of dependable cyber physical systems. Information on DCPS network activities is available on the following web pages:
http://www.iele.polsl.pl/~pawlak/DCPS/index.htm
http://www.iele.polsl.pl/~pawlak/DCPS/index-DCPS.htm
These web pages are accessible from the Institute's home page (Bookmark: *Projects*).

2. Increasing the professional competence of students studying Electronics and Telecommunication at Silesian University of Technology. A project financed by the European Social Fund and the National Centre for Research and Development within the Operational Programme - Human Capital - Measure 4.1 Strengthening and Development of Didactic Potential of Universities and Increasing the Number of Graduates from Faculties of Key Importance for Knowledge-Based Economy. Grant Number: POKL.04.01.01-00-073/14
Period: 1.10.2014–01.01.2017
Coordination: D. Grzechca, PhD, DSc
The main objective of the project is to prepare graduates for entering the labour market by offering certified courses and national/international internships.

3.European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability – EuNetAir within European Cooperation in the Field of Scientific and Technical Research (COST), VII Framework Programme of European Union Grant: OC-2011-1-9706
Period: 2011-2016
Coordination: M. Penza PhD, (ENEA), Brindisi, Italy
Polish National Coordination: M. Kwoka, PhD, DSc

The main objective of the Action is to develop new sensing technologies for Air Quality Control at integrated and multidisciplinary scale by coordinated research on nanomaterials, sensor-systems, air-quality modelling and standardised methods for supporting environmental sustainability with a special focus on Small and Medium Enterprises.

RESEARCH GRANTS AWARDED BY NATIONAL SOURCES

1. Advising support in verification methodology of integrated circuits – Project No. U-637/RAu-3/2016, financed by Evatronix S.A., a private company from Bielsko-Biała
Coordination: Prof. E. Hrynkiewicz
The aim of this project is to provide consulting services in the field of modern methodology verification of integrated circuits. For this purpose the following methodologies are considered: Universal Verification Methodology (UVM), virtual prototyping and device emulation. All of these approaches are carried out on the basis of recognition of the present knowledge state and the comparative studies of technological solutions presented in the literature.

2. Development of techniques to improve the reliability of measurements of bioelectric signals in real electromagnetic environment –National Centre for Research and Development, agreement No. PBS3/B3/34/2015
Period: 01-05-2015 - 30-04-2017
Coordination: D. Wójcik, PhD
The main goal of the project is to develop new methods of increasing the reliability of the measurement of low-level biomedical signals recorded in real electromagnetic environment by medical devices, such as electroencephalogram or high-resolution electrocardiogram, having a high sensitivity to electromagnetic disturbances. The result of the work will be development of the hardware and software methods for detection of influence of disturbances produced by wireless communication systems. In the first stage a database of real disturbances for typical electromagnetic environment will be performed. Subsequently, simulation and measurement methods will be utilized to explore coupling phenomena of EM disturbances to medical devices. This research will lead to the design of hardware and software detection methods allowing to identify those parts of the registered signal that do not provide any diagnostic value due to the presence of the disturbances.

3. Dynamic properties of voltage source inverters with impedance networks, supplied from low DC voltage, taking into account the real parameters of the soft magnetic materials. (PRELUDIUM 9) 2015/17/N/ST7/03720.
Period: March 2016-March 2018
Coordination: K. Bernacki, PhD
Scientific advisor: Prof. Z. Rymarski
The description of the small signal models of voltage source inverters for UPS systems, in relation to the influence of DC/DC step-up input voltage converters (impedance networks) is the main research project target. The influence of changes of the magnetic materials parameters of the cores for coils and transformers will be implemented in the models. The analysis will concern single-phase small and medium power (<4kVA) inverters. The small-signal models will be used in the design of the digital robust control of inverters that fill the requirements of the required standards that limit the output voltage distortions of UPS devices for static and dynamic, linear and nonlinear loads. The generalized methodology of a voltage source inverter design based on using the created models of the single-phase low and medium power inverters will be the final result of the project.

4. Testing and diagnostics of interconnections between digital cores of Systems-on-Chip. The project (DSc grant) is financed by the Rector of Silesian University of Technology. Grant Number: RGH- 11/RAU3/2014.
Period: 1.10.2014 - 31.12.2016.
Coordination: T. Garbolino, PhD
The main objective of the grant is to prepare the whole documentation that is required in the process leading to the postdoctoral degree. One of the major outcomes of the grant is a monograph devoted to various methods of detection, localization and identification of static and dynamic faults in lines connecting digital cores in Systems-on-Chip. It is mainly focused on applications of linear feedback registers – including specific linear ring registers – in interconnect built-in self-test structures.

INTERNATIONAL CO-OPERATION

1. University of Brescia, Italy (Prof. J. Szuber, Dr M. Kwoka)
2. Technical University of Ostrava, Faculty of Electrical Engineering and Computer Science, Department of Measurements and Control, Czech Republic, (Prof. E. Hrynkiewicz)
3. Brandenburg University of Technology, Cottbus, Germany (Dr A. Pawlak, Dr A. Pułka, Prof. E. Hrynkiewicz)
4. Brno University of Technology, Faculty of Electrical Engineering and Communication, Department of Control and Instrumentation, Czech Republic (Dr A. Milik, Prof. E. Hrynkiewicz)

SCIENTIFIC CONFERENCES ORGANISED AND CO-ORGANISED BY THE INSTITUTE OF ELECTRONICS

Cyber Physical Systems in Medical Applications (DCPS Workshop), Gliwice, Poland, 18 November 2016 (Dr A. Pawlak)

Co-organizer of the 14th IFAC/IEEE Conference on Programmable Devices and embedded Systems (PDeS 2016), Brno/Lednice, Czech Republic, 5-7 October 2016

STAFF MEMBERS PARTICIPATING IN SCIENTIFIC AND ORGANISING COMMITTEES OF CONFERENCES AND SYMPOSIA

International

1. **Dr R. Czabański,** Program Committee, 8th International Conference on Computational Collective Intelligence, Special Session on Machine Learning in Medicine and Biometrics, 28-30 September 2016, Halkidiki, Greece
2. **Dr T. Garbolino**, Steering Committee and Program Committee, 19th IEEE Symposium on Design and Diagnostics of Electronic Circuits and Systems, (DDECS 2016), 20-22 April 2016, Košice, Slovakia
3. **Dr D. Grzechca,** Program Committee, International Conference on Data Mining and Artificial Intelligence Methods for Automotive Systems (DMAIMAS 2016), 23-25 May 2016, Szczyrk, Poland

4. **Prof. E. Hrynkiewicz**, Steering Committee and Program Committee, 19th IEEE Symposium on Design and Diagnostics of Electronic Circuits and Systems, (DDECS 2016), 20-22 April 2016, Košice, Slovakia
5. **Prof. E. Hrynkiewicz**, Program Committee, 12th IEEE International Conference: Beyond Databases, Architectures and Structures (BDAS 2016), 31 May - 3 June 2016, Ustroń, Poland
6. **Prof. E. Hrynkiewicz**, Program Committee, The International Scientific Conference: Computer Networks (CN 2016), 14-17 June 2016, Brunów Palace, Poland
7. **Prof. D. Kania**, organizer of the session, 12th International Conference of Computational Methods in Science and Engineering, (ICCMSE 2016), 17-20 March 2016, Athens, Greece
8. **Prof. D. Kania**, Program Committee, 20th International Conference Electronics 2016, 13-15 June 2016, Palanga, Lithuania
9. **Prof. D. Kania**, Program Committee, 14th IFAC International Conference on Programmable Devices and Embedded Systems (PDeS'16), 5-7 October 2016, Brno, Czech Republic
10. **Dr P. Kłosowski**, Program Committee, International Symposium on Engineering Education and Educational Technologies, (IEEE 2016), 5-8 July 2016, Florida, USA
11. **Dr P. Kłosowski**, Program Committee, International Multi-Conference on Engineering and Technological Innovation, (IMETI 2016), 5-8 July 2016, Orlando, Florida, USA
12. **Dr J. Kulisz,** Organizing Committee, 12th International Conference of Computational Methods in Science and Engineering, (ICCMSE 2016), 17-20 March 2016, Athens, Greece
13. **Dr A. Milik**, Program Committee, 14th IFAC International Conference on Programmable Devices and Embedded Systems (PDeS'16), 5-7 October 2016, Brno, Czech Republic
14. **Dr A. Pawlak**, 11th International Scientific and Technical Conference Computer Science and Information Technologies, (CSIT-2016), 6-10 September 2016, Lviv, Ukraine
15. **Dr A. Pawlak**, Program Committee (vice-chair), 19th IEEE Symposium on Design and Diagnostics of Electronic Circuits and Systems, (DDECS 2015), 20-22 April 2016, Košice, Slovakia

16. **Dr A. Pawlak**, Program Committee, 17th IFIP Working Conference on Virtual Enterprises - Collaboration in a Hyperconnected World (PRO-VE 2016), 3-5 October 2016, Porto, Portugal
17. **Dr A. Pawlak**, Program Committee, 19th Euromicro Conference on Digital System Design (DSD16), 31August - 2 September 2016, Limassol, Cyprus
18. **Dr A. Pułka**, Program Committee, IEEE International Conference on Signals and Electronic Systems (ICSES), 5-7 September 2016, Kraków, Poland
19. **Dr A. Pułka**, Program Committee, 14th IFAC International Conference on Programmable Devices and Embedded Systems (PDeS'16), 5-7 October 2016, Brno, Czech Republic
20. **Prof. J. Rutkowski**, Program Committee, 3rd International KES Conference on Smart Education and E-Learning (KES-SEEL-16), 15-17 June 2016, Tenerife, Spain
21. **Prof. J. Rutkowski**, Scientific Committee, 23rd International Conference on Mixed Design of Integrated Circuits & Systems (MIXDES), 23-25 June 2016, Łódź, Poland
22. **Dr W. Sułek**, Technical Program Committee, 39th International Conference on Telecommunications and Signal Processing (TSP 2016), 27-29 June 2016, Vienna, Austria
23. **Dr K. Waczyński**, Scientific Committee, 40th International Microelectronics and Packaging Poland Conference (IMAPS 2016), 25-28 September 2016, Książ Castle, Poland

National

1. **Prof. Z. Filus**, Scientific Committee, 15th National Electronics Conference, 6-10 June 2016, Darłowo
2. **Prof. E. Hrynkiewicz**, Scientific Committee, 15th National Electronics Conference, 6-10 June 2016, Darłowo
3. **Prof. E. Hrynkiewicz**, Scientific Committee, 19th Conference on Reconfigurable Ubiquitous Computing, (RUC 2016), 2-3 June 2016, Szczecin
4. **Prof. D. Kania**, Scientific Committee, 19th Conference on Reconfigurable Ubiquitous Computing, (RUC 2016), 2-3 June 2016, Szczecin

5. **Prof. A. Karwowski**, Scientific Committee, National Conference on Radiocommunications and Broadcasting, 27-29 June 2016, Kraków
6. **Dr M. Kwoka**, Scientific Committee, 6th Congress of Polish Vacuum Society (PVS 2016), 6-9 September 2016, Trzebnica
7. **Dr A. Milik**, Scientific Committee, 19th Conference on Reconfigurable Ubiquitous Computing, (RUC 2016), 2-3 June 2016, Szczecin
8. **Prof. J. Rutkowski**, Scientific Committee, 15th National Electronics Conference, 6-10 June 2016, Darłowo
9. **Prof. J. Szuber**, Scientific Committee, 14th Conference on Electronic and Optical and Sensors (COE2016), 19-22 June 2016, Gdańsk
10. **Prof. J. Szuber,** Scientific Committee, 6th Congress of Polish Vacuum Society (PVS 2016), 6-9 September 2016, Trzebnica

REVIEWERS

1. **Dr Ł. Chruszczyk**, Circuits, Systems and Signal Processing Journal, International Conference on Signals and Electronic Systems (ICSES 2016)
2. **Dr R. Czabański**, Journal of Healthcare Engineering, 16th International Conference on Artificial Intelligence and Soft Computing (ICAISC 2017), Zakopane, Poland
3. **Dr R. Czerwiński,** International Journal of Applied Mathematics and Computer Science, IEEE Transactions on Industrial Electronics, IEEE Transactions on Power Electronics, Elektronika i Elektrotechnika
4. **Dr G. Dziwoki,** ETRI Journal
5. **Dr W. Filipowski**, Elektronika - Konstrukcje Technologie Zastosowania
6. **Prof. Z. Filus**, International Journal of Electronics, Szybkobieżne Pojazdy Gąsienicowe, National Electronics Conference, IEEE International Conference on Signals and Electronic Systems (ICSES)
7. **Dr T. Garbolino**, Microelectronics Reliability, Microprocessors and Microsystems, Journal of Circuits, Systems, and Computers, Conferences: IEEE DDECS 2016, Euromicro DSD 2016 (special session), ICSES 2016

8. **Dr T. Golonek**, Engineering Applications of Artificial Intelligence (Elsevier), International Conference on Signals and Electronic Systems, ICSES 2016
9. **Dr D. Grzechca**, Journal of Electronic Testing: Theory and Applications, Circuits, Systems & Signal Processing, Metrology and Measurement Systems, Elektronika - Konstrukcje Technologie Zastosowania, Przegląd Elektrotechniczny, projects in the EU Operational Programme Innovative Economy 1.4
10. **Prof. E. Hrynkiewicz**, Journal of Circuits, Systems and Computers; International Journal of Electronics and Telecommunication, Journal of Applied Mathematics, IEEE DDECS Symposium, Elsevier Journal on Microprocessors and Microsystems, International IFAC/IEEE Conference on Programmable Devices and Embedded Systems, International Conference Beyond Databases Architectures and Structures, International Science Conference on Computer Networks, International Conference on Artificial Intelligence and Soft Computing, National Electronics Conference, The 19th Conference on Reconfigurable Ubiquitous Computing (RUC 2016), Associate Editor for IFAC World Congress in the frame of IFAC TC 4.1.
11. **Dr J. Izydorczyk**, Physica B - Condensed Matter; PIER & JEMVA (Progress In Electromagnetics Research, Journal of Electromagnetic Waves and Applications), Micro & Nano Letters from the Institution of Engineering and Technology (IET), IEEE Transactions on Circuit and Systems I, IEEE Transactions on Magnetics, Journal of Applied Physics from American Institute of Physics (AIP), International Journal of Electronics and Telecommunications, Studia Informatica
12. **Prof. D. Kania**, Bulletin of the Polish Academy of Sciences – Technical Sciences, IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, International Journal of Electronics and Telecommunication, International Journal of Applied Mathematics and Computer Science, Journal of Circuits, Systems and Computers; Electronics and Electrical Engineering, International Conference of Computational Methods in Science and Engineering, International Symposium on Applied Reconfigurable Computing, International IFAC Conference on Programmable Devices and Embedded Systems, National Conference on Reconfigurable Ubiquitous Computing, Przegląd Elektrotechniczny, Elektronika – Konstrukcje, Technologie, Zastosowania

13. **Prof. A. Karwowski**, Journals: IET Proceedings Microwaves, Antennas & Propagation (London), Electronics Letters; IEEE Transactions on Antennas and Propagation; IEEE Transactions on Microwave Theory and Techniques; Progress in Electromagnetics Research, International Journal of Microwave and Wireless Technologies; COMPEL: The International Journal for Computation and Mathematics in Electrical and Electronic Engineering; Conferences: European Microwave Conference, EMC Europe, International Conference on Microwaves, Radar & Wireless Communications (MIKON)
14. **Dr P. Kłosowski**, International Symposium on Engineering Education and Educational Technologies, EEET 2016, International Multi-Conference on Engineering and Technological Innovation, IMETI 2016, support in the reviewing process of The 8th International Conference on Education, Training and Informatics: ICETI 2017
15. **Dr J. Konopacki**, IEEE Transactions on Circuits and Systems II: Express Briefs, 15th International Conference on Artificial Intelligence and Soft Computing 2016
16. **Dr M. Kotas**, Medical Engineering & Physics, IEEE Transactions on Biomedical Engineering, Biomedical Signal Processing and Control, Biocybernetics and Biomedical Engineering, Computers in Biology and Medicine, Editorial Board of International Journal of Information and Electronics Engineering
17. **Dr P. Kowalik**, Microelectronics International
18. **Dr A. Kristof,** Circuits, Devices & Systems, Mathematics and Computers in Simulation
19. **Dr M. Kwoka**, Guest Editor of Proceedings of IX International Workshop on Semiconductor, Applied Surface Science, Journal of Alloys and Compounds, Thin Solid Films
20. **Prof. J. Łęski**, IEEE Transactions Systems, Man & Cybernetics, Fuzzy Sets and Systems, European Journal of Operational Research, Pattern Recognition Letters, IEEE Transactions Biomedical Engineering, IEEE Transactions Fuzzy Systems, IEEE Transactions Signal Processing, Pattern Analysis and Applications, Neural Processing Letters, Soft Computing
21. **Dr A. Milik**, World Scientific: Journal of Circuits, Systems, and Computers, Elsevier: Control Engineering Practice, Elsevier: International Journal of Electronics and Communications, Conference

on Reconfigurable Ubiquitous Computing, RUC'2016, Programmable Devices and Systems PDeS 2016, International Conference of Computational Methods in Sciences and Engineering (ICCMSE 2016) Special Session: Logic Synthesis and Control Systems, IFAC World Congress 2017, 8th Annual International Conference on Industrial Technology IEEE ICIT 2017

22. **Dr T. Pander**, International Journal of Electronics and Communications, Biomedical Signal Processing and Control, Biocybernetics and Biomedical Engineering, IEEE Transactions on Signal Processing
23. **Dr A. Pawlak,** Elsevier Journal MICPRO Microprocessors and Microsystems, Special Section co-editor on Advanced Systems for Health, Wellness and Personal Assistance, Volume 46, Part A, Elsevier Journal Computers and Electrical Engineering, Reviews for the European Commission projects submitted in the competition FOF-04-2016 "Continuous adaptation of work environments with changing levels of automation in evolving production systems" H2020-IND-CE-2016-17
24. **Dr A. Pułka**, Guest Editor of : Special Issue of Elsevier Microprocessors and Microsystems Embedded Hardware Design on Modern Techniques of Design and Implementation of Highly Flexible Controllers, IET Circuits, Devices and Systems, IEEE ACCESS - IEEE Transactions on Computers
25. **Prof. Z. Rymarski**, International Journal of Electronics, IET Power Electronics, Przegląd Elektrotechniczny
26. **Dr E. Straszecka**, International Conference on Artificial Intelligence and Soft Computing
27. **Dr W. Sułek**, IEEE Communications Letters, Frontiers of Information Technology & Electronic Engineering, 39th International Conference on Telecommunications and Signal Processing (TSP 2016)
28. **Prof. J. Szuber**, Member of Expert's Panel of National Science Centre (NCN), ACS Applied Materials and Interfaces, Applied Surface Science, Beilstein Journal of Nanotechnology, Materials Science Poland, Materials Today, Organic Electronics, Sensors and Actuators B, Thin Solid Films, Vacuum
29. **Dr T. Topa**, International Journal of Numerical Modelling: Electronic Networks, Devices and Fields; IEEE Antennas and Wireless Propagation Letters, IET Science, Measurement and Technology

30. **Dr K. Waczyński**, 40th International Microelectronics and Packaging IMAPS-CPMT Poland Conference
31. **Dr D. Wójcik**, Progress in Electromagnetics Research
32. **Dr P. Zawadzki**, Ukrainian Scientific Journal of Information Security, Theoretical and Applied Informatics, International Journal of Quantum Information, Communications in Control Science and Engineering, Quantum Information and Computation, Scientific Report

OTHER IMPORTANT AFFILIATIONS

1. **Dr Ł. Chruszczyk**, member of the Institute of Electrical and Electronics Engineers (IEEE)
2. **Dr W. Filipowski,** member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences
3. **Prof. Z. Filus**, member of the Institute of Electrical and Electronics Engineers (IEEE)
4. **Prof. Z. Filus**, chairman of the section Electronics at the Katowice Branch of the Polish Academy of Sciences
5. **Prof. Z. Filus**, member of the Section on Signals, Circuits and Systems of the Electronics and Telecommunication Committee, Polish Academy of Sciences
6. **Dr D. Grzechca**, senior member of the Institute of Electrical and Electronics Engineers (IEEE)
7. **Dr D. Grzechca,** member of the Association of Polish Electrical Engineers (SEP)
8. **Prof. E. Hrynkiewicz,** member of the Institute of Electrical and Electronics Engineers (IEEE)
9. **Prof. E. Hrynkiewicz,** member of the Electronics and Telecommunication Committee of Polish Academy of Sciences
10. **Prof. E. Hrynkiewicz,** member of the IFAC Technical Committee TC 4.1 – Components and Technology for Control

11. **Prof. E. Hrynkiewicz,** member of the Steering Committee of the Polish Society of Measurements, Automatic Control and Robotics (POLSPAR)
12. **Prof. E. Hrynkiewicz,** member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences
13. **Prof. E. Hrynkiewicz,** member of the Section on Signals, Circuits and Systems of the Electronics and Telecommunication Committee, Polish Academy of Sciences
14. **Prof. E. Hrynkiewicz,** member of the Microelectronics Section of the Electronics and Telecommunication Committee, Polish Academy of Sciences
15. **Dr J. Izydorczyk**, vice-chair of the Computer Society Chapter, Poland Section of the Institute of Electrical and Electronics Engineers (IEEE)
16. **Dr J. Izydorczyk**, member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences
17. **Dr J. Izydorczyk,** member of the Association of Polish Electrical Engineers (SEP)
18. **Dr W. Izydorczyk,** member of the Institute of Electrical and Electronics Engineers (IEEE)
19. **Dr W. Izydorczyk,** member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences
20. **Prof. D. Kania,** member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences
21. **Prof. D. Kania,** member of the Electronics and Telecommunication Committee, Polish Academy of Sciences
22. **Prof. D. Kania,** member of the Section on Signals, Circuits and Systems of the Electronics and Telecommunication Committee, Polish Academy of Sciences

23. **Prof. D. Kania**, member of the Microelectronics Section of the Electronics and Telecommunication Committee, Polish Academy of Sciences

24. **Prof. A. Karwowski**, member of the International Steering Committee of EMC Europe - International Symposia and Workshops on Electromagnetic Compatibility

25. **Prof. A. Karwowski**, member of the Scientific Advisory Committee, Advanced Electromagnetics Symposia AES

26. **Prof. A. Karwowsk**i, member of the Electromagnetic Compatibility Sectionof the Electronics and Telecommunication Committee, Polish Academy of Sciences

27. **Prof. A. Karwowski**, member of the Microwave Section of the Electronics and Telecommunication Committee, Polish Academy of Sciences

28. **Prof. A. Karwowski**, member of the Editorial Board, Radio-engineering

29. **Prof. A. Karwowski**, member substitute, Management Committee, Action IC1102, European Cooperation in Science and Technology (COST)

30. **Prof. A. Karwowski**, senior member of the Institute of Electrical and Electronics Engineers (IEEE)

31. **Dr P. Kłosowski**, member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences

32. **Dr J. Konopacki**, secretary of the Electronics section at the Katowice Branch of the Polish Academy of Sciences

33. **Dr M. Kotas,** member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences

34. **Dr M. Kotas**, member of the Polish Biomedical Engineering Society

35. **Dr M. Kucharczyk**, secretary/treasurer of the Computer Society Chapter, Poland Section of the Institute of Electrical and Electronics Engineers (IEEE)

36. **Dr M. Kwoka,** member of the Division on Semiconductor Materials and Processing, International Union of Vacuum Science, Technology and Application (IUVSTA) for the period 2016-2019

37. **Dr M. Kwoka**, member of the Executive Council of the Polish Vacuum Society for the period 2013-2016; Chair of the Section of Surface Science

38. **Dr M. Kwoka**, member of the International Society of Olfaction and Chemical Sensing (ISOCS) for the period 2013-2016

39. **Prof. J. Łęski**, member of the division Fuzzy Logic and Neural Networks at the section Automatics and Robotics of the Polish Academy of Sciences

40. **Prof. J. Łęski**, member of the Polish Biomedical Engineering Society

41. **Prof. J. Łęski**, member of the Scientific Committee of the Biomedical Engineering Centre

42. **Prof. J. Łęski**, member of the Scientific Committee of the Institute of Medical Technology and Equipment

43. **Prof. J. Łęski,** member of the Committee for Science Policy at the Ministry of Science and Higher Education

44. **Prof. J. Łęski**, member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences

45. **Prof. J. Łęski**, member of the Steering Committee at the Gliwice-Opole Branch of the Polish Society of Theoretical and Applied Electrotechnics (PTETiS)

46. **Prof. J. Łęski**, senior member of the Institute of Electrical and Electronics Engineers (IEEE)

47. **Dr A. Milik**, member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences

48. **Dr T. Pander,** member of the section Electronics at the Katowice Branch of Polish Academy of Science

49. **Dr A. Pawlak**, member of IFIP (International Federation for Information Processing) W.G. 10.5 "Electronic Systems Description and Design Tools"

50. **Dr A. Pawlak**, member of SOCOLNET (Society of Collaborative Networks)

51. **Dr A. Pawlak,** member of the Steering Committee of the DDECS (Design and Diagnostics of Electronic Circuits and Systems*)* conference

52. **Dr A. Pawlak**, correspondent of Poland, member of EUROMICRO (European Association for Microprocessing and Microprogramming)

53. **Dr A. Pułka,** senior member of the Institute of Electrical and Electronics Engineers (IEEE)

54. **Dr A. Pułka,** member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences

55. **Prof. J. Rutkowski**, member of the Board of Directors SEFI (European Society for Engineering Education)

56. **Prof. J. Rutkowski**, member of the Electronics and Telecommunication Committee of the Polish Academy of Sciences

57. **Dr E. Straszecka,** member of the section Electronics at the Katowice Branch of the Polish Academy of Sciences

58. **Dr W. Sułek,** member of the Institute of Electrical and Electronics Engineers (IEEE)

59. **Prof. J. Szuber**, alternate councillor of the International Union of Vacuum Science, Technology and Application for the period 2013-

2016; Vice-Chair of Division on Semiconductor Materials and Processing

60. **Prof. J. Szuber**, member of the Steering Committee of the International Society of Olfaction and Chemical Sensing – ISOCS, for the period 2013-2016
61. **Prof. J. Szuber,** member of the Executive Council of the Polish Vacuum Society for the period 2013-2016
62. **Prof. J. Szuber,** member of the section Electronics at the Katowice Branch of Polish Academy of Science
63. **Prof. J. Szuber,** coordinator of research centers and networks: CESIS, NANOMET
64. **Prof. J. Szuber,** Associate Editor of Thin Solid Films
65. **Dr T. Topa,** member of the Institute of Electrical and Electronics Engineers (IEEE)
66. **Dr K. Waczyński,** member of the International Microelectronics and Packaging Society (IMAPS) Poland Chapter
67. **Dr K. Waczyński,** member of the section Electronics at the Katowice Branch of Polish Academy of Science
68. **Dr P. Zawadzki**, member of the section Electronics at the Katowice Branch of the Polish Academy of Science

PATENTS AND PATENT APPLICATIONS

Magnuski, M. (PhD), Wójcik D. (PhD), Patent No. PL224091 of 22 April 2016, "An array of two Vivaldi antennas with a widened impedance matching band"

Magnuski, M. (PhD), Wójcik D. (PhD), Patent No. PL224092 of 22 April 2016, "A capacitively coupled antenna array with a widened impedance matching band"

Wieczorek G. (PhD), Patent No. PL223554 of 19 January 2016, "A method and a device for distance measurement"

Wieczorek G. (PhD), Oliwa W. (PhD), Patent No. PL224966 of 4 August 2016, ”A method and a device for signal's delay time measurement in rangefinders”

Magnuski, M. (PhD), Wrotniak J. (MSc), Patent application No. PL419823 of 15 December 2016,”A test set for detection of chemical compounds in a gas atmosphere with a SAW sensor”

OTHER IMPORTANT ACHIEVEMENTS

Dr M. Kwoka - Scientific Fellowship of the Polish Ministry of Science and Higher Education for the Prominent Young Scientist for the period 2013-2016

Dr M. Kwoka - First degree Award of the Polish Ministry of Science and Higher Education for Scientific Achievements – 2016

LIST OF PUBLICATIONS - 2016

1. Blacha-Grzechnik A., Piwowar K., Krukiewicz K., **Kościelniak P., Szuber J.,** Żak J., Photogeneration of singlet oxygen by the phenothiazine derivatives covalently bound to the surface-modified glassy carbon, Applied Surface Science, Vol. 2016, No. 371, pp. 151-159

2. Borysiewicz A.M., Kamińska E., Wojciechowski T., Gołaszewska K., Dynowska E., Wzorek M., Kruszka K., Kruszka R., Pągowska D.K., **Kwoka M., Szuber J.,** Boll T., Stiller K., Wojtowicz T., Piotrowska A., Technology of zinc oxide thin films with controlled structural, transport and optical properties, Elektronika: Konstrukcje, Technologie, Zastosowania, Vol. 57, No. 8, 2016, pp. 75-80

3. **Chęciński J., Filus Z.,** LED lamp with colour temperature control, Przegląd Elektrotechniczny, Vol. 92, No. 9, 2016, pp. 51-54

4. **Chmiel M.,** Kloska W., Mocha **J., Polok D.,** FPGA-Based Two-Processor CPU for PLC, International Conference on Signals and Electronic Systems (ICSES 2016), Kraków, 5-7 September 2016, pp. 247-252

5. **Chmiel M., Kulisz J., Czerwiński R.,** Krzyżyk A., Rosół M., Smolarek P., An IEC 61131-3-based PLC implemented by means of an FPGA, Microprocessors and Microsystems, Vol. 44, July 2016, pp. 28-37

6. **Chodorowski P., Chmiel M.,** IEC 61131-3 Compliant PLC Structure Based on FPGA Multi-Core Solution, International Conference on Signals and Electronic Systems (ICSES 2016), Kraków, 5-7 September 2016, pp. 237-242

7. Choiński D., Wodołażski A., Skupin P., **Stachańczyk D.,** Niedźwiedź M., Analysis of the thermal properties of a heat flow chip

calorimeter using CFD, Applied Thermal Engineering, Vol. 96, March 2016, pp. 508-518

8. **Chruszczyk Ł.,** Zając A., Comparison of indoor/outdoor, RSSI-based positioning using 433, 868 or 2400 MHz ISM bands, International Journal of Electronics and Telecommunications, Vol. 62, No. 4, 2016, pp. 395-399

9. **Chruszczyk Ł., Zając A., Grzechca D.,** Comparison of 2.4 and 5 GHz WLAN network for purpose of indoor and outdoor location, International Journal of Electronics and Telecommunications, Vol. 62, No. 1, 2016, pp. 71-79

10. **Czabański R., Jeżewski M.,** Horoba K., Jeżewski J., **Łęski J.,** Fuzzy analysis of delivery outcome attributes for improving the automated fetal state assessment, Applied Artificial Intelligence, Vol. 30, No. 6, 2016, pp. 556-571

11. **Czerwiński R., Kania D.,** State assignment and optimization of ultra-high-speed FSMs utilizing tristate buffers, ACM Transactions on Design Automation of Electronic Systems, Vol. 22, No. 1, 2016, pp. 1-25

12. Drabczyk K., **Wróbel E.,** Kulesza-Matlak G., **Filipowski W., Waczyński K.,** Lipiński M., Comparison of diffused layer prepared using liquid dopant solutions and pastes for solar cell with screen printed electrodes, Microelectronics International, Vol. 2016, No. 33(1), 2016, pp. 167-171

13. D'Urso P., **Łęski J.,** Fuzzy c-ordered medoids clustering for interval-valued data, Pattern Recognition, Vol. 58, Issue C, October 2016, pp. 49-67

14. **Dustor A.,** Influence of Noise and Voice Activity Detection on Speaker Verification, 23rd International Conference on Computer Networks (CN 2016), Brunów, 14-17 June 2016, pp. 207-215

15. Dusza K., Korda D., Kozłowski K., Szwej B., **Kozielski M.,** Michalak M., Sikora M., Wróbel Ł., Application of RapidMiner and R Environments to Dangerous Seismic Events Prediction, Federated Conference on Computer Science and Information Systems (FedCSIS 2016), Gdańsk, 11-14 September 2016, Proceedings of the 2016 Federated Conference on Computer Science and Information Systems (FedCSIS), pp. 249-252

16. **Dziwoki G.,** Averaged Properties of the Residual Error in Sparse Signal Reconstruction, IEEE Signal Processing Letters, Vol. 23, No. 9, 2016, pp. 1170-1173

17. **Dziwoki G., Izydorczyk J.,** Iterative Identification of Sparse Mobile Channels for TDS-OFDM Systems, IEEE Transactions on Broadcasting, Vol. 62 , No. 2, 2016, pp. 384-397

18. Filipowska A., **Filipowski W.,** Tkacz E., Nowicka G., Struga M., Statistical Analysis of the Impact of Molecular Descriptors on Cytotoxicity of Thiourea Derivatives Incorporating 2-Aminothiazole Scaffold, Chemical & Pharmaceutical Bulletin, Vol. 64, No. 8, 2016, pp. 1196-1202

19. Filipowska A., **Filipowski W.,** Tkacz E., Wujec M., Chemometric analysis of the thiourea derivatives incorporating 2-aminothiazole scaffold, 8th Seminar of Medicinal Chemistry, Lublin, 15-17 September 2016, pp. 106

20. **Filipowski W., Wróbel E.,** Drabczyk K., **Waczyński K.,** Kulesza-Matlak G., Lipiński M., Spray-on glass solutions for fabrication of the silicon solar cell emitter layer, 40th International Microelectronics and Packaging IMAPS Poland 2016 Conference (IMAPS 2016), Wałbrzych, 25-28 September 2016, pp. 70-71

21. **Garbolino T.,** Selected aspects of testing and diagnostics connections between modules of digital systems, Prace Komisji PAN Katowice, No. 39-40, 2016, pp. 327-331

22. **Golonek T.,** Analog Circuits Specifications Testing by Means of Fast Fourier Transformation, International Conference on Signals and Electronic Systems (ICSES 2016), Kraków, 5-7 September 2016, pp. 13-18

23. **Golonek T., Kotas M.,** Jantos P., Home Ultrasound Device for Heart Beats Monitoring Based on ARM Microcontroller, International Conference on Signals and Electronic Systems (ICSES 2016), Kraków, 5-7 September 2016, pp. 243-246

24. **Grzechca D.,** Pelczar P., **Chruszczyk Ł.,** Analysis of Object Location Accuracy for iBeacon Technology based on the RSSI Path Loss Model and Fingerprint Map, International Journal of Electronics and Telecommunications, Vol. 62, No. 4, 2016, pp. 371-378

25. Horoba K., Jeżewski J., Kupka T., Matonia A., **Czabański R.,** Roj D., Electrical activity of uterus as reliable information on contractions during pregnancy and labour, 5th International Conference on Information Technologies in Biomedicine (ITIB 2016), Kamień Śląski, 20-22 June 2016, Vol. 1, pp. 353-366

26. Horoba K., Jeżewski J., Matonia A., Wróbel J., **Czabański R., Jeżewski M.,** Early predicting a risk of preterm labour by analysis of antepartum electrohysterograhic signals, Biocybernetics and Biomedical Engineering, Vol. 36, No. 4, 2016, pp. 574-583

27. Horoba K., Jeżewski J., Wróbel J., Kupka T., **Pawlak A., Czabański R., Jeżewski M.,** Design and interfacing aspects of the medical instrumentation for modern hospital system for pregnancy and labour monitoring, 23rd International Conference on Mixed Design of Integrated Circuits and Systems (MIXDES 2016), Łódź, 23-25 June 2016, pp. 492-497

28. Horoba K., Wróbel J., Jeżewski J., Kupka T., Roj D., **Jeżewski M.,** Automated detection of uterine contractions in tocography signals -

comparison of algorithms, Biocybernetics and Biomedical Engineering, Vol. 36, No. 4, 2016, pp. 610-618

29. Jeżewski J., **Pawlak A.,** Horoba K., Wróbel J., **Czabański R., Jeżewski M.,** Selected design issues of the medical cyber-physical system for telemonitoring pregnancy at home, Microprocessors and Microsystems, Vol. 46, Part A, October 2016, pp. 35-43

30. **Jeżewski M., Czabański R.,** Horoba K., **Łęski J.,** Clustering with pairs of prototypes to support automated assessment of the fetal state, Applied Artificial Intelligence, Vol. 30, No. 6, 2016, pp. 572-589

31. Kajstura K., **Kania D.,** Binary Tree-based Low Power State Assignment Algorithm, International Conference of Computational Methods in Sciences and Engineering (ICCMSE 2016), Athens, 17-20 March 2016 (Proceedings)

32. Karasiński P., Gondek E., Drewniak S., Kajzer A., **Waczyńska-Niemiec N.,** Basiaga M., **Izydorczyk W.,** Kouari Y.E.L., Porous titania films fabricated via sol gel rout – Optical and AFM characterization, Optical Materials, Vol. 2016, No. 56, 2016, pp. 64-70

33. **Karwowski A., Noga A., Topa T.,** An Efficient Framework for Analysis of Wire-Grid Shielding Structures over a Broad Frequency Range, Radioengineering, Vol. 25, No. 4, 2016, pp. 629-636

34. **Karwowski A., Topa T., Noga A.,** Implementation of the method of moments on a heterogenous CPU/GPU platform, Przegląd Telekomunikacyjny - Wiadomosci Telekomunikacyjne, Vol. 88, No. 6, 2016, pp. 503-505

35. **Kłosowski P.,** Algorithm and Implementation of Automatic Phonemic Transcription for Polish, 20th IEEE International Conference Signal Processing Algorithms, Architectures,

Arrangements, and Applications (SPA 2016), Poznań, 21-23 September 2016, pp. 298-303

36. **Kłosowski P.,** Statistical Analysis of the Polish Language Corpus for Speech Recognition Application, 20th IEEE International Conference Signal Processing Algorithms, Architectures, Arrangements, and Applications (SPA 2016), Poznań, 21-23 September 2016, pp. 304-309

37. Kobylecki M., **Kania D.,** Double-tick realization of binary control program, International Conference of Computational Methods in Sciences and Engineering (ICCMSE 2016), Athens, 17-20 March 2016 (Proceedings)

38. Koczor A., Matoga Ł., Penkala P., **Pawlak A.,** Verification Approach Based on Emulation Technology, IEEE 19th International Symposium on Design and Diagnostics of Electronic Circuits & Systems (DDECS 2016), Kosice, 20-22 April 2016, pp. 169-174

39. Komorowski D., **Pietraszek S.,** The use of continuous wavelet transform based on the fast Fourier transform in the analysis of multi-channel electrogastrography recordings, Journal of Medical Systems, Vol. 40, Issue 10, 2016, pp. 1-15

40. **Kotas M., Łęski J.,** Wróbel J., Sequential Separation of Twin Pregnancy Electrocardiograms, Bulletin of the Polish Academy of Sciences-Technical Sciences, Vol. 2016, No. 64(1), pp. 91-101

41. **Kowalik P., Wróbel E.,** Mazurkiewicz J., Electrical parameters of solar cells with electrodes made by selective metallization, Microelectronics International, Vol. 33, No. 1, 2016, pp. 36-41

42. **Kozielski M.,** A Meta-Learning Approach to Methane Concentration Value Prediction, 12th International Scientific Conference on Beyond Databases, (BDAS 2016), Ustroń, 31 April - 3 May 2016, pp. 716-726

43. **Kozielski M.,** Sikora M., Wróbel Ł., Decision support and maintenance system for natural hazards, processes and equipment monitoring, Eksploatacja i Niezawodność - Maintenance And Reliability, Vol. 18, No. 2, 2016, pp. 218-228

44. Kubica M., **Kania D.,** Opara A., Decomposition time effectiveness for various synthesis strategies dedicated to FPGA structures, International Conference of Computational Methods in Sciences and Engineering (ICCMSE 2016), Athens, 17-20 March 2016 (Proceedings)

45. Kubica M., **Kania D.,** SMTBDD: New Form of BDD for Logic Synthesis, International Journal of Electronics and Telecommunications, Vol. 62, No. 1, 2016, pp. 33-41

46. **Kulisz J.,** Nawrot R., **Kania D.,** Synthesis of energy-efficient counters implemented in PLD circuits, International Conference of Computational Methods in Sciences and Engineering (ICCMSE 2016), Athens, 17-20 March 2016 (Proceedings)

47. **Kulisz J.,** State Assignment for Asynchronous FSMs with the use of the Incompatibility and Complement Graph, International Conference of Computational Methods in Sciences and Engineering (ICCMSE 2016), Athens, 17-20 March 2016

48. **Lasota S.,** Models of modern active devices for effective and always cancelation-free symbolic analysis, 14th IFAC/IEEE International Conference on Programmable Devices and Embedded Systems (PDeS 2016), Brno, 5-7 October 2016, IFAC-PapersOnLine, Vol. 49, Issue 25, 2016, pp. 80-85

49. **Łęski J.,** Fuzzy c-ordered-means clustering, Fuzzy Sets and Systems, Vol. 2016, No. 286, pp. 114-133

50. Łukaszewicz T., **Kidoń Z., Kania D.,** Pethe-Kania K., Postural symmetry evaluation using wavelet correlation coefficients calculated

for the follow-up posturographic trajectories, Elektronika IR Elektrotechnika, Vol. 22, No. 5, 2016, pp. 84-88

51. Masłyk M., Borysiewicz A. M., Wzorek M., Kruszka K., **Kwoka M.,** Kamińska E., Influence of absolute argon and oxygen flow values at a constant ratio on the growth of Zn/ZnO nanostructures obtained by DC reactive magnetron sputtering, Applied Surface Science, Vol. 389, 2016, pp. 287-293

52. Mazur P., **Chmiel M., Czerwiński R.,** Central processing unit of IEC 61131-3-based PLC, 14th IFAC/IEEE International Conference on Programmable Devices and Embedded Systems (PDeS 2016), Brno, 5-7 October 2016, IFAC-PapersOnLine, Vol. 49, No. 25, pp. 454-459

53. Mazurek P., **Bernacki K., Noga A.,** The levels of high-frequency electromagnetic emissions in the urban environment, Przegląd Elektrotechniczny, Vol. 92, No. 1, 2016, pp. 9-12

54. **Milik A., Chmiel M., Hrynkiewicz E.,** Multiple Core PLC CPU with Tight Thread Synchronization, International Conference on Signals and Electronic Systems (ICSES 2016), Kraków, 5-7 September 2016, pp. 253-258

55. **Milik A., Chmiel M., Hrynkiewicz E.,** On the systematic method of conditional control program execution by a PLC, Bulletin of the Polish Academy of Sciences-Technical Sciences, Vol. 64, No. 1, 2016, pp. 160-170

56. **Milik A., Hrynkiewicz E.,** Distributed PLC Based on Multicore CPUs - Architecture and Programming, 14th IFAC/IEEE International Conference on Programmable Devices and Embedded Systems (PDeS 2016), Brno, 5-7 October 2016, IFAC-PapersOnLine, Vol. 49, No. 25, pp. 1-7

57. **Milik A., Hrynkiewicz E.,** Nonlinearity measurement of a voltage ramp using a digital technique, Journal of Circuits Systems and Computers, Vol. 25, No. 4, 2016, pp. 1-14

58. **Milik A.,** On hardware synthesis and implementation of PLC programs in FPGAs, Microprocessors and Microsystems, Vol. 44, 2016, pp. 2-16

59. **Noga A., Wójcik D., Surma M., Karwowski A., Topa T.,** Numerical analysis of the EEG device radiated immunity, 26th International Symposium on Applied Electromagnetics (PTZE 2016), Wrocław, 26-29 June 2016, pp. 208-209

60. **Noga A., Wójcik D., Surma M., Karwowski A., Topa T.,** The EEG device radiated immunity - examples of numerical analysis, Przegląd Elektrotechniczny, Vol. 92, No. 12, 2016, pp. 109-112

61. **Pander T.,** The iterative trimming approach to the myriad filter computation, 3rd European Network Intelligence Conference (ENIC 2016), Wrocław, 5-7 September 2016, pp. 209-216

62. **Polok D., Hrynkiewicz E.,** About some peculiar approaches to seeking the Ashenhurst decomposition of logic functions in the Reed-Muller spectrum domain, 23rd International Conference on Mixed Design of Integrated Circuits and Systems (MIXDES 2016), Łódź, 23-26 June 2016, pp. 155-159

63. **Polok D., Hrynkiewicz E.,** Some Observations Related to Searching for Logic Functions Decomposition in Reed-Muller Spectral Domain, 14th IFAC/IEEE International Conference on Programmable Devices and Embedded Systems (PDeS 2016), Brno, 5-7 October 2016, IFAC-PapersOnLine, Vol. 49, No. 25, pp. 104-108

64. **Porębski S., Straszecka E.,** Membership Functions for Fuzzy Focal Elements, Archives of Control Sciences, Vol. 26, No. 3, 2016, pp. 395-427

65. **Porębski S., Straszecka E.,** Rule Extraction Using the Dempster-Shafer Theory in the Medical Diagnosis Support, 3rd European Network Intelligence Conference (ENIC 2016), Wrocław, 5-7 September 2016, pp. 195-202 (Proceedings)

66. Pruszowski Z., **Filipowski W., Waczyński K., Kowalik P.,** Kulawik J., Experimental and mathematical relation between resistance and temperature coefficient of resistance and temperature of thermal stabilization of metallic layers based on amorphous Ni-P alloy obtained by electroless metallization, 40th International Microelectronics and Packaging IMAPS Poland 2016 Conference (IMAPS 2016), Wałbrzych, 25-28 September 2016, pp. 137-138

67. **Pułka A.,** Golly Ł., Some Issues Concerning Design Space Exploration in Time Predictable Embedded Systems, International Conference on Signals and Electronic Systems (ICSES 2016), Kraków, 5-7 September 2016, pp. 231-236

68. **Rudnicki T.,** Sikora A., **Czerwiński R., Polok D.,** Impact of PWM Control Frequency onto Efficiency of a 1 kW Permanent Magnet Synchronous Motor, Elektronika IR Elektrotechnika, Vol. 22, No. 6, 2016, pp. 10-16

69. **Rutkowski J.,** Evaluation of the correlation between formative tests and final exam results - Theory of Information Approach, International Journal of Electronics and Telecommunications, Vol. 62, No. 1, 2016, pp. 55-60

70. **Rymarski Z., Bernacki K.,** Different approaches to modelling single-phase voltage source inverters for uninterruptible power supply systems, IET Power Electronics, Vol. 9, Issue 7, 2016, pp. 1513-1520

71. **Rymarski Z., Bernacki K.,** The dynamic properties of a single-phase transformer-based inverter for UPS systems, International Journal of Circuit Theory and Applications, Vol. 44, No. 2, 2016, pp. 444-459

72. Siołek M., **Henzel N.**, Matlengiewicz M., Sequence distribution of PMMA/iBuA copolymer by incremental calculation of 13C NMR spectra, International Journal of Polymer Analysis and Characterization, Vol. 21, No. 1, 2016, pp. 69-76

73. **Straszecka E.,** Suggestions to make Dempster's rule convenient for knowledge combining, Novel Developments in Uncertainty Representation and Processing, 2016, pp. 17-27

74. **Sułek W.,** Nonbinary Quasi-Regular QC-LDPC Codes Derived From Cycle Codes, IEEE Communications Letters, Vol. 2016, No. 9, 2016, pp. 1705-1708

75. **Sułek W., Kucharczyk M.,** Partial parallel encoding and algorithmic construction of non-binary structured IRA codes, China Communications, Vol. 2016, No. 8, 2016, pp. 103-116

76. **Sułek W.,** Non-binary LDPC Decoders Design for Maximizing Throughput of an FPGA Implementation, Circuits, Systems and Signal Processing, Vol. 2016, No. 11, 2016, pp. 4060-4080

77. **Surma M., Wójcik D.,** Mocha J., **Noga A., Karwowski A., Topa T.,** Application of software defined radio in immunity tests of medical equipment to interferences produced by wireless network devices, Przeglad Elektrotechniczny, Vol. 92, No. 12, 2016, pp. 165-168

78. **Temich S., Grzechca D.,** A fuzzy logic controller to seat comfort correction for manually propelled wheelchair – a case study, 14th IFAC Conference on Programmable Devices and Embedded Systems (PDeS 2016), Brno, 5-7 October 2016, IFAC-PapersOnLine, Vol. 49, No. 25, pp. 416-421

79. **Temich S., Grzechca D.,** Application of Neural Network for Testing Voltage-Controlled Oscillators, 14th IFAC Conference on Programmable Devices and Embedded Systems (PDeS 2016), Brno,

5-7 October 2016, IFAC-PapersOnLine, Vol. 49, No. 25, pp. 429 – 434

80. **Topa T.,** Load balanced Fortran-based out-of-GPU memory implementation of the method of moments, IEEE Antennas and Wireless Propagation Letters, 2016, Issue 99, pp. 1-4

81. **Topa T., Noga A., Karwowski A.,** Accelerating frequency-domain simulations using small shared-memory CPU/GPU cluster, 21st International Conference on Microwave, Radar and Wireless Communications (MIKON 2016), Kraków, 9-11 May 2016, pp. 597-600

82. Waluś M., **Bernacki K., Konopacki J.,** Finger-vein image acquisition system, 15th National Electronics Conference (XV KKE), Darłówko Wschodnie, 6-10 June 2016, pp. 520-525

83. Waluś M., **Bernacki K.,** Popowicz A., Quality assessment of NIR finger vascular images for exposure parameter optimization, Biomedical Research-India, Vol. 27, No. 2, 2016, pp. 383-391

84. **Wójcik D.,** Mocha J., **Surma M., Noga A., Magnuski M., Karwowski A., Topa T.,** Radiated immunity of medical devices versus nonlinear performance of analog input circuit, 26th International Symposium on Applied Electromagnetics (PTZE 2016), Wrocław, 26-29 June 2016, pp. 307-308

85. **Wójcik D., Surma M., Noga A., Magnuski M.,** Design of dual-polarized MIMO linear antenna arrays with increased port-to-port isolation, 21st International Conference on Microwave, Radar and Wireless Communications (MIKON 2016), Kraków, 9-11 May 2016, pp. 578-580

86. **Wyrwoł B., Hrynkiewicz E.,** Implementation of a microcontroller-based simplified FITA-FIS model, Microprocessors and Microsystems, Vol. 2016, No. 44, 2016, pp. 22-27

87. **Zawadzki P.,** Eavesdropping on quantum secure direct communication in quantum channels with arbitrarily low loss rate, Quantum Information Processing, Vol. 15, No. 4, 2016, pp. 1731-1741

88. **Zawadzki P.,** Miszczak J. A., A General Scheme for Information Interception in the Ping-Pong Protocol, Advances In Mathematical Physics, Vol. 2016, 2016 pp. 1-7

89. **Zawadzki P.,** Ping-Pong Protocol Eavesdropping in Almost Perfect Channels, 23rd International Conference on Computer Networks (CN 2016), Brunów, 14-17 June 2016, pp. 260-268

PUBLICATIONS OF THE INSTITUTE OF ELECTRONICS

Filus Z., Hrynkiewicz E., Annual Review 2015 – Institute of Electronics, Gliwice, March 2016, 67 pages

ABSTRACTS OF SELECTED RESEARCH PROJECTS

DIVISION OF ELECTRONICS FUNDAMENTALS AND RADIO ENGINEERING

M. Magnuski (PhD), M. Surma (PhD), D. Wójcik (PhD), A. Noga (PhD), *A double conversion broadband SDR receiver*

Contemporary RF telecommunications systems widely adopt SDR (Software Defined Radio) technology due to its flexibility and simplicity. Many of signal processing functions, such as filtration, modulation, demodulation or signal conditioning, are realized in SDR devices as effects of algorithms implemented on signal processors or PLD circuits. Therefore the key features of the SDR systems could be changed or modified without any electrical circuit modifications. This property is fundamental for reconfigurability of SDR systems and makes them able to operate in multiple frequency bands and with numerous types of modulations by means of exchange of their software rather than their hardware. The application of the SDR technology is especially significant in simplification of the construction of the receivers operating in narrow bands having their operating frequency band determined by means of an input band-pass filter. According to the existing band-plan, the majority of applied SDR systems have simple, narrow band architecture. However modern trends in communications resulted in the conception of cognitive radio where RF systems should operate (should be tuned) in broad frequency bands.
The authors designed, fabricated, partly assembled and tested a prototype of the full double-conversion broadband SDR receiver for 900 MHz to 2.4 GHz applying the smart antenna technology which is dedicated to cooperate with broadband antenna systems. It could be utilized in Cognitive Radio systems. The device consists of six blocks built on separate PCBs: the first broadband frequency conversion block, beamformer, IF regulated gain amplifier, the second quadrature frequency conversion block and two frequency synthesizers for the first and second local oscillators. Input signals from antennas are delivered to the first two-way frequency conversion block built of two HMC992LPE high IP3 frequency mixers with the LO signal fed through the JPS2-1N power divider. There are two pass-band filters Sawtek 856490 (for each path) applied in this block. The input block cooperates with the two-input beamformers consisting of two phase shifters JPSHS4N, two attenuators AT210 and signal combiner JPS2-1N. The signal from the beamformer's output is delivered to the IF block built of Sawtek 856490 filter and two cascaded HMC1090-LP3E variable gain amplifiers. After amplification the signal is downconverted in a quadrature mixer built of two SYM2 ring mixers and QNC3 quadrature hybrid. The second conversion block has two LC low-pass antialiasing filters included. As local oscillators, ADF4350 frequency synthesizers are applied. All additional gain blocks are realized with ERA1 or ERA3 MIMIC

amplifiers. During the tests the frequency and phase response of the blocks and the intermodulation intercept points IP2 of 39dBm and OIP3 of -3dBm were measured.

G. Wieczorek (PhD), W. Oliwa (PhD), *Picosecond precision time-of-flight digital converter*

Precision measurements of the signals' time-of-flight (TOF) in the picosecond range are vital to many scientific disciplines and industrial applications such as range finders, fluid and gas flow meters, reflectometers, etc. Many measurement methods are known but digital domain methods are becoming more and more important due to their relatively fast and simple implementation. A range of TOF measurement apparatus is based on repetitive time interval measurements. It makes possible to implement a new class of measurement methods in FPGAs. The repetitive methods usually require smaller hardware resources than the single shot ones. High resolution TOF measurements could be made in a device using out of tune oscillators. The operation is based on transmitting a train of pulses and counting the received pulses in a bank of counters. The clock signal for the bank of counters and the clock signal for the transmitted pulses are slightly different in frequency. This small difference is a key factor for the measurement method and is achieved by a phase locked loop (PLL). TOF for the transmitted pulses is directly calculated upon counters counts. The time interval measurement resolution could be denoted as TLSB=TCLK/N, where TCLK is the clock signal period, and N is the number of transmitted pulses. A prototype instrument was implemented using Altera's FPGA Cyclone II. The achieved time resolution is 10.4ps and the average RMS uncertainty value is 12.3ps. Digital design does not demand special constraints and resources of FPGA. The experimental device (measurement circuit and interface) has taken only about 10% of the Altera's tiny EP2C8. The measurement method is suitable for low-cost applications and the VHDL code is portable, so it is possible to implement it in any kind of FPGA devices. There is no need for special calibration.

Prof. A. Karwowski, A. Noga (PhD), T. Topa (PhD), *Efficient technique for full-wave analysis of grid-like spatial shields for protection against LEMP effects*

Wire meshes in the form of spatial grid-like structures are widely used as lightning protection systems (LPS) designed to reduce aggressive high-intensity electromagnetic (EM) effects caused by lightning strikes. For effective design of LPS, prediction of its response to lightning induced electromagnetic excitation is of vital importance. For spatial grid-like structures composed of arbitrarily arranged conductors, perhaps the best choice is the full-wave method of moments (MoM) formulated in the frequency domain (FD). When a wideband response of a structure is required, the investigation is usually carried out by point-by-point frequency swept computations, i.e., evaluation of samples of the required physical observable over a predefined set of uniformly spaced frequency nodes. The approach is computationally inefficient, since EM simulation must be performed repeatedly at many frequencies resulting in that the computation time can be

unacceptably long for complex resonant structures. Among available approaches aimed at reducing the number of EM simulations needed for reconstruction of the system response and thus minimizing the overall processing time is the rational-function interpolation approach based upon the assumption that the system response can be represented by a rational polynomial. The approach usually involves adaptive procedures for selecting the interpolation nodes and the rational interpolant order. The main purpose of the study is employing an adaptive frequency sampling (AFS) technique based upon interval halving (bisection) in combination with the rational interpolation implemented through the Stoer-Bulirsch (SB) algorithm. The performance of the simulations of grid-like lightning shields over a wide frequency band is increased remarkably by extending a traditional CPU-based computation model through adoption of the General-Purpose computing on Graphics Processing Unit (GPGPU) paradigm.

DIVISION OF DIGITAL AND MICROPROCESSOR SYSTEMS

Prof. E. Hrynkiewicz, Prof. D. Kania, A. Milik (PhD), M. Chmiel (PhD), R Czerwiński (PhD), J. Kulisz (PhD), B. Wyrwoł (PhD), A. Malcher (PhD), *Fast Logic Controllers*

The research is focused on fast operating and easy programmable logic controllers according to standard requirements given in IEC61131-3 and IEC61499. The main goals of the project are reducing the response time and increasing the throughput of a control system. These goals link together two areas of research that are hardware platforms and program mapping algorithms. The hardware platform development is oriented to deliver a controller's architecture that perfectly fits to control algorithms implementation. Potential improvements are possible with the use of multi-processor implementations or utilizing reconfigurable direct hardware implementation. The developed dedicated processing units deliver instructions that simplify program implementation and utilize hardware accelerated support of standard functions. In the domain of processing units there are developed multiprocessing units with hardware supported mechanism of multithreaded computation synchronization. Finally a direct hardware implementation with massively parallel computation is developed. The last implementation utilizes FPGA devices as reconfigurable processing components for direct implementation. Multithreaded program execution or direct hardware implementation is only possible thanks to the development of a control program compiler and mapping procedures. The compiler utilizes a unique control and data flow representation enabling: extraction of computation threads and optimizations of logic and arithmetic operations. The hardware mapping module is developed to bridge the gap between PLC programming languages and HDL description languages. It is able to fully utilize specific components like DSP48 modules. The multithreaded program mapper extracts blocks that are executed in parallel and uniformly distribute computation tasks among processing resources. Advanced control algorithms based on Fuzzy Logic concepts are commonly used. An efficient implementation of them with the use of software and hardware implementation is in the interest of the group. An optimization of the Mamdani's inference method has been developed. It resulted in a

reduction of the rules database size and the complexity of the inference system by introducing a merge of rules calculation. The introduced optimizations and improvements allowed to reduce both system resource requirements and a computation time of the crisp output.

R. Czerwinski (PhD), J. Kulisz (PhD), Prof. D. Kania, *Methods of logic synthesis orientated towards exploiting specific features of programmable structures*

The research is focused on the methods of logic synthesis orientated towards exploiting specific features of programmable structures have. The developed method is dedicated for CPLDs and the basic idea is to use tri-state buffers and it takes into account the limited number of terms contained in the programmable-AND/fixed-OR logic cell. The method is suitable for combinational circuits and for Finite State Machines (FSMs) as well.
The speed optimization leads to the implementation of digital circuits in the form of one-cell-level structures. The algorithm consists in a sequential search for a partition that makes it feasible to implement the suitable parts of the implicants in one PAL-based cell containing a predefined number of product terms and a tri-state buffer. The proposed method is an alternative to the classical approach based on two-level minimization and a classical product term expansion. A two-level splitting minimization procedure is performed and then a partition of the individual implicants' groups takes place. As a result of these two procedures, the initial set of the implicants is divided into subsets with cardinality greater than or equal to the number of terms within certain PAL-based logic blocks. In the case of FSM logic synthesis the state assignment is based on a well-known method that uses output vectors and is performed by means of a special form of the binary decision tree. The proposed state assignment method involves elements of two-level minimization.
Adjusting elements of the technology mapping to the logical resources allows a significant improvement in the effectiveness of the synthesis compared to the classical approach, especially in speed. Experiments were carried out for commonly used benchmarks, applying various PAL-based logic blocks. The designed strategies were compared with academic tools. The strategies proposed seem to be especially advantageous because they lead to minimizing the number of logic levels in the structures synthesized.
This research comprises also a comparison of methods for implementing sequential circuits in Programmable Logic Devices with respect to the dissipated power too. The objective of the research was to investigate influence of different methods of "disabling" the clock signal on the dynamic power consumed by the circuit. The comparison is carried out using simple counter circuits, i.e. circuits whose algorithm is described by linear graphs. However, the presented considerations are general, and can be applied to any sequential circuit. Results of simulation tests show that the method based on clock gating is the most efficient one, and it leads to significant reduction of the dissipated dynamic power. A simple modification of global clock network structures in order to facilitate clock gating is proposed.

A. Pawlak (PhD), D. Stachańczyk (PhD), *Dependable medical cyber-physical system for home telecare of high-risk pregnancy*

This research aims at the home telemonitoring system of high-risk pregnancies. It is realized in collaboration with the Institute of Medical Technology and Equipment (Prof. Janusz Jeżewski, ITAM, Zabrze). The telemonitoring system consists of BAN and PAN networks.
Body Area Network comprises sensors that are interconnected on a body of a pregnant woman; whereas Personal Area Network is responsible for processing of physical signals, smart alerts generation, and the transmission channel to the Surveillance Centre.
In 2016 interfacing problems of the fetal monitors were the main focus. ITAM has designed a smart interface unit that is able to reconstruct the original information on the fetus object being monitored and to verify the recorded signals based on additional patterns. The challenge here to overcome is a lack of any standards for medical data content and communication, as well as measurement limitations of the medical devices being used.
Further investigations that are somehow central for telemonitoring are related to alerting Surveillance Centre in case of abnormal and dangerous for the mother and her baby health states. Smart alerting procedures based on simultaneous analysis of the recorded signals: fetal heart rate and uterine contractions, as well as the maternal movement activity during the monitoring session have been proposed.
Another challenge addressed by the Institute of Electronics concerns a different level of interfacing, namely the Human-Machine Interface (HMI). HMI is generally recognized, as one of the key problems related to the design of user-centric medical cyber-physical systems.
Designing an advanced HMI requires extensive modelling of the interactions between patients, care givers in diverse roles, as well as the telemonitoring system. Specialized knowledge modelling languages and systems are required for this creative design task. Active Knowledge Models have been investigated in this context. Further efforts involve other modelling paradigms, like SysML.

DIVISION OF CIRCUIT AND SIGNAL THEORY

A. Pułka (PhD, DSc), *Design space exploration in time predictable electronic embedded systems*

The topic is a continuation of research work conducted in the last few years. The author focused on the analysis of the overall costs of design of electronic real-time embedded systems. His approach is based on the original high level abstract SystemC transaction level model of a time predictable multitasking system. The presented methodology allows dynamic task scheduling and interleaving of threads thanks to the original designed control part of the embedded real-time system. The methodology is very flexible; it allows examining hardware, software and bridge-ware (communication) of the system. Thanks to such controlling components, like TSC, DIC or MACU, the

system is able to use available resources very efficiently and flexibly; it dynamically extends the number of necessary cores. The presented high-level platform is very useful for early prototyping real time electronic embedded systems. This approach is implementation independent. Some quality factors reflecting the system demands and design requirements are formulated and analyzed on many simulation experiments. The flexibility of the design technique is emphasized on the examples with tasks' scalability from one to multi-processor architecture.

J. Konopacki (PhD, DSc), M. Waluś (PhD student), K. Bernacki (PhD student), *Selected applications of digital signal processing*

This project has been concentrated on image acquisition for finger vein biometric authentication. Vein imaging requires near-infrared (NIR) light for the complex vascular structures residing inside the hand to become visible. Vein structures are subcutaneous and hidden, thus they do not leave traces, which could be used against individuals and cannot be seen by a naked eye. NIR imaging constitutes an aliveness detection of the user, since blood must be circulating in order for the veins patterns to be captured. Owing to these properties, compared with other modalities such as fingerprints and face, they are more robust against spoofing and external conditions. Moreover, they cannot be captured without the subject's consent. In this context, the hand veins, in particular finger veins because of their size, have emerged as a promising new biometric modality, in particular for banking transactional applications, where hygienic, contact-free sensors without guidance for the hand or finger can be deployed.
A new modular model of the image acquisition system has been constructed which provides NIR diodes replacement in order to obtain a change of light wavelength. Additionally, the system allows automatic adjustment of diodes brightness for image dynamic range enhancement. The system applies two techniques for the improvement of the image quality. The first is based on automatic adjustment of diode light intensity. The process is performed iteratively in a feedback loop, wherein the quality of the obtained images is estimated in real-time. The second technique uses several low dynamic range (LDR) images, acquired for different diode light intensities, and next forms one high dynamic range (HDR) image. Both techniques can be started independently and the user of the system decides which one should be used. This model was used to perform experimental work and proof that some NIR wavelengths better suit for vein patterns acquisition, allowing to increase the recognition effectiveness of finger vein biometric systems.

D. Grzechca (PhD, DSc), Ł. Chruszczyk (PhD), *Indoor and outdoor positioning of objects in motion*

Current research activities concern techniques of indoor object location and positioning (e.g. private rooms, office area, public buildings, production/storage facilities). Two fundamental cases have been investigated, i.e. accuracy of static positioning and object in motion. The research team has experience in signal processing for designing and

building systems based on signal strength indicator and signal latency acquisition. The prototype system based on signal quality has been designed and investigated, it consists of five fixed base stations (reference) and two mobile terminals (localized objects). The location method has been primarily based on the measurement of the received signal level (RSSI). There have been used WLAN wireless modules (2.4 GHz and 5 GHz), Bluetooth Low Energy (BLE) devices and ISM modules (433 MHz, 868 MHz, 2.4 GHz and 5 GHz). There have also been used ultra-wide band (UWB) modules, performing self-positioning based on short-time pulses and latency information. Real measurements allow description of accuracy and statistical analysis, as a function of distance measurement method, frequency range used and the operating environment (indoor or outdoor - for comparative purposes). Additionally, influence of data fusion methods has been investigated for complex systems (e.g. mobile phones with BT, WLAN and video data available parallelly).
Both systems can be applied for real world problems like drone 3D positioning, miners location, etc.

DIVISION OF TELECOMMUNICATION

G. Dziwoki (PhD), J. Izydorczyk (PhD, DSc), Iterative identification of sparse mobile channels for TDS-OFDM systems

Improvement of spectral efficiency is essential for the development of mobile systems in the light of growing demand for high data transmission rate. The TDS-OFDM transmission system increases bandwidth utilization by time-domain channel estimation without any support from frequency-domain pilot signals. Channel identification methods use a training sequence, added at the beginning of every OFDM symbol. Sparse nature of the channel impulse response, which manifests itself during wireless broadband transmission, enables one to implement compressed sensing techniques for channel identification. Channel sparsity reduces the number of measurement samples required in the channel reconstruction procedure, but they should be taken from the inter-block interference (IBI) free part of the received training sequence. If maximum delay spread of the channel is comparable with the length of the training sequence, the number of measurements within the IBI-free region may be insufficient for accurate channel identification.
The research proposed a new iterative approach to sparse channels estimation, which uses the measurements from outside the IBI-free region. The method does not require collecting the measurements over many consecutive OFDM symbols like in the case of structured compressed sensing approach as well as a support from the frequency domain pilot training. Restriction of the channel identification to a single OFDM symbol preserves a quick response of the system to possible transmission errors. The proposed solution was examined for simulated transmission over randomly generated doubly-selective channels when compared with the conventional CS technique and perfect channel state information condition. The experiments revealed an enhancement of the transmission quality in terms of SER for slow-time selective channels when both delays

and gains of the channel impulse response are estimated with the Orthogonal Matching Pursuit algorithm. Further improvement, also for transmission over moderate varying channels, is observed when the path delays are found in advance. To improve the delay estimators, the framed transmission was suggested. The extended training sequence of the first OFDM symbol in the frame was proposed to enhance precision of the paths delays estimation through the OMP algorithm.

W. Sułek (PhD), M. Kucharczyk (PhD), *Nonbinary LDPC codes and their efficient hardware implementation*

Nonbinary (NB) Low Density Parity Check (LDPC) codes are a generalization of the industrial standard binary LDPC codes for forward error correction in communication and information systems. Operation over high order Galois Field GF(q) gives an additional error correcting coding gain at the cost of increased decoding complexity. In consequence, the decoder hardware implementation as well as an implementation friendly code design is still a challenging task.
This research project concerns the NB-LDPC hardware coding system design approach, primarily targeted for the FPGA devices. We reformulate the mixed-domain FFT-BP decoding algorithm and develop a decoder architecture that does not exclude the multiplication units. This allows mapping a part of the algorithm to the multiplier cores embedded in an FPGA, thus making use of all the types of FPGA resources. Then, the throughput limit achievable in a single FPGA by the proposed decoder is significantly increased. We also consider another important optimization of the decoder implementation, mainly an efficient realization of the permutation units and an approximated evaluation of the nonlinear functions of messages.
Another motivation is to make the coding system implemented in an FPGA easily scalable for a broad range of throughputs required for different applications. To achieve this goal, the configurable semi-parallel decoder architecture is designed as well as the design methods for constructing implementation oriented codes with scalable parallelization of the associated decoder are developed. Particularly, we propose an algorithmic design method for a subclass of structured S-NB-IRA codes, efficiently encodable and decodable in hardware architectures. The developed construction method offers an unrestricted choice of the submatrix size as well as the other code parameters: the GF(q) order, the code rate and block length. Experimental results show that the constructed S-NB-IRA codes outperform significantly the binary IRA and S-IRA codes and their performance is similar or a little better than the other recent NB-LDPC codes.

DIVISION OF BIOMEDICAL ELECTRONICS

Prof. J. Łęski, *Fuzzy c-Ordered Medoids Clustering For Interval-Valued Data*

Fuzzy clustering for interval-valued data helps to find natural vague boundaries in such data. The Fuzzy c-Medoids Clustering (FcMdC) method is one of the most popular clustering methods based on a partitioning around medoids approach. However, one of

the greatest disadvantages of this method is its sensitivity to the presence of outliers in the data. This work introduces a new robust fuzzy clustering method named Fuzzy c-Ordered-Medoids clustering for interval-valued data (FcOMdC-ID). The Huber's M-estimators and the Yager's Ordered Weighted Averaging (OWA) operators are used in the method proposed to be robust to outliers. The described algorithm is compared with the fuzzy c-medoids method in the experiments performed on synthetic data with different types of outliers. A real world application of the FcOMdC-ID is also provided.
The real interval-valued data can contain outliers. Therefore the clustering methods need to be robust. This work combines the fuzzy c-medoids clustering with the robust ordered statistics using Huber's M-estimator. The developed FcOMdC-ID clustering method is based on various dissimilarity measures (as squared, linear, Huber, sigmoidal and logarithmic) and an ordering of models residuals. The method is introduced as the problem of a constrained minimization of the criterion function. The necessary conditions for obtaining local minimum of the criterion function with respect to the elements of the partition matrix are shown. The existing fuzzy c-medoids clustering method can be obtained as special cases of the method developed. The study of the FcOMdC-ID with the traditional fuzzy c-medoids as the reference methods is included. These numerical examples show the usefulness of the method proposed when applied to clustering data with different types of outliers. Furthermore, in order to show the effectiveness of our method in an empirical context, the FcOMdC-ID method is applied and compared with other robust fuzzy clustering methods.

M. Kotas (PhD, DSc), T. Moroń (PhD student), *ECG signals reconstruction in subbands for QT interval measurements*

The ECG signal is a source of compound diagnostic information. Unfortunately, it is often embedded in high energy noise, making its analysis and interpretation rather cumbersome. Therefore, during decades, many different approaches to ECG noise suppression have been proposed. In this study, we propose a combination of two methods. The first one is the projection pursuit based robust principal component analysis (RPCA), applied to QRS complexes reconstruction. The second is the method of weighted averaging of nonlinearly aligned signal cycles. The novelty of the approach consists in the way these methods are combined. First, a processed ECG signal is decomposed into three spectral subbands, of high, medium and low frequency. Then the both methods are applied in such a way that their operation is prevented from the most common unfavourable factors. RPCA reconstructs QRS complexes in a medium and high frequency subbands added. This makes the method more immune to low frequency artifacts that can be caused by the motion of electrodes. Dynamic time-warping for nonlinear alignment of the ECG cycles is performed on the medium frequency subband which again prevents the procedure from the unfavourable influence of electrode motion artifacts. After the warping paths have been determined, the weighted addition of nonlinearly aligned signal cycles is executed, separately in the three subbands, with optimal weights estimated in each subband. Finally, by the appropriate addition of the obtained signals, the whole spectrum ECG is reconstructed.

In the experimental section, the proposed method was applied to ECG signals enhancement prior to the measurements of the QT interval. This made the measurements remarkably immune to different types of ECG noise. They were rather accurate even in cases of muscle artifacts whose amplitude was comparable to that of the QRS complexes. This opens new possibilities for a reliable analysis of the QT interval variability in signals of very poor quality (e.g. Holter records).

M. Kwoka (PhD, DSc), Prof. J. Szuber, *Influence of Nb doping on surface chemistry and morphology of titanium dioxide nanotubular arrays*

This is well known for more than 20 years that the transduction of chemical information into the electrical signal change of metal oxides responsible for sensing performances of TiO2 nanotubes takes place within the surface space charge layer within the Debye length (about several nm). This is why it is absolutely crucial to have a new insight into the sensor properties of TiO_2 nanotubes (TNT), especially when different metals as dopants are added to enhance their gas sensing performances (sensitivity, selectivity, response time, etc.).
In order to obtain the above mentioned information the X-ray photoelectron spectroscopy (XPS) has been applied for the control of surface chemistry of pure and Nb-doped TiO_2 nanotubes (including surface stoichiometry and undesired C surface contaminations that mainly cause the aging effect after their exposure to gas atmosphere), in combination with the Scanning Electron Microscopy (SEM) for the control of their surface morphology. Our experiments showed that:

- The obtained TiO_2 nanotubes are highly aligned and well-ordered, as confirmed by SEM studies,
- The surface of all TiO_2 nanotubes is over-stoichiometric with respect to TiO_2 matrix as confirmed by XPS,
- XPS studies confirmed that Nd dopants are also located at the surface of all TiO_2 nanotubes,
- Moreover, a huge amount of undesired C contaminations at TiO_2 nanotubes surfaces was additionally recognized by XPS.

GROUP FOR MICROELECTRONICS AND NANOTECHNOLOGY

W. Izydorczyk (PhD), K. Waczyński (PhD, DSc), W. Domański (PhD), J. Uljanow (PhD), J. Mazurkiewicz (PhD, DSc), N. Waczyńska-Niemiec (MSc), *Microstructure and NO_2 gas-sensing properties of SnO_2 thin films and 1-D nanostructures*

Tin dioxide SnO_2 is a wide band-gap oxide semiconductor (E_g = 3.6 eV). The presence of oxygen vacancies both in the bulk and on the surface is a characteristic feature of oxide semiconductors. Electronic properties of SnO_2 films strongly depend on their stoichiometry and microstructure. Such layers can be used to measure low concentrations of both reducing gases (e.g. CO, H_2, NO) and oxidizing gases (e.g. NO_2, O_2).

The aim of the work was to explain how factors such as the structure layer, the gas concentration and operating temperature determine the sensor response to gas adsorption.
Gas sensitive layers were composed of grains that had various diameters and shapes. The studied sensor structures were based on SnO_2 thin film grown by the Rheotaxial Growth and Thermal Oxidation (RGTO) process and on one-dimensional (1D) SnO_2 nanowires (NWs) grown by thermal deposition on silicon substrate.
XRD characterisation proved crystalline structure of both types of SnO_2 layers from the peaks corresponding to (110), (101), (200), (211), (112) and (321) planes in the SnO_2 phase. The topography of SnO_2 layers were investigated by means of scanning electron microscopy (SEM). Grain diameter in the range of 100 nm to 3000 nm in the RGTO films was observed. In addition, on the basis of the SEM micrograph, it can be concluded that the SnO_2 NWs forming the layer have different diameters varying in the range of 40-110 nm, while their length is < 40 μm.
The resistance measurements of SnO_2 which was exposed to gas (mixture of nitrogen dioxide, oxygen and nitrogen) showed that both studied types of layers were highly sensitive to nitrogen dioxide (content from 3 ppm to 240 ppm) in the temperature range from 150 °C to 300 °C. The structure response to gas action was dependent on the operating temperature and gas concentration. The performed measurements proved that the response time of the sensor structure lies in the 100 s to 270 s interval for all tested temperatures. Relative changes of the sensor resistance versus NO_2 concentration and temperature were analyzed. In particular, maximum sensitivities were observed at about 250°C and 300°C in the case of the RGTO thin film and SnO_2 NWs, respectively.

W. Filipowski (PhD), E. Wróbel (PhD), K. Waczyński (PhD, DSc), K. Drabczyk (PhD) (Institute of Metallurgy and Materials, Polish Academy of Sciences, Kraków, Poland),
Research on spray-on glass solution for fabrication of the silicon solar cell emitter layer

To decrease prices of industrially produced silicon-based solar cells, the new low-cost production processes are necessary. The investigation was focused on dopant sources fabrication and diffusion processes. The doping solution was made in two stages. In the first stage, a base solution (without dopants) was made: dropwise deionized (DI) water and ethyl alcohol were added to a solution consisting of tetraethoxysilane (TEOS) and 99.8 per cent ethyl alcohol. Next, to the base solution, orthophosphoric acid dissolved in ethyl alcohol was added. The dopant solution prepared in that way was subjected to filtration using submicron filters with the pore size equal to 0.2 μm. In the next step dopant solution was deposited on the silicon wafers surface by a spray-on method using the airbrush powered by compressed nitrogen. After drying process the wafers were transferred directly from the drier to a resistance furnace with one side open quartz tube, where the doping process was carried out in nitrogen atmosphere. After the diffusion process the PSG layer was removed in hydrofluoric acid (HF) bath. The great advantage of the presented dopant solution is the possibility of easy cleaning of phosphorous silica glass (PSG) after the diffusion process. Sheet resistance of the emitter layer obtained using the prepared dopant solution was in the range of 66-82 Ω/sq.