



**INSTITUTE OF RADIOELECTRONICS
AND MULTIMEDIA TECHNOLOGY**

WARSAW UNIVERSITY OF TECHNOLOGY

FACULTY OF ELECTRONICS AND INFORMATION TECHNOLOGY



ANNUAL REPORT

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From the Director

Dear Colleagues,

The year 2019, whose outcomes are presented in this edition of the Annual Report, was marked by some important events driving substantial changes in the Institute of Radioelectronics and Multimedia Technology. We welcomed the year 2020 with high expectations, but also awareness of the transformation challenges we are confronted with.

In September 2019, the Institute experienced an unexpected loss: its Director, Professor Wiesław Winiński, passed away after a short illness. As a consequence, the Board of Directors had to be changed: being the former Director of the Institute, I accepted this role for the last year of the term of office.

The first important factor, affecting the functioning of the Institute, became the new Act on Higher Education, promulgated by the Polish Parliament in July 2018 and fully implemented by the Ministry of Science and Higher Education since October 2019. This Act has redefined the operational rules of the Polish institutions of higher education; in particular, it has charged them with additional administrative and technical duties. The new organisational structure of Warsaw University of Technology, determined after several busy months of vivid discussions, seems to strengthen the position of the institutes as research centres while reducing the role of the faculties to teaching responsibilities.

The second important factor affecting the functioning of Warsaw University of Technology is the process of its transformation into the research university, supported by an increase in the State funding for research activities. The Institute's contribution to this process requires increased efforts aimed at reaching scientific excellence and producing measurable techno scientific results. Thus, our research activity must be, at least up to certain extent, redirected towards the declared priority areas – including *artificial intelligence, internet of things, data processing methods* and *material technologies* – without compromising the quality of work achieved in our traditional fields of expertise. We have responded to this challenge by starting the conceptual work on the adaptation of the Institute's structure to the new needs.

To face the above challenges, we have modified the structure of the Institute. Starting from March 2020 three divisions will be established (replacing previous ones): Division of Multimedia Engineering (led by prof. K. Snopek), Division of Radiocommunication and Radiolocation (led by prof. W. Wojtasiak), and Division of Subterahertz Technique (led by prof. E. Yaschyshyn). At the same time, the Division of Nuclear and Biomedical Electronics and Division of Electroacoustics continues its work in the same structure as before. I hope the new structure of the Institute will better reflect the current research trends.

An important event was also the 20th anniversary of the *Foundation for the Development of Radiocommunication and Multimedia Technologies*. It has been one of the most significant organizations supporting activities of our Institute, having funded multiple grants and scholarships for young, outstanding researchers, fostering their careers. Its wide recognition enables promoting both the Institute and the University.

We closed the year 2019 with many assets that will, hopefully, bring important benefits to the Institute in 2020. Undoubtedly, the most important among them is the academic staff including 15 Professors, 32 Assistant Professors and over 40 Ph.D. students who are involved in multiple national and international projects financed, *inter alia*, by Norway Grants, National Centre for Research and Development, National Science Centre and Foundation for Polish Science. We have had well-established cooperation with external institutions – both national, like Warsaw University of Life Sciences, and foreign, like CERN, Chinese Academy of Sciences or South-Korean Agency for Defence Development. The latter liaisons give us the potential to become more attractive for foreign students and to expand industrial and research collaboration at the global scale. Special attention has been paid to the R&D works focused on the defence-and-security issues, as well as to the commercialisation of research outcomes related to material characterisation for 5G applications.

Not only research activities of the Institute, but also its educational activities have undergone recently a process of important enhancement. We have been, in particular, involved in a number of academic projects aimed at modification of curricula in the fields of electronics, telecommunications, computer science and biomedical engineering, in particular – in the projects belonging to the EU-financed programme Science–Education–Development–Cooperation (with NERW being its Polish acronym).

In conclusion of this preface to the Annual Report 2019, let me express my appreciation for the huge amount of work accomplished by the whole academic, technical and administrative staff of the Institute, and invite the PT Readers to browse through the contents of this report.



Professor Józef Modelski

Warsaw, February 2020

Classification of publications presented in this Report
is in accordance with the rules in force in 2019

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1. GENERAL INFORMATION

1.1. Mission of the Institute

In defining its mission, the Institute of Radioelectronics and Multimedia Technology is amenable to contemporary needs of academia, industry, and society. Therefore, it aims at the three measurable objectives: to provide teaching of societal relevance; to seek excellence in scientific research; and to run projects meeting the international standards. Technically, we focus on the well-defined specializations: radioelectronics, multimedia, nuclear and medical electronics. These are very well perceived by our students and partners in national and international activities.

As educators, our staff performs sterling work and exhibit immense stamina. The effects are directly measurable in terms of quality and numbers of supervised diplomas. Our graduates prove competitive on the demanding job market in Poland and abroad. They find employment in telecommunication services, mobile communications, information technology, television, and also in public services. We reach further into these sectors through the successful scheme of continuing education. The offer of courses including Radioelectronics and Multimedia Technology attracts an increasing number of participants.

As researchers, we are faithful to the highest standards of the Faculty and the University. We also feel quite unique due to an extremely broad spectrum of addressed subjects, which comprise:

- In Radioelectronics

We are interested in all theoretical and practical aspects concerning transmitting and receiving parts of radio systems. As radio systems we understand radio broadcasting systems, telecommunication systems including various configurations from point-to-point to multiple input-multiple output systems as well as the radio-location and radio-navigation systems. These systems can operate in narrow band, wide band or ultra-wide band. Special attention has been recently put on reconfigurable and software-defined radio systems (incl. smart and reconfigurable antennas).

The frequency range of our interest spans from kHz range (for high efficiency energy conversion) through all ranges used in classical telecommunication up to the terahertz and optical range.

In our applied research we have a vast experience in designing up-to-date, ready to use parts of the radio systems including various types of antennas, power amplifiers, modulators and even entire TR modules for radar systems.

Our special attention has been recently brought to the Internet of Things, the growing importance of which contributed to the increase of research in multiple areas, including design of antennas, development of embedded systems and implementation of software applications (e.g. dedicated to the code optimization, transmission protocols application and hardware subsystems control). Advanced aspects of the sensor-based networks, such as secure data transmission (cryptographic protocols) or data processing algorithms (like Artificial Intelligence) are also of our deep interest.

We also specialize in physical aspects of the propagation of electromagnetic and acoustic waves. The waves are interested in as the means of transmission of the telecommunication information but also as the means of transmitting high power and/or means of investigating the properties of materials (incl. semiconductors, ferroelectrics, graphene, composites etc.).

- In Multimedia

Multimedia at our Institute assembles various lines of research in visual and audio technology. The Multimedia branch comprises people working in two major research and teaching groups: the Television Division and the Electroacoustics Division. Activities of the Television Division focus on media compression, object recognition in images, and digital processing for measurement signals. Moreover, media security, extracting 3D models from video streams, the augmented reality for TV applications, and novel multimedia applications based on deep, convolution, and recurrent artificial neural networks - extend the traditional area of research and teaching in the Television Division.

The Electroacoustics Division, in its research and teaching, focuses on fundamental and applied issues in acoustics, electroacoustics, design of sound systems, signal processing for audio as well as various aspects of perception of sound including noise control and its effects on people.

- In Nuclear and Medical Electronics

Nuclear and Medical Electronics assemble designing of the detectors and front-end electronics for high energy physics and neutrino experiments (e.g. COMPASS – CERN, T2K – Japan, ICARUS – Italy), software and hardware developments in Magnetic Resonance Imaging (MRI), like studies of hyper-polarization (DNP) with RF and processing methods in functional and structural neuroimaging, data analysis in proteomics, software and hardware developments in Electrical Capacitance Tomography and Nanoparticle Magnetic Tomography.

It is also our ambition to implement the new scientific knowledge into a good engineering practice. The Institute covers the full process of technological development, from innovative ideas up to the construction of prototypes.

The Foundation for Development of Radiocommunications and Multimedia Technology plays a special role in perpetuating scientific research within our Institute and the whole Faculty. The Foundation subsidizes undergraduate and graduate scholarships. It monitors and awards the progress of young Polish researchers. Its generous support helps us face the socio-economical obstacles, and compete with commercial opportunities awaiting the young people on the open market.

1.2. Board of Directors

Director of the Institute

Wiesław Winiecki, Prof. D.Sc., Professor
 Józef Modelski, Prof. D.Sc., from Oct.'19
room: 535, phone: +48 22 2347723
e-mail: J.Modelski@ire.pw.edu.pl

Secretariat

Anna Tratkiewicz, Senior Administrative Clerk (0.6)
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fax: +48 22 8253769
e-mail: A.Tratkiewicz@ire.pw.edu.pl

Anna Smenda, Administrative Clerk
room: 422, phone: +48 22 2347742, +48 22 8253929
fax: +48 22 8253769
e-mail: A.Smenda@ire.pw.edu.pl

Deputy Director for Research

Yevhen Yashchychyn, Prof. D.Sc. Professor (till Mar.'19)
 Kajetana Snopek, D.Sc. (till Sept.'19)
 Piotr Bilski, D.Sc., University Professor (from Oct.'19)
room: 127, phone: +48 22 234 5367, +48 22 2347644
e-mail: P.Bilski@ire.pw.edu.pl

Secretariat

Anna Noińska, Administrative Clerk for Research (0.8)
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e-mail: A.Noinska@ire.pw.edu.pl

Deputy Director for Academic Affairs

Jacek Cichocki, Ph.D., Reader
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Secretariat

Izabela Dudek, Administrative Clerk for Teaching
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Director's Representative for Economy & Administration

Piotr Brzeski, Ph.D., Senior Lecturer (0.5)
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e-mail: P.Brzeski@ire.pw.edu.pl

1.3. Organisation of the Institute

The Institute of Radioelectronics and Multimedia Technology consists of the following research and teaching divisions:

- Electroacoustics Division;
- Microwave and Radiolocation Engineering Division;
- Nuclear and Medical Electronics Division;
- Radiocommunications Division;
- Television Division.

The structure of the Institute includes Library, Accounting Department, Supply Section.

1.3.1. Electroacoustics Division

Head of Division

Jan Żera, Prof. D.Sc., Professor

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Senior academic staff

Wiesław Winiecki, Prof. D.Sc., Professor
 Piotr Bilski, D.Sc., University Professor
 Marcin Lewandowski, Ph.D., Assistant Professor
 Grzegorz Makarewicz, Ph.D., Assistant Professor (0.5)
 Krzysztof Mroczek, Ph.D., Assistant Professor
 Piotr Bobiński, Ph.D., Senior Lecturer

Junior academic staff

Robert Łukaszewski, Ph.D., Assistant
 Agnieszka Pietrzak, M.Sc., Assistant

Technical staff

Grzegorz Makarewicz, Ph.D., Research Support Engineer (0.5)

Ph.D. Students

Krzysztof Dowalla, M.Sc., from Feb. 2017
 Salomea Grodzicka, M.Sc., from Oct. 2019
 Maciej Jasiński, M.Sc., from Feb. 2018
 Jacek Majer, M.Sc., from Oct. 2018
 Tomasz Markowski, M.Sc., from Feb. 2018
 Bartosz Połok, M.Sc., from Oct. 2015
 Agnieszka Pietrzak, M.Sc., from Feb. 2015
 Augustyn Wójcik, M.Sc., from Oct. 2015
 Katarzyna Wynimko, M.Sc., from Oct. 2018
 Bartosz Żłobiński, M.Sc., from Feb. 2015

Retired

Zbigniew Kulka, Prof. D.Sc.,
 Ewa Kotarbińska, Ph.D.,
 Andrzej Leszczyński, Ph.D.,
 Maria Tajchert, Ph.D.

The activities of the Division concern electroacoustics and digital audio techniques, including investigations, measurements and applications. They are focused on:

- fundamentals of acoustics;
- electroacoustics;
- psychoacoustics;
- digital audio;
- design and measurements of electroacoustic transducers;
- investigation and modeling of acoustic field distribution;
- noise control and active noise reduction;
- architectural and industrial acoustics;
- sound studio techniques;
- hearing protection.

Current research topics include:

- digital audio signal processing;
- low-level acoustic signals measurements and analysis;
- objective and subjective methods of sound quality evaluation;
- detection of auditory warning signals in the presence of industrial noise;
- elaboration of computation methods for acoustic field radiated in free space by surface acoustic sources and their implementation on a PC.

The other field of interest concerns fundamental and applied research associated with metrology, instrumentation

and measuring systems. It is focused on design of automated computer-based measuring systems. Current research topics include:

- modern information technologies, e.g. LabVIEW, Java, XML, and modern communication technologies, e.g. the Internet, GSM, Bluetooth, ZigBee in distributed control and measuring systems;
- virtual instrumentation, plug-in boards for data acquisition, IEEE-488 equipment;
- artificial intelligence methods in diagnostics of analog systems;
- non-invasive methods for monitoring and analysis of electricity consumption around the end users.

The Division is equipped with an anechoic chamber and sound studio with two control rooms.

1.3.2. Microwave and Radiolocation Engineering Division

Head of Division

Wojciech Wojtasiak, D.Sc., University Professor
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e-mail: W.Wojtasiak@ire.pw.edu.pl

Senior academic staff

Bartłomiej Salski, D.Sc., University Professor
 Paweł Kopyt, D.Sc., University Professor
 Daniel Gryglewski, Ph.D., Assistant Professor
 Przemysław Korpas, Ph.D., Assistant Professor
 Dawid Rosołowski, Ph.D., Assistant Professor
 Maciej Sypniewski, Ph.D., Senior Lecturer (0.5)
 Przemysław Miazga, Ph.D. Senior Lecturer

Junior academic staff

Mateusz Kryszicki, M.Sc., Research Assistant

Technical staff

Mirosław Lubiejewski, Foreman

Ph.D. students

Jerzy Cuper, M.Sc., from Oct. 2019
 Marcin Góralczyk, M.Sc., from Oct. 2014
 Tomasz Karpisz, M.Sc., from Feb. 2015
 Mateusz Kryszicki, M.Sc., from Oct. 2014
 Dawid Kuchta, M.Sc., from Oct. 2014
 Adam Pacewicz, M.Sc., from Oct. 2017
 Adam Raniszewski, M.Sc., from Feb. 2015

Temporary Staff

Dariusz Kołodziej, M.Sc., Support Enginner (0.5)
 Marcin Piasecki, Ph.D., R&D Engineer (0.5, till Oct. 2019)

Retired

Wojciech Gwarek, Prof. D.Sc.,
 Tadeusz Morawski, Prof. D.Sc.,
 Stanisław Rosłonec, Prof. D.Sc.

The Microwave and Radiolocation Engineering Division conducts scientific and applied research around electromagnetic field theory, microwave theory and techniques, and measurement techniques for very high frequency ranges. This includes the subjects of computer-aided design, data acquisition and data processing. Specific research topics in 2018 included: design of Front-Ends for wireless systems, radar applications (oscillators, synthesizers, modulators, amplifiers, transmitter/receiver modules), high-power high frequency stability sources for

microwave heating and GaN HEMT structure topology design; methods of synthesis and computer-aided design of passive and active microwave circuits (couplers, power combiners and dividers, switches, transistor circuits); analysis and design of multi-element planar in-phase radar antenna arrays intended to work at high power level; numerical electromagnetic compatibility analysis; methods for measurements of electric and magnetic properties of materials at microwave frequencies; development of numerical methods and implementation of computer programs for full-wave analysis and design of two- and three-dimensional microwave circuits (filters, periodic guiding structures, matching circuits, structures incorporating dispersive and anisotropic media, antennae); methods of coupled electromagnetic-thermodynamic simulations, design of microwave heating applicators for material science applications; methods of coupled electromagnetic-optical modeling; radio-frequency identification and wireless sensing; development of multithread and distributed programming techniques, non-linear programming, and artificial intelligence methods for application in automated design of microwave circuits.

1.3.3. Nuclear and Medical Electronics Division

Head of Division

Janusz Marzec, D.Sc., University Professor
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e-mail: J.Marzec@ire.pw.edu.pl

Senior academic staff

Krzysztof Zaremba, Prof. D.Sc., Professor
 Piotr Bogorodzki, D.Sc., University Professor
 Waldemar Smolik, D.Sc., University Professor
 Grzegorz Domański, Ph.D., Assistant Professor
 Michał Dziewiecki, Ph.D., Assistant Professor (till Jul. 2019)
 Bogumił Konarzewski, Ph.D., Assistant Professor
 Jacek Kryszyn, Ph.D., Assistant Professor
 Ewa Piątkowska-Janko, Ph.D., Assistant Professor
 Dariusz Radomski, Ph.D., Research Assistant Professor
 Tymon Rubel, Ph.D., Assistant Professor
 Andrzej Rychter, Ph.D., Assistant Professor
 Piotr Brzeski, Ph.D., Senior Lecturer (0.5)
 Tomasz Olszewski, M.Sc., Senior Lecturer

Junior academic staff

Robert Kurjata, Ph.D., Assistant
 Wojciech Obrębski, M.Sc., Assistant (0.5)
 Przemysław Wróblewski, M.Sc., Assistant
 Marcin Ziembicki, M.Sc., Assistant

Technical staff

Marcin Krzewski, M.Sc., R&D Engineer (from Nov. 2019)
 Bartłomiej Radzik, M.Sc., R&D Engineer (from Nov. 2019)
 Mateusz Stosio, M.Sc., R&D Engineer (from Nov. 2019)
 Damian Wanta, M.Sc., R&D Engineer (from Nov. 2019)
 Andrzej Wasilewski, Worker

Ph.D. students

Monika Drabik, M.Sc. from Oct. 2016
 Bartosz Kossowski, M.Sc., from Oct. 2013
 Kamil Lipiński, M.Sc., from Oct. 2019
 Mateusz Midura, M.Sc., from Oct. 2019
 Katarzyna Orzechowska, M.Sc., from Oct. 2019

Mateusz Stosio, M.Sc., from Oct. 2015
 Damian Wanta, M.Sc., from Oct. 2016
 Michał Wieteska, M.Sc., from Feb. 2015
 Przemysław Wróblewski, M.Sc., from Oct. 2013
 Agata Zakrzewska, M.Sc., from Oct. 2019

Retired

Zdzisław Pawłowski, Prof. D.Sc.,
 Roman Szabatin, Ph.D.

The research and teaching activities carried out in the Nuclear and Medical Electronics Division are concentrated on two areas: biomedical engineering and nuclear electronics. Research in the interdisciplinary area of biomedical engineering covers a broad range of topics and integrates sophisticated electronics and information technology with elements of medical knowledge. The activity in the area of nuclear engineering is concentrated on the design of electronics systems and data processing software for high energy physics experiments. The Division's research is focused on the following topics:

- nuclear medicine (emission tomography: SPECT, PET);
- magnetic resonance imaging (MRI), functional MRI, advanced applications of MRI;
- quantitative computer-aided tomography;
- tomographic dynamic studies;
- process tomography, impedance tomography;
- analogue and digital radiography;
- medical image processing and recognition;
- methods and instrumentation for electrocardiography;
- medical applications of isotope techniques;
- telemedicine;
- design of apparatus and software for high energy physics experiments;
- data analysis in genetics and proteomics;
- mathematical modeling of physiological and disease processes.

Areas of recent studies include:

- advanced applications of MRI and CT imaging systems, covering: dynamic scanning protocols, a new methodology and instrumentation for functional MRI, fMRI image analysis methods;
- a new contrast media for MRI: functional lung imaging with hyper-polarized agents;
- multi-modal imaging of topographic, tomographic and functional studies in medicine;
- electrical instability of heart study research, high resolution ECG systems;
- digital structural radiography, modeling of radiographic imaging systems;
- optical tomography applications in medicine;
- algorithms for image reconstruction for electrical and process tomography;
- construction of capacitance tomographs and sensors for medical and industrial applications;
- study of a bioelectrical activity of a pregnant uterus and using EHG for telemetric monitoring of upcoming labor;
- application of nonlinear predictive algorithms to control of insulin dosing in diabetic patients;
- algorithms for the data analysis in genomics and proteomics;
- characterization and modeling of photosensor for high-energy physics and astronomy experiments;
- development of detectors, front-end electronics, and test devices for high energy physics experiments;

- applications of "soft-computing" methods (neural networks, evolutionary algorithms, etc.) for data processing and analysis in high energy physics experiments.

1.3.4. Radiocommunications Division

Head of Division

Józef Modelski, Prof. D.Sc., till Sept. 2019
 Kajetana Snopek, D.Sc., from Oct. 2019
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e-mail: K.Snopek@ire.pw.edu.pl

Senior academic staff

Yevhen Yashchychyn, Prof. D.Sc., Professor
 Kajetana Snopek, D.Sc., Associate Professor
 Jacek Cichocki, Ph.D., Reader
 Paweł Bajurko, Ph.D., Assistant Professor
 Grzegorz Bogdan, Ph.D., Assistant Professor
 Krzysztof Derzakowski, Ph.D., Assistant Professor
 Konrad Godziszewski, Ph.D., Assistant Professor
 Wojciech Kazubski, Ph.D., Assistant Professor
 Jerzy Kołakowski, Ph.D., Assistant Professor
 Sebastian Kozłowski, Ph.D., Assistant Professor
 Krzysztof Kurek, Ph.D., Assistant Professor
 Mirosław Mikołajewski, Ph.D., Assistant Professor

Junior academic staff

Vitimir Djaja-Joško, M.Sc, Assistant
 Denys Nyzovets, M.Sc., Research Assistant (till Aug. 2019)

Ph.D. students

Vitimir Djaja-Joško, M.Sc., from Oct. 2015
 Marcin Kołakowski, M.Sc., from Oct. 2016
 Tomasz A. Miś, M.Sc., from Oct. 2017
 Przemysław Piasecki, M.Sc., from Oct. 2013
 Jakub Sobolewski, M.Sc., from Feb. 2017
 Maciej Soszka, M.Sc., from Oct. 2018
 Arkadiusz Wójcik, M.Sc., from Oct. 2017

Retired

Jan Ebert, Prof. D.Sc.,
 Stefan Hahn, Prof. D.Sc.,
 Waldemar Kiełek, D.Sc.,
 Tomasz Kosiło, Ph.D.,
 Karol Radecki, Ph.D.
 Henryk Chaciński, M.Sc

The research and teaching activities of the Radiocommunications Division are related to radiocommunication systems and networks, including antennas, signal processing and measurement techniques. The research is focused on analog and digital radio transmission. It includes system design with advanced CAD software, particularly cellular and short-range systems, as well as some aspects of electromagnetic compatibility, numerous measurements issues and deep insight into antenna techniques.

The most important research topics include analysis, development and investigation of:

- radiocommunication systems and networks – cellular networks, short range systems, ad-hoc networks, satellite systems and broadband access networks, MIMO systems, Radio-over-Fiber links, wireless optic systems, energy harvesting devices;

- Internet of Things technology and applications – methodologies for the antenna design and embedded software for the single board computer-based systems; advanced data processing algorithms.
- wireless ultra-wideband systems (UWB) – methods and systems for communication and localization, systems for road safety, microwave imaging systems;
- antennas and propagations – electrodynamic modeling and design of various types of microwave, millimeter, submillimeter and terahertz antennas, including electronically controlled and reconfigurable antennas, photonic antennas, integrated antennas, rectennas, metamaterial based antennas, time-modulated antennas; channel modeling and simulation for MIMO, UWB, and cellular systems;
- measurements – spectrum monitoring methods and systems; channel and antenna including automatic far and near-field measurements of antennas characteristics in time and frequency domain, antenna and channel pulse response, transfer functions of UWB antennas, transient states in reconfigurable antennas;
- material characterization (including ferroelectric) in range up to 500 GHz;
- RF circuits and microwave devices – high-efficiency resonant power amplifiers (class D, DE, E, F and G), linear wide-band HF amplifiers, high-power amplitude modulators, high-efficiency power supplies, power factor correctors, LNA, microwave filters and phase shifters and their applications in radio transmitters, receivers, and industrial electronics;
- digital radio broadcasting systems – MF and HF DRM transmitters and receivers;
- theory of signals and modulations – multidimensional Hilbert transform and its applications, “time-frequency” transformations for RF signal processing, applications of “time-frequency” techniques in audio watermarking;
- environmental, biological and social problems – the influence of radiocommunication systems on a human health and environment as well as on electronic equipment, protection zones planning, radio systems for aid and support of disabled persons.

1.3.5. Television Division

Head of Division

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Senior academic staff

Roman Z. Morawski, Prof. D.Sc.
 Grzegorz Pastuszek, D.Sc., University Professor
 Jacek Naruniec, D.Sc., Assoc. Professor (till Dec. 2019)
 Andrzej Buchowicz, Ph.D., Assistant Professor
 Grzegorz Galiński, Ph.D., Assistant Professor
 Paweł Mazurek, Ph.D., Assistant Professor
 Andrzej Miękina, Ph.D., Assistant Professor
 Krystian Ignasiak, Ph.D., Senior Lecturer

Technical staff

Tomasz Krzymień, M.Sc., Administrative Clerk for Health and Safety (0.5)

Ph.D. students

Xin Chang, M.Sc., from Oct. 2018
 Zbigniew Nasarzewski, M.Sc., from Feb. 2017
 Rafał Pilarczyk, M.Sc., from Oct. 2017
 Rafał Protasiuk, M.Sc., from Oct. 2016

Jakub Wagner, M.Sc., from Feb. 2014

Retired

Marek Rusin, Ph.D.
 Andrzej Podgórski, Ph.D.

Activities of the Television Division focus on media compression, object recognition in images, and media searching. Moreover, media security, extracting 3D models from video streams, the augmented reality for TV applications, and novel multimedia applications based on deep, convolution, and recurrent artificial neural networks – extend the traditional area of research and teaching in the Television Division. *Digital Processing of Measurement Signals Group* is active in the field of measurement science and technology. Its research activities are focused on improving the quality of measurements by means of digital signal processing. The current research topics include:

- general-purpose algorithms for reconstruction of measurands and for calibration of measuring channels;
- portable sound-and-vibration analyzers for applications in technical diagnostics and in the environmental monitoring;
- radar-based systems for monitoring of disabled and elderly persons;
- ethical aspects of measurement-based empirical research.

1.4. Evening Studies and Continuing Education

1.4.1. Postgraduated Studies “Deep Neural Networks – Application in Digital Media”

Head

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1.4.2. Engineer Degree Evening Studies on Radiocommunications and Multimedia Technology

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Staff

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Andrzej Owczarek, M.Sc., Maintenance Enginner (0.5)
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M.Sc. ('04), Ph.D. ('12); antennas and antenna arrays; reconfigurable systems, sub-THz techniques, wireless localization; **Assistant Professor**, Radiocommunications Division;

[Pro3], [Pro13], [Pro35], [Pro51], [Pro52]; [MSc12], [MSc32]; [BSc13], [BSc58]; [Pub31], [Pub32], [Pub45], [Pub56], [Pub108], [Pub109], [Pub116].

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Deputy Director for Research of the Institute of Radioelectronics and Multimedia Technology ('19-); Member of IEEE ('05-), POLSPAR Board ('14-), and IMEKO TC-10 Board ('12-). Member of the Control Committee of the iUSER Sector Program, National Centre for the Research and Development ('16-); Member of the Scientific Council of the Discipline: Automatics, Electronics and Electrical Engineering, WUT ('19-); Recipient of an individual award of the Rector ('19).

[Edu16], [Edu58]; [Pro20], [Pro33], [Pro36]; [PhD2]; [BSc30], [BSc32], [BSc42], [BSc47], [BSc64]; [Pub61]; [Pub62], [Pub112]; [Pat2], [Pat4].

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[Edu3], [Edu103]; [Pro36]; [MSc29]; [BSc48].

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[Pro13], [Pro35], [Pro39], [Pro53]; [PhD1]; [Pub11], [Pub63], [Pub64], [Pub94].

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Silver Cross of Merit ('19).

[Edu70], [Edu102]; [Pro6], [Pro16], [Pro19], [Pro29],

[Pro45], [Pro45a]; [MSc2], [MSc16], [MSc21]; [BSc3], [BSc69]; [Pub21], [Pub33], [Pub120], [Pub121].

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[Edu4], [Edu17], [Edu62], [Edu63], [Edu102]; [Pro29], [Pro43].

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M.Sc. ('88), Ph.D. ('97); television, digital signal and image processing, digital television systems; **Assistant Professor**, Television Division.

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[Edu48], [Edu86], [Edu87], [Edu105]; [Pro1], [Pro26].

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[Edu7], [Edu14], [Edu33], [Edu38], [Edu88], [Edu89], [Edu90], [Edu103]; [Pro9], [Pro10], [Pro27]; [MSc18], [MSc20]; [Pub47], [Pub49], [Pub80], [Pub98].

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[Edu5], [Edu23]; [Pro35].

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[Edu40], [Edu102]; [Pro16], [Pro29], [Pro44]; [MSc7], [MSc8], [MSc9], [MSc25]; [BSc36], [BSc50], [BSc68]; [Pub120], [Pub121].

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[Edu9], [Edu59], [Edu95]; [Pro1], [Pro26]; [BSc17], [BSc19], [BSc33], [BSc65].

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Recipient of a team award of the Rector ('19).

[Edu37], [Edu39], [Edu103]; [Pro13], [Pro16], [Pro35]; [Pub11], [Pub63], [Pub64], [Pub113], [Pub115].

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[Edu8], [Edu45]; [Pro4], [Pro12], [Pro17], [Pro34], [Pro42], [Pro46]; [MSc22]; [BSc73]; [Pub72].

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[Edu6],[Edu6a] [Edu19], [Edu32], [Edu35], [Edu103]; [Pro26]; [BSc26], [BSc39], [BSc70].

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[Pro30].

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[Edu14], [Edu50], [Edu88]; [Pro9], [Pro10], [Pro27]; [MSc1], [MSc23], [MSc37]; [BSc23], [BSc52]; [Pub13], [Pub47], [Pub84].

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Director's Representative for Software and Computer Devices ('16-).

[Edu1], [Edu5], [Edu102], [Edu104]; [Pro5], [Pro29]; [BSc57].

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[Edu64]; [Pro4], [Pro11], [Pro14], [Pro15], [Pro18], [Pro22], [Pro24], [Pro34]; [MSc4]; [Pub17], [Pub20], [Pub22], [Pub23], [Pub24], [Pub28], [Pub37], [Pub67], [Pub68], [Pub76], [Pub82], [Pub83], [Pub99], [Pub100], [Pub107], [Pub117], [Pub118].

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Tutorial assistance of 3Z5PW Experimental Amateur Radio Station ('16-).

[Edu57], [Edu105]; [Pro12], [Pro17], [Pro34], [Pro42], [Pro46].

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[Edu27], [Edu66], [Edu104]; [Pro13], [Pro28], [Pro51]; [Pub16], [Pub63].

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M.Sc. ('96), Ph.D. ('02); radiocommunications, radio-frequency engineering, space technologies; **Assistant Professor**, Radiocommunications Division.

Tutorial assistance of Space Engineering Student Scientific Group ('04-); Member of the Committee on Space Research of the Polish Academy of Sciences ('07-).

[Edu7], [Edu42], [Edu76]; [Pro28], [Pro37]; [MSc33], [MSc41]; [Pub16], [Pub53].

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[Edu102], [Edu104]; [Pro29], [Pro40], [Pro43]; [BSc7], [BSc8], [BSc14], [BSc44], [BSc62]; [Pub33], [Pub50], [Pub120], [Pub121].

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[Edu47], [Edu61], [Edu103]; [Pro36], [Pro38]; [MSc5], [MSc34]; [BSc18]; [Pub38], [Pub75].

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M.Sc. ('80), Ph.D. ('93); acoustics, mechanical vibrations, active noise and vibration control, tube audio devices, digital signal processing; **Assistant Professor**, Electroacoustics Division.

[Edu12], [Edu54]; [Pro36]; [MSc35]; [BSc22]; [Pub62], [Pub95].

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[Edu13], [Edu17], [Edu36], [Edu62], [Edu63], [Edu74], [Edu102], [Edu104]; [Pro7], [Pro8], [Pro29]; [Pub8], [Pub9].

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Recipient of an individual award of the Rector ('19).

[Edu21], [Edu30]; [Pro23]; [Pro41]; [Pub25], [Pub85], [Pub86], [Pub87], [Pub88].

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[Edu15], [Edu20], [Edu65]; [Pro34].

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[Edu30]; [Pro31].

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Golden Medal for Long-lasting Service ('19-).

[Edu18]; [Pro30]; [BSc11], [BSc37], [BSc72]; [Pub26], [Pub89].

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M.Sc. ('73), Ph.D. ('78), D.Sc. ('87), Prof. Title ('94), Honoris Causa Doctorates from: Military University of Technology ('11), and the Lodz University of Technology ('14); radio-frequency engineering, microwave techniques; **Professor**, Director of the Institute of Radioelectronics and Multimedia Technology ('96-16, '19-). Radiocommunications Division, Head of Division ('17-'19).

Full Member of the Polish Academy of Sciences ('19); President of URSI National Committee ('12-); Corresponding Member of the Polish Academy of Sciences – PAN ('07-); Member of the National Committee for Co-operation with the Inter. Council of Science ('12-), Member of the Com. on Electronics and Telecommunications PAN ('07-); Member of the Committee on Space and Satellite Research PAN ('01-); Associated Member of the Ukrainian National Academy of Sciences ('99-); Member of Scientific Councils: Military Communication Institute ('10-), Space Research Centre PAN ('11-); Chairman of the MIKON Foundation Council ('15-); President of the Foundation for the Development of Radiocommunications and Multimedia Technology ('00-); Member of Editorial Board of *IEEE Transactions on MTT* ('95-); Chairman of the Microwave and Radar Week ('04-); TPC Member of the IEEE MTT-S International Microwave Symposium ('95- and European Microwave Conference ('01-); Chair of the Programme Council of the International Conference the Polish Chamber for Electronic Communication ('05-); Golden Graduates' Book of WUT ('15); Chair of the Faculty Council Committee on Awards ('16-), Polish Congress Ambassador ('17); Honorary Citizen of Golina city in the Wielkopolskie Voivodship ('18); Recipient of an individual, and a team award of the Rector ('19).

[Edu62], [Edu63], [Edu103], [Edu105]; [Pro28]; [Pub13], [Pub18], [Pub92], [Pub93], [Pub94].

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Member of the Editorial Board of the journal *Measurement* ('97-); Member of the Editorial Board of the journal *Technisches Messen* ('15-); Reviewer of several *IEEE* and *Elsevier* journals ('00-); Member of the Senate Committee on Professional Ethics ('12-); Member of the WUT Committee on Ethics of Scientific Research Involving Human Subjects ('16-); Member of the Senate Committee on Academic Staff ('16-). Honorary Senior Fellow of University of London ('10-); Chair of the Faculty Council Committee on Academic Staff Development ('16-); Member of the Working Group for implementation at WUT of the principles of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers ('18-), Member of the Jury of the WUT Medal for Young Scientist ('08-);

Recipient of a team award of the Rector ('19).

[Edu21], [Edu30], [Edu72], [Edu101], [Edu102], [Edu104]; [Pro31]; [Pub25], [Pub27], [Pub57], [Pub58], [Pub59], [Pub85], [Pub86], [Pub87], [Pub88], [Pub110].

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[Pro33].

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[Pro26]; [DSc1].

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[BSc51]; [Pro1], [Pro26]; [Pub1], [Pub2].

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Golden Medal for Long-lasting Service ('19-).
[Edu102], [Edu104]; [Pro6], [Pro16], [Pro19], [Pro29], [Pro45], [Pro45a]; [MSc31]; [BSc5], [BSc28], [BSc67].

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[Edu102]; [Pro29].

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Tutorial assistance of 3Z5PW Experimental Amateur Radio Station ('16-).
[Edu103], [Edu105]; [Pro12], [Pro16], [Pro34], [Pro42], [Pro46], [Pro50]; [Pub15], [Pub43], [Pub44].;

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[Edu11], [Edu69], [Edu102], [Edu104]; [MSc6], [MSc11]; [BSc6], [BSc24]; [Pub10].

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neering; **Assistant Professor**, Nuclear and Medical Electronics Division.

[Edu25]; [Pro1], [Pro5], [Pro7], [Pro8], [Pro29], [Pro44]; [MSc27]; [BSc34], [BSc40]; [Pub3], [Pub4], [Pub5], [Pub6], [Pub7], [Pub8], [Pub9], [Pub10].

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[Edu22], [Edu34]; [Pro11], [Pro14], [Pro15], [Pro18], [Pro21], [Pro24], [Pro25], [Pro34]; [MSc15]; [BSc12]; [Pub17], [Pub20], [Pub22], [Pub23], [Pub37], [Pub66], [Pub68], [Pub76], [Pub81], [Pub82], [Pub83], [Pub99], [Pub100], [Pub107], [Pub117], [Pub118].

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[Edu51], [Edu71], [Edu82], [Edu103], [Edu105]; [Pro26]; [Pub29], [Pub30], [Pub41], [Pub60], [Pub65], [Pub104], [Pub106].

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[Edu55], [Edu68], [Edu102], [Edu104]; [Pro29], [Pro43]; [BSc2], [BSc27]; [Pub39], [Pub120], [Pub121].

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Head of the Radiocommunications Division (19'-); Deputy Director for Research of the Institute of Radioelectronics and Multimedia Technology (from Mar. till Sept. 2019); Head of the "WUT Eagle School" Project at the Faculty of Electronics and Information Technology, (19'-); Secretary of the Board of the Foundation for the Development of Radiocommunications and Multimedia Technology ('16-); Member of

the Scientific Council of the Discipline: Automatics, Electronics and Electrical Engineering, WUT ('19-); Member of the Programme Committee of *The Fifteenth Advanced International Conference on Telecommunications: AICT 2019*; Recognized Reviewer of *Signal Processing* ('17-).
[Edu43], [Edu44], [Edu52], [Edu102], [Edu104]; [Pro32]; [BSc16], [BSc49], [BSc60], [BSc61], [BSc74].

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M.Sc. ('83), Ph.D. ('96); microwave technique; **Senior Lecturer**, Microwave and Radiolocation Engineering Division.
[Pro33]; [Pub97].

Wiesław Winięcki

M.Sc. ('75), Ph.D. ('86), D.Sc. ('03), Prof. Title ('11); measurement and instrumentation; **Professor**, Electroacoustics Division.

Director of the Institute of Radioelectronics and Multimedia Technology ('16-'19);

Chairman of the Rector Committee on Research and Scientific Instrumentation ('12-'19); Vice-president of Polish Society for Measurement, Automatic Control and Robotics POLSPAR ('11-'19), Chairman of Measurement Committee of POLSPAR ('04-'19), Member of the National Commission for Environmental Impact Assessment within the General Directorate for Environmental Protection ('19); Member of the Editorial Board of the *International Journal of Computing* ('06-'19); Member of the Programme Board in Journal *Measurement Automation Monitoring MAM* (earlier titled as *Pomiary Automatyka Kontrola [PAK]* ('07-'19); Reviewer of the *IEEE Transactions on Instrumentation and Measurement* ('03-'19), Metrology and Measuring Systems ('07-'19); Member of the International Program Committee of the IEEE Conference on Intelligent Data Acquisition and Advanced Computing Systems IDAACS ('01-'19), Member of the IEEE IDAACS International Advisory Board ('09-'19); Member of the Scientific and Programme Committees of the following National Conferences: Measurement Systems in the Scientific Research and Industry ('01-'19), Dynamic Measurements ('06-'19), Fundamental Problems of Metrology ('09-'19).

[Edu17]; [Pro33]; [Pub36], [Pub112]; [Pat2], [Pat3], [Pat4].

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M.Sc. ('84), Ph.D. ('98), D.Sc. ('15); microwave technique; **University Professor**, Microwave and Radiolocation Engineering Division, Head of Division ('17-). Member of IEEE ('96-); Member of the Scientific Council of the Discipline: Automatics, Electronics and Electrical Engineering, WUT ('19-).

Medal of the National Education Committee ('19).
[Edu17], [Edu26], [Edu103], [Edu105]; [Pro4], [Pro12], [Pro17], [Pro34], [Pro42], [Pro46], [Pro48]; [Pub14], [Pub15], [Pub72].

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M.Sc. ('79), Ph.D. ('86), D.Sc. ('06), Prof. Title ('16); telecommunications; **Professor**, Radiocommunications Division.

Deputy Director for Research of the Institute of

Radioelectronics and Multimedia Technology ('16-'19); Member of the Organizing Committee of the International Conference *TCSET- Modern Problems of Radio Engineering, Telecommunications and Computer Science* ('98-); Reviewer of the *IEEE Transactions on Micro. Theory and Techniques* ('04-), *IEEE Trans on Antennas and Propagation* ('06-) and *IEEE Microwave and Wireless Components Letters* ('04-); Member of Editorial Board of *Izvestiya Wuzow Radioelektronika* ('09-); Member of the Microwave and Radiolocation Section of the Electronics and Telecommunication Committee of the Polish Academy of Sciences ('07-); TPC Member of the MIKON ('09-), TPC Member of the European Wireless Conference EW ('10-), Member of the Programme Committee of the National Conference of Radiocommunications and Broadcasting ('09-); Member of the Faculty Council Committee on Scientific Researches ('16-); Member of the Scientific Council of the Discipline: Automatics, Electronics and Electrical Engineering, WUT ('19-). Recipient of a team award of the Rector ('19).

[Edu2], [Edu53], [Edu106]; [Pro2], [Pro3], [Pro13], [Pro16], [Pro35]; [PhD1]; [BSc15], [BSc59]; [Pub11], [Pub34], [Pub35], [Pub55], [Pub63], [Pub64], [Pub94], [Pub96], [Pub113], [Pub115], [Pub122].

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M.Sc. ('81), Ph.D. ('90), D.Sc. ('03), Prof. Title ('12), biomedical engineering, nuclear electronics; **Professor**, Dean of the Faculty ('12-); Nuclear and Medical Electronics Division.

Member of CERN ('89-); Member ('05-) and Chairman ('16-) of the University Council Committee on Property and Finances ('16-); Member of the Programme Board of the Institute of Applied Researches, WUT ('14-); Member of the Editorial Advisory Board of the *Polish Journal of Medical Physics and Engineering* ('07-), Deputy Chairman of the Board of the Center for Imaging and Biomedical Research ('06-); Member of the Scientific Board of the Nałęcz Institute of Biocybernetics and Biomedical Engineering, Polish Academy of Science ('15-); Member of the Scientific Board of the Automotive Industry Institute ('17-); Member of the Scientific Board of the Institute of the Nuclear Chemistry and Technology ('17-); Member of the Committee on Biocybernetics and Biomedical Engineering Polish Academy of Science ('16-'19); Member of the Scientific Council of the Discipline: Automatics, Electronics and Electrical Engineering, WUT ('19-).

[Edu41], [Edu62], [Edu63]; [Edu73], [Edu102], [Edu104]; [Pro5], [Pro7], [Pro8], [Pro29]; [Pub3], [Pub4], [Pub5], [Pub6], [Pub7], [Pub8], [Pub9].

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M.Sc. ('76), Ph.D. ('90), D.Sc. ('04); acoustics, Prof. Title ('17); electroacoustics, psychoacoustics, noise control; **Professor**, Electroacoustics Division, Head ('13).

Member of Polish Acoustical Society ('78-), European Acoustics Association ('01-), Acoustical Society of America ('90-); Member of the Technical Committees of the Polish Committee for Standardization ('09-); Member of the Scientific Council of the Discipline: Automatics, Electronics and Electrical Engineering, WUT ('19-).

[Edu28], [Edu67], [Edu101], [Edu103], [Edu105]; [Pro36], [Pro49]; [MSc13], [MSc36]; [Pub42], [Pub70],

[Pub74], [Pub103], [Pub114], [Pub123].

2.2. Junior academic staff

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2.3. Ph.D. students (the third-level studies)

Ph.D. Student (tutor)

Przemysław Buczkowski, M.Sc. (*W. Skarbek*)
Xin Chang, M.Sc. (*W. Skarbek*)
Vitomir Djaja-Joško, M.Sc. (*J. Modelski*)
Krzysztof Dowalla, M.Sc. (*P. Bilski*)
Monika Drabik, M.Sc. (*P. Bogorodzki*)
Marcin Góralczyk, M.Sc. (*W. Wojtasiak*)
Salomea Grodzicka, M.Sc. (*P. Bilski*)
Maciej Jasiński, M.Sc. (*J. Żera*)
Tomasz Karpisz, M.Sc. (*B. Salski*)
Marcin Kołakowski, M.Sc. (*J. Modelski*)
Dawid Kuchta, M.Sc. (*W. Wojtasiak*)
Kamil Lipiński, M.Sc. (*P. Bogorodzki*)
Jacek Majer, M.Sc.* (*J. Żera*)
Tomasz Markowski, M. Sc.* (*P. Bilski*)
Mateusz Midura, M.Sc. (*W. Smolik*)
Tomasz A. Miś, M.Sc. (*J. Modelski*)
Zbigniew Nasarzewski, M.Sc.* (*W. Skarbek*)
Katarzyna Orzechowska, M.Sc. (*K.Zaremba*)
Przemysław Piasecki, M.Sc.* (*Y. Yashchyshyn*)
Rafał Pilarczyk, M.Sc.* (*W. Skarbek*)
Agnieszka Pietrzak, M.Sc. (*J. Żera*)
Bartosz Połok, M.Sc.* (*P. Bilski*)
Rafał Protasiuk, M.Sc. (*W. Skarbek*)
Adam Raniszewski, M.Sc. (*W. Wojtasiak*)
Jakub Sobolewski, M.Sc. (*Y. Yashchyshyn*)
Maciej Soszka, M.Sc. (*Y. Yashchyshyn*)
Mateusz Stosio, M.Sc.* (*W. Smolik*)
Jakub Wagner, M.Sc. (*R. Z. Morawski*)
Damian Wanta, M.Sc. (*W. Smolik*)
Michał Wieteska, M.Sc. (*P. Bogorodzki*)

Arkadiusz Wójcik, M.Sc. (*J. Modelski*)
Augustyn Wójcik, M.Sc. (*P. Bilski*)
Przemysław Wróblewski, M.Sc.* (*W. Smolik*)
Katarzyna Wymimko, M.Sc. (*J. Żera*)
Agata Zakrzewska, M.Sc. (*W. Smolik*)
Bartosz Żłobiński, M.Sc. (*J. Żera*)

* without scholarship

2.4. Technical and administrative staff

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temporary research staff for the projects: *TEAM-
-TECH, **WidePOWER ***PRO-WM

3. TEACHING ACTIVITIES

(the summer semester of the academic year 2018/2019 and the winter semester of the academic year 2019/2020)

3.1. Regular studies – main fields of study

1. Telecommunications

Specialization: Radiocommunications and Multimedia Technology

Head

Jacek Cichocki, Ph.D., Reader
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e-mail: J.Cichocki@ire.pw.edu.pl

2. Electronics

Specialization: Electronics and Information Technology in Medicine

Head

Krzysztof Zaremba, Prof. D.Sc., Professor
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e-mail: K.Zaremba@ire.pw.edu.pl

3. Biomedical Engineering

Head

Waldemar Smolik, D.Sc., University Professor
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e-mail: W.Smolik@ire.pw.edu.pl

3.1.1. Basic courses

- | | | | |
|---------|---|---------|--|
| [Edu1] | <i>Analysis of Measurement Data in Medicine</i> (Analiza danych pomiarowych w medycynie – ADP); 45 h/sem.; B. Konarzewski. | [Edu11] | <i>Computer Graphics</i> (Grafika komputerowa – GRK); 30 h/sem.; T. Rubel. |
| [Edu2] | <i>Antennae</i> (Anteny – ANT); 45 h/sem.; Y. Yashchysyn. | [Edu12] | <i>Construction of High Quality Audio Equipment</i> (Konstrukcja urządzeń audio wysokiej jakości – KUA); 30 h/sem.; G. Makarewicz. |
| [Edu3] | <i>Basics of Sound Techniques</i> (Podstawy techniki dźwiękowej – PTD); 60 h/sem.; P. Bobiński. | [Edu13] | <i>Detection of Nuclear and Biomedical Signals</i> (Detekcja sygnałów biomedycznych i jądrowych – DSBJ); 60 h/sem.; J. Marzec. |
| [Edu4] | <i>Basics of Medical Imaging Techniques</i> (Podstawy technik obrazowania w medycynie – PTOM); 60 h/sem.; P. Brzeski. | [Edu14] | <i>Digital Cellular Systems</i> (Cyfrowe systemy komórkowe – CSK); 45 h/sem.; J. Cichocki, J. Kofakowski. |
| [Edu5] | <i>Basics of Microprocessor Technique</i> (Podstawy techniki mikroprocesorowej – TMIK); 60 h/sem.; K. Derzakowski B. Konarzewski. | [Edu15] | <i>Digital Circuits</i> – EDC1; 60 h/sem.; P. Miazga (English-medium studies). |
| [Edu6] | <i>Basics of Programming</i> (Podstawy programowania – PPR); 60 h/sem.; K. Ignasiak, R. Kurjata. | [Edu16] | <i>Digital Communications</i> – EDICO; 60 h/sem.; P. Biłski (English-medium studies). |
| [Edu6a] | <i>Basics of Programming</i> (Podstawy programowania – PRM1T); 60 h/sem.; K. Ignasiak. | [Edu17] | <i>Diploma Seminar for Undergraduate Students</i> (Seminarium dyplomowe inżynierskie – SDI); 30 h/sem.; P. Brzeski, J. Marzec, W. Winiecki, W. Wojtasiak. |
| [Edu7] | <i>Basics of Radiocommunications</i> (Podstawy radiokomunikacji – PR); 45 h/sem.; J. Cichocki, K. Kurek. | [Edu18] | <i>D Power Converters Supply</i> (Zasilanie układów elektronicznych - ZUE); 45 h/sem.; M. Mikołajewski. |
| [Edu8] | <i>Basics of Radiolocation and Radionavigation</i> (Podstawy radiolokacji i radionawigacji – PRIR); 45 h/sem.; D. Gryglewski | [Edu19] | <i>Event-Driven Programming</i> (Programowanie zdarzeniowe – PROZE); 45 h/sem.; K. Ignasiak. |
| [Edu9] | <i>Basics of Image Techniques</i> (Podstawy techniki obrazowej – PTO); 45 h/sem.; G. Galiński. | [Edu20] | <i>Evolutionary Algorithms</i> (Algorytmy ewolucyjne – AE); 45 h/sem.; P. Miazga. |
| [Edu10] | <i>Biomedical Accelerators</i> (Akceleratory biomedyczne – ABM); 30 h/sem.; S. Wronka. | [Edu21] | <i>Ethical Aspects of Research and Engineering</i> – EEARE; 30 h/sem.; R. Z. Morawski, P. Mazurek (English-medium studies). |
| | | [Edu22] | <i>Fields and Waves</i> (Pola i fale – POFA); 60 h/sem.; B. Salski. |
| | | [Edu23] | <i>Influence of Electromagnetic Waves on Living Organisms</i> (Oddziaływanie fal elektromagnetycznych na organizmy żywe – OFE); 30 h/sem.; K. Derzakowski. |
| | | [Edu24] | <i>Introduction to Medical Science</i> (Wprowadzenie do nauk medycznych – WNM); 45 h/sem.; K. Szopiński. |
| | | [Edu25] | <i>Medical Electronic Instrumentation</i> (Elektroniczna aparatura medyczna – EAME); 60 h/sem.; A. Rychter. |
| | | [Edu26] | <i>Microwave Technique</i> (Technika mikrofalowa – TMO); 45 h/sem.; W. Wojtasiak. |
| | | [Edu27] | <i>Multi-service and Multimedia Networks</i> – EMSMN; 60 h/sem.; S. Kozłowski (English-medium studies). |
| | | [Edu28] | <i>Musical Acoustics</i> (Akustyka muzyczna – AM); 30 h/sem.; J. Żera. |
| | | [Edu29] | <i>Nuclear Medicine Techniques</i> (Techniki medycyny nuklearnej – TMENU); 30 h/sem.; R. Szabatin. |

- [Edu30] *Numerical Methods* (Metody numeryczne – MNUB); 45 h/sem.; A. Miękina, P. Mazurek, R. Z. Morawski.
- [Edu31] *Object-oriented Programming* (Programowanie obiektowe – PROBI); 60 h/sem.; R. Kurjata.
- [Edu32] *Object-oriented Programming of Multimedia Applications in Java* (Java – obiektowe programowanie aplikacji multimedialnych – OPA); 45 h/sem.; K. Ignasiak.
- [Edu33] *Orientation* (Orientacja – ORM); 15 h/sem.; (Orientacja - ORIT); 8 h/sem. J. Cichocki.
- [Edu34] *Physics 2 – EPHY2*; 60 h/sem.; B. Salski (English-medium studies).
- [Edu35] *Programming of Geoinformation Applications* (Programowanie aplikacji geoinformacyjnych – PAG); 30 h/sem.; K. Ignasiak (for Faculty of Geodesy and Cartography).
- [Edu36] *Radiation Detection* (Detekcja promieniowania jonizującego – DEPJO); 30 h/sem.; J. Marzec.
- [Edu37] *Radiocommunication Systems* (Systemy radiokomunikacyjne – SRKO); 45 h/sem.; K. Godziszewski.
- [Edu38] *Radioelectronics Measurements* (Miernictwo radioelektroniczne – MR); 45 h/sem.; J. Cichocki.
- [Edu39] *Radio Networks and Systems* (Sieci i systemy radiowe – SISR); 45 h/sem.; K. Godziszewski.
- [Edu40] *Radiological Apparatus in Medical Diagnostics* (Aparatura radiologiczna w diagnostyce medycznej – ARDM); 30 h/sem.; G. Domański.
- [Edu41] *Radiology and Nucleonics* (Radiologia z nukleoniką – RN); 45 h/sem.; K. Zaremba.
- [Edu42] *Satellite Communications* (Łączność satelitarna – LS); 45 h/sem.; K. Kurek.
- [Edu43] *Signals and Systems* (Sygnały i systemy – SYGSY); 60 h/sem.; K. Snopek.
- [Edu44] *Signals, Modulations and Systems* (Sygnały, modulacje i systemy – SYMSE); 45 h/sem.; K. Snopek.
- [Edu45] *Simulations of Radioelectronics Circuits* (Symulacja układów radioelektronicznych – SUREL); 45 h/sem.; D. Gryglewski.
- [Edu46] *Software for Medical Systems* (Oprogramowanie systemów medycznych – OSM); 45 h/sem.; R. Kurjata, T. Jamrógiewicz.
- [Edu47] *Sound Recording Technique* (Dźwiękowa technika studyjna – DTS); 45 h/sem.; M. Lewandowski.
- [Edu48] *Television Systems* (Systemy telewizyjne – SYTE); 45 h/sem.; A. Buchowicz.
- [Edu49] *Ultrasonography Instrumentation* (Aparatura ultrasonograficzna – AUS); 30 h/sem.; R. Józwiak.
- [Edu50] *UMTS and LTE Systems* (Systemy UMTS i LTE – ULTE); 45 h/sem.; J. Kotakowski.
- 3.1.2. Advanced courses**
- [Edu51] *Adaptive Image Recognition – EADIR*; 60 h/sem.; W. Skarbak.
- [Edu52] *Analysis of Signals and Systems in Practice* (Analiza sygnałów i systemów w praktyce); 60 h/sem.; K. Snopek (for Faculty of Mathematics and Information Science)
- [Edu53] *Antennae Theory and Design* (Teoria i projektowanie anten – TPA); 60 h/sem.; Y. Yashchyshyn.
- [Edu54] *Audio Equipment Investigation* (Badania urządzeń audio – BUA); 45 h/sem.; G. Makarewicz.
- [Edu55] *Computed Tomography* (Tomografia komputerowa – TOM); 60 h/sem.; W. Smolik.
- [Edu56] *Computer - Aided Medical Image Diagnostics* (Komputerowe wspomaganie obrazowej diagnostyki medycznej – KWOD); 45 h/sem.; A. Przelaskowski.
- [Edu57] *Computational Electromagnetics for Telecommunications – ECOET*; 60 h/sem.; P. Korpas (English-medium studies).
- [Edu58] *Contemporary Heuristic Techniques* (Współczesne techniki heurystyczne – WMH); 60 h/sem.; P. Bilski.
- [Edu59] *Data Compression* (Kompresja danych – KODA); 45 h/sem.; G. Galiński, G. Pastuszek.
- [Edu60] *Design of Radiocommunication Networks* (Projektowanie sieci radiokomunikacyjnych – PSRD); 60 h/sem.; T. Kosilo.
- [Edu61] *Digital Audio Signal Processing* (Cyfrowe przetwarzanie sygnałów fonicznych – CPSF); 45 h/sem.; M. Lewandowski.
- [Edu62] *Diploma Seminar for Graduate Students 1* (Seminarium dyplomowe magisterskie 1 – SDM1); 30 h/sem.; P. Brzeski, J. Marzec, J. Modelski, K. Zaremba.
- [Edu63] *Diploma Seminar for Graduate Students 2* (Seminarium dyplomowe magisterskie 2 – SDM2); 30 h/sem.; P. Brzeski, J. Marzec, J. Modelski, K. Zaremba.
- [Edu64] *Electromagnetic Compatibility* (Kompatybilność elektromagnetyczna – KE); 30 h/sem.; P. Kopyt
- [Edu65] *Evolutionary Algorithms – EEVAL*; 60 h/sem.; P. Miazga (English-medium studies).
- [Edu66] *Graphs and Networks* (Grafy i sieci – GIS); 60 h/sem.; S. Kozłowski.
- [Edu67] *Hearing and Sound Perception* (Słyszenie i percepcja dźwięku – SPD); 45 h/sem.; J. Żera.
- [Edu68] *Information Systems in Medicine* (Systemy informatyczne w medycynie – SIM); 45 h/sem.; W. Smolik.
- [Edu69] *Large-scale Measurement Methods in*

- Molecular Biology* (Wielkoskalowe metody pomiarowe w biologii molekularnej – MPB); 45 h/sem.; T. Rubel.
- [Edu70] *Magnetic Resonance Imaging* (Tomografia rezonansu magnetycznego – TRM); 45 h/sem.; P. Bogorodzki.
- [Edu71] *Mathematics in Multimedia* (Matematyka w multimediach – MATMU); 60 h/sem.; W. Skarbek.
- [Edu72] *Methodological and Ethical Aspects of Research* – EMAR); 45 h/sem.; R. Z. Morawski.
- [Edu73] *Neural Networks in Biomedical Applications* (Sieci neuronowe w zastosowaniach biomedycznych – SNB); 45 h/sem., K. Zaremba.
- [Edu74] *Noise and Electromagnetic Interference in Electronic Devices* (Szumy i zakłócenia w aparaturze elektronicznej – SZAE); 45 h/sem., J. Marzec.
- [Edu75] *Nuclear Medicine Techniques* (Techniki medycyny nuklearnej – TMN); 60 h/sem.; R. Szabatin.
- [Edu76] *Satellite Telecommunications* (Telekomunikacja Satelitarna – TSAT); 30 h/sem.; K. Kurek (for Faculty of Power and Aeronautical Engineering).
- [Edu77] *Telemedical Systems* (Systemy telemedyczne - TELM); 45 h/sem. R. Kurjata.
- [Edu84] *Digital Objects Indexing* (Indeksowanie obiektów cyfrowych – IOC); 24 h/sem.; R. Pilarczyk.
- [Edu85] *Digital Objects Recognition* (Rozpoznawanie obiektów cyfrowych – ROC); 24 h/sem.; R. Pilarczyk.
- [Edu86] *Security in Digital Media* (Bezpieczeństwo w mediach cyfrowych – BMC); 12 h/sem.; A. Buchowicz.

3.2.2. Engineer Degree Evening Studies on Radiocommunications and Multimedia Technology

3.2. Special courses

3.2.1. Post-graduated studies: “Deep neural networks – applications in digital media”

- [Edu78] *Compression and Immersion of Digital Objects* (Kompresja i zanurzenie obiektów cyfrowych – KZO); 12 h/sem.; R. Protasiuk.
- [Edu79] *3D Modeling – Face and Body Image Analysis* (Modelowanie 3D – analiza obrazu twarzy i sylwetki osoby – M3D), 24 h/sem.; G. Gwardys.
- [Edu80] *Deep Networks in the Design of Computer Games - Content and Strategy Aspects* (Sieci głębokie w projektowaniu gier komputerowych – aspekty treści i strategii) – SGS); 24 h/sem.; Z. Nasarzewski.
- [Edu81] *Deep Networks in the Design of Computer Games – Aspects of Player Intelligent Interface* (Sieci głębokie w projektowaniu gier komputerowych – aspekty inteligentnego interfejsu gracza – SGI); 24 h/sem.; R. Pilarczyk.
- [Edu82] *Deep Neural Networks-Basics* (Głębokie sieci neuronowe – podstawy – GSP); 24 h/sem.; W. Skarbek.
- [Edu83] *Deep Neural Networks Programming* (Programowanie głębokich sieci neuronowych – PGS); 24 h/sem.; R. Pilarczyk.
- [Edu87] *Broadcasting Systems* (Systemy radiodfuzyjne – SRDM); 60 h/sem.; semester 6; A. Buchowicz, H. Chaciński.
- [Edu88] *Digital Cellular Systems* (Cyfrowe systemy komórkowe – CSKM); 36 h/sem.; semester 7; J. Cichocki, J. Kołakowski.
- [Edu89] *Diploma Seminar 1* (Seminarium dyplomowe – SDM); 15 h/sem.; semester 7; J. Cichocki.
- [Edu90] *Diploma Seminar 2* Seminarium dyplomowe – SD2M); 30 h/sem.; semester 8; J. Cichocki.
- [Edu91] *Elements of Material Culture* (Elementy kultury materialnej – EKM); semester 6; 15 h/sem.; W. Brzeziński.
- [Edu92] *Ergonomics and Safety* (Ergonomia i bezpieczeństwo pracy – EBPZ); 30 h/sem.; semester 8; L. Kryst.
- [Edu93] *Internet Techniques* (Techniki Internetowe – TINM), 30 h/sem.; semester 7; K. Ignasiak.
- [Edu94] *Management and Marketing* (Zarządzanie i marketing – ZMM), 15 h/sem.; semester 7, T. Tyc.
- [Edu95] *Multimedia Techniques* (Techniki Multimedialne – TMM); 30h/sem.; semester 6; G. Galiński.
- [Edu96] *Radiocommunication Systems 1* (Systemy radiokomunikacyjne 1 – SRKM); 60 h/sem.; semester 6; T. Kosiło.
- [Edu97] *Radiocommunication Systems 2* (Systemy radiokomunikacyjne 2 – SRK2M); 60 h/sem.; semester 7; T. Kosiło.
- [Edu98] *Signal Processors* (Procesory sygnałowe – SKMM); 30 h/sem.; semester 6, A. Podgórski.
- [Edu99] *Sound Techniques* (Techniki dźwiękowe – TDRM); 30 h/sem.; semester 7; P. Bobiński.
- [Edu100] *Telecommunication Networks* (Sieci telekomunikacyjne – SKMM); 15 h/sem.; semester 6, S. Kula,

3.3. International co-operation

- [Edu101] Within the Advanced Technology Higher Education Network / Socrates (ATHENS), the course “Ethical Aspects of Research

and Engineering" was given by **Roman Z. Morawski**, and the course "Sound: Hearing and Acoustical Measurements" was given by **Jan Żera**. The students who attended this course were from the following EU institutions of higher education:

- Budapesti Műszaki és Gazdaságtudományi Egyetem, Budapest, Hungary (1 person);
- Delf University of Technology, the Netherlands (2 persons);
- École des Mines de Paris, Paris, France (8 persons);
- École Nationale Supérieure de Techniques Avancées, Paris, France (2 persons);
- École Supérieure de Physique et de Chimie Industrielle, Paris, France (8 persons);
- Instituto Superior Técnico, Lisbon, Portugal (5 persons);
- Istanbul Teknik Üniversitesi, Istanbul, Turkey (1 person);
- Katholieke Universiteit Leuven, Leuven, Belgium (14 persons);
- Politecnico di Milano, Milano, Italy (5 persons);
- Technische Universität München, Munich, Germany (7 persons);
- Technische Universität Wien, Austria (2 persons);
- University Politehnica of Bucharest (1 person);
- Universidad Politécnica de Madrid, Madrid, Spain (1 person).

3.4. Educational projects

[Edu102] **Modification B.Sc. Studies: Biomedical Engineering in the frame of Knowledge – Education – Development - Cooperation Project** (Modyfikacja studiów pierwszego stopnia na kierunku „Inżynieria Biomedyczna” w ramach projektu NERW – Nauka – Edukacja - Rozwój - Współpraca). **Waldemar Smolik**, K. Zaremba, J. Marzec, R. Z. Morawski, P. Bogorodzki, K. Snopek, P. Brzeski, G. Domański, T. Jamrógiewicz, B. Konarzewski, J. Kryszyn, R. Kurjata, E. Piątkowska-Janko, D. Radomski, T. Rubel, A. Rychter, W. Obrębski, P. Wróblewski;

Feb. 01, 2018 – Jan. 01, 2021

Funded by the National Centre for Research and Development EU Operational Programme Knowledge – Education – Development - Cooperation 2014-2020

The main goal of this project is to modify Biomedical Engineering B.Sc. studies, by means of introduction two specializations: Electromedical Equipment and Systems, and Biomedical Informatics. Research team taking part in this project includes scientists from the Faculty of Electronics and Information Technology and the Faculty of Mechatronics, WUT.

[Edu103] **Modification B.Sc. Studies: Telecommunications in the frame of Knowledge – Education – Development - Cooperation Project** (Modyfikacja studiów pierwszego stopnia na kierunku „Telekomunikacja” w ramach projektu NERW – Nauka – Edukacja - Rozwój - Współpraca)

Jacek Cichocki, P. Bobiński, A. Buchowicz, K. Godziszewski, K. Ignasiak, P. Korpas, S. Kozłowski, M. Lewandowski, R. Łukaszewski, J. Modelski, D. Rosołowski, W. Skarbek, W. Wojtasiak, J. Żera.

Feb. 01, 2018 – Jan. 01, 2021

EU Operational Programme Knowledge – Education – Development - Cooperation 2014-2020

Funded by the National Centre for Research and Development

The project is realized in the frame of EU The main goal of this project is to modify Telecommunications B.Sc. academic programme by means of introduction two new specializations: Teleinformatics and Wireless and Multimedia Technologies using new teaching methods.

[Edu104] **Modification M.Sc. Studies: Biomedical Engineering in the frame of Knowledge – Education – Development - Cooperation Project** (Modyfikacja studiów drugiego stopnia na kierunku „Inżynieria Biomedyczna” w ramach projektu NERW2 PW: Nauka – Edukacja - Rozwój - Współpraca).

Waldemar Smolik, K. Zaremba, J. Marzec, R. Z. Morawski, P. Bogorodzki, K. Snopek, P. Brzeski, G. Domański, T. Jamrógiewicz, B. Konarzewski, R. Kurjata, E. Piątkowska-Janko, D. Radomski, T. Rubel, J. Kryszyn, W. Obrębski;

Mar. 01, 2019 – Feb. 28, 2023

Funded by the National Centre for Research and Development EU Operational Programme Knowledge – Education – Development - Cooperation 2014-2020

The main goal of this project is to modify Biomedical Engineering M.Sc. studies, by means of introduction two specializations: Electromedical Equipment and Systems, and Biomedical Informatics. Research team taking part in this project includes scientists from the Faculty of Electronics and Information Technology and the Faculty of Mechatronics, WUT.

[Edu105] **Modification M.Sc. Studies: Telecommunications in the frame of Knowledge – Education – Development - Cooperation Project** (Modyfikacja studiów drugiego stopnia na kierunku „Telekomunikacja” w ramach projektu NERW2 PW: Nauka – Edukacja - Rozwój - Współpraca)

Jerzy Siuzdak (general project head), **Andrzej Buchowicz (head on the IRTiM side)**, P. Bobiński, K. Godziszewski, K. Ignasiak, P. Korpas, S. Kozłowski, R. Łukaszewski, J. Modelski, D. Rosołowski, W. Skarbek, W. Wojtasiak, J. Żera.

Mar. 01, 2019 – Feb. 28, 2023

EU Operational Programme Knowledge – Education – Development - Cooperation 2014-2020

Funded by the National Centre for Research and Development

The project is realized in the frame of EU The main goal of this project is to modify Telecommunications M.Sc. academic programme by means of introduction two new specializations: Teleinformatics and Wireless and Multimedia Technologies using new teaching methods.

3.5. Summer schools

[Edu106] **Y. Yashchyshyn:** *“New opportunities in quasi-optical materials characterization in far infrared region”* a lecture delivered during *Joint ITN CELTA & TeraApp Summer School 29th International Travelling Summer School on Microwave and Lightwaves* (Frankfurt am Main, Germany, Jul. 13-19, 2019).

4. RESEARCH ACTIVITIES

4.1. International projects

4.1.1. European grants

[Pro1] **Super-Kamiokande to Hyper-Kamiokande (SK2HK)**

Marcin Ziembicki, R. Kurjata, A. Rychter, A. Klekotko, W. Obrębski, G. Pastuszek, A. Buchowicz, G. Galiński;

Nov. 01, 2019 – Oct. 31, 2023

Horizon 2020 EU Framework Programme **MSCA-RISE Action**

The study of the neutrino properties and interactions has been key in the development of the Standard Model of fundamental interactions and it is providing first clues on the understanding of its deeper foundations. In this aspect the Super-Kamiokande (SK) detector (ICRR, U. Tokyo, Japan) for many years has played a crucial role. It contributed to the discovery of oscillations of atmospheric neutrinos, thus establishing their 'massive' character. Because of this discovery, Takaaki Kajita, the "person in charge of this proposal" from our main Third Country partner ICRR, was awarded with the Nobel Prize in Physics 2015.

With SK2HK we aim to continue the very successful SKPLUS, through extension of participation of European institutes in the state-of-the-art experimental program related to the SK, the SK-Gd and the Hyper-Kamiokande (HK) experiments. We want to gain insight and even discover the hypothesized charge-parity violation in the leptonic sector with SK and the future HK. We want to discover the "Diffuse Neutrino Supernova Background" with SK-Gd and to explore in depth the Grand Unification with SK and the future HK. Those measurements are key to the complete understanding of the most fundamental concepts of Physics.

An important aspect of this proposal is significant amount of hardware R&D related to HK, especially given the decision to start HK construction in 2020. Timely finalization of these activities is crucial to the success of HK and requires even closer cooperation with our partners. Given the uniqueness of the technologies that are being developed, it is efficient to do some work at the location where most of the infrastructure needed for the R&D is. In this project those are the ICRR of the Univ. of Tokyo and the TRIUMF laboratory in Canada, as well as several European laboratories, incl. the applying institutions. The proposed secondment program offers a unique opportunity to fulfil these goals while working with World leading experts.

[Pro2] **CELTA – Convergence of Electronics and Photonics Technologies for Enabling Terahertz Applications** (Konwergencja elektroniki i technik fonicznych na rzecz rozwoju zastosowań techniki).

Yevhen Yashchyshyn

D. Nyzovets;

Mar. 01, 2016 - Feb. 29, 2020

Horizon 2020, EU Framework Programme for Innovative Training Networks.

The project is realized in the frame of MSCA-ITN-2015-ETN: Marie Skłodowska-Curie Innovative Training Networks.

CELTA is the acronym for Convergence of Electronics and Photonics Technologies for Enabling Terahertz Applications. CELTA aims to produce the next generation of researchers who will enable Europe to take a leading role in the multidisciplinary area of utilising Terahertz technology for applications involving components and complete systems for sensing, instrumentation, imaging, spectroscopy, and communications. All these technologies are keys to tackling challenges and creating solutions in a large number of focus areas relevant for the societal challenges identified in the Horizon 2020 programme. To achieve this objective, CELTA is comprised of 11 leading research institutions and has assembled a comprehensive research training programme for all the 15 early-stage researchers (ESRs). CELTA integrates multidisciplinary scientific expertise, complementary skills, and experience working in academia and industry to empower ESRs to work in interdisciplinary teams, integrate their activities, share expertise, and promote a vision of a converged co-design and common engineering language between electronics and photonics for Terahertz technologies. CELTA will introduce the strategy of converged electronics and photonics co-design in its research programme and makes a special effort on establishing a common engineering language in its training programme across the electronics, photonics and applications disciplines. We believe this common engineering language and converged co-design is mandatory to make the next logical step towards efficient and innovative solutions that can reach the market. The detailed compendium of lectures on state-of-the-art technology, soft skills and entrepreneurship is accompanied by a research programme that focuses on THz key technologies. CELTA ESRs will develop three demonstrators: beam steering technology for communication applications, a photonic vector analyser for spectroscopy and materials characterisation, and a THz imager for sensing applications.

[Pro3] **Innovative Optical/Quasioptical Technologies and Nano-Engineering of Anisotropic Materials for Creating Active Cells with Substantially Improved Energy Efficiency** (Innowacyjne optyczne/quasi optyczne techniki oraz inżynieria nanomateriałów i materiałów anizotropowych dla opracowania struktur czynnych z zasadniczo poprawioną efektywnością energetyczną).

Yevhen Yashchyshyn, P. Bajurko, J. Sobolewski;

Feb. 01, 2018 - Jan. 31, 2022

Horizon 2020, IMAGE, EU Framework Programme for Innovative Training Networks.

The principal goal of the project is to combine research expertise in optics, crystallography and material science with efforts in material engineering to go beyond state-of-the-art in the development of highly efficient energy saving optical cells based on electroacousto- and nonlinear optical effects and designed to operate in optical and quasi-optical (sub-THz) ranges. The idea of the project arises from recent advances in nano engineering combined with our technology.

[Pro4] **Precision Technique of Millimeter and sub-THz Band Characterization of Materials for Microelectronics** (Dokładne metody charakteryzacji materiałów dla mikroelektroniki w paśmie fal milimetrowych i subterahercowych).

Jerzy Krupka (IMiO) **Paweł Kopyt** (IRiTM): heads of the research teams; D. Gryglewski, M. Piasecki, W. Wojtasiak; Nov. 01, 2016 - Oct. 31, 2019

TEAM-TECH, EU Framework Programme "Intelligent Development 2014-2020", and Foundation for the Polish Science.

The main objective of this project was to develop novel sensors and sensing methodologies useful to non-destructive contactless electric and magnetic characterization of materials at millimeter and sub-THz spectra. The implementation of this goal was two-pronged. On one hand, the said resonant structures was exploited to benefit from their inherent narrow-band properties, which are particularly useful at measuring low-loss materials. On the other hand, the research was also concerned broadband measurement techniques based on multimode resonant structures. The auxiliary goal was adopting the technological approaches typical for the microelectronics industry and apply them for precise fabrication of novel resonant cavities operating in the millimeter and the sub-THz bands. Another such goal was development of a new low-loss yet high dielectric constant material for dielectric posts inserted into sensing cavities.

4.2. Projects granted by the Ministry of Science and Higher Education (National Centre for Research and Development, and National Science Centre)

4.2.1. International grants

[Pro5] **T2K Experiment (Tokai To Kamionka)** (Eksperyment T2K) (Tokai To Kamionka).

Krzysztof Zaremba, R. Kurjata, M. Ziembicki, A. Rychter;

HARMONIA, International project is realized in collaboration with the Faculty of Physics, University of Warsaw, the Andrzej Soltan Institute for Nuclear Studies, the Henryk Niewodniczański Institute of Nuclear Physics Polish Academy of Sciences, Faculty of Physics and Astronomy, Wrocław University, Silesian University; Oct. 10, 2012 - Sept. 22, 2022

Funded by the Ministry of Science and Higher Education

The main aim of this project is an upgrade of ND 280 detector, development of neutrino interactions simulation (NuWro) and data analysis software, responsibility for detector operation and its data quality.

[Pro6] **Self-Navigated Integrin Receptors Seeking "Thermally-Smart" Multifunctional Few-Layer Graphene-Encapsulated Magnetic Nanoparticles for Molecular MRI-Guided Anticancer Treatments in "Real Time" Personalized Nanomedicine** (Samonaprowadzające na receptory integrynowe "termicznie-reaktywne" wielofunkcyjne

nanocząstki magnetyczne enkapsulowane w kilku warstwach grafenu w molekularnym obrazowaniu MR przeciwnowotworowej terapii opartej na personalizowanej nanomedycynie "czasu rzeczywistego").

Piotr Bogorodzki, E. Piątkowska-Janko, B. Kossowski, J. Orzeł, M. Wieteska; Aug. 03, 2015 - Nov. 01, 2019

GEMNS, FP7 ERA-NET EuroNanoMed II Funded by the National Centre for Research and Development

The GEMNS project was realized in collaboration between the Warsaw University of Technology, Medical University of Warsaw, University of Warsaw, University of Bergen, Babes-Bolyai University of Cluj, NILU Norwegian Institute for Air Research, Sciencepharma Ltd. The project was designed to develop novel, thermally "smart", multifunctional, multi-layered graphene-encapsulated magnetic nanoparticles (GEMNS) for molecular MR imaging (mMRI) and anticancer treatments. The theranostic GEMNS was bioengineered with self-assembled polymeric nano-gels and decorated with antibodies that recognize; certain integrin receptors on lung cancer tissues and identify new cancer vessels. A chosen enzyme was absorbed onto the GEMNS and released in a controllable and fully predictable manner in order to promote anticancer activity. The release of the enzyme triggers "on-off" hypoxia states at the molecular level in lung cancer cells and tissues. After several courses of such enzymatic-based molecular pre-sensing, mMRI-guided targeted X-ray radiotherapy were applied to target lung cancer in preclinical animal models. A new nanosafety paradigm for the PRE-FIM strategy was developed using comprehensive QSAR, microfluidic, and genetic/epigenetic approaches to characterize the GEMNS theranostic contrast/drug candidates compliant with regulatory requirements.

[Pro7] **Upgrade of the CEDAR Detectors for COMPASS Experiment at CERN** (Modernizacja zespołu detektorów CEDAR w eksperymencie COMPASS w CERN).

Krzysztof Zaremba, J. Marzec, R. Kurjata, M. Ziembicki, A. Rychter, A. Klekotko;

OPUS, International project realized in collaboration with ;

Jul. 28, 2017 - Jan. 27, 2019

Funded by the National Science Centre

The goal of this project was to upgrade the Cherenkov Differential counters with Achromatic Ring Focus type N (CEDAR) used in beam line of the COMPASS experiment at CERN. Their function was to separate and time-tag different particle types (pions, kaons, antiprotons). The upgrade was necessary to allow for working with a high intensity beams with particle rates of up to 108 pps. Another goal was to alleviate the flaws of the original design of the CEDARs (late 70s last century, detectors were in continuous operation from 80s). Three main problems were identified: (A) original electronics design limits acceptable rates to 107, (B) detector, lack of beam-independent means of monitoring of photomultipliers (PMTs) stability and efficiency, (C) detectors manifest problems with thermal management (temperature stability and its equality along vessel were a main operating parameter as particle selection was directly coupled

with the gas pressure to temperature ratio). Furthermore, gas leaks were detected.

- [Pro8] **Experiment COMPASS – Study of the Internal Structure of the Nucleon** (Eksperyment COMPASS – badania wewnętrznej struktury nukleonu).
Krzysztof Zaremba, J. Marzec, R. Kurjata, M. Ziembicki, A. Rychter;
HARMONIA, International project realized in collaboration with the Andrzej Soltan National Centre for Nuclear Research and Faculty of Physics, University of Warsaw.
 May 15, 2018 - May 14, 2020
Funded by the National Science Centre

The goal of this project is to experimentally study the internal, three-dimensional structure of the nucleon at the level of its elemental components. The project is located in a new field of QCD research that goes beyond the one-dimensional description commonly used so far. A description of the three-dimensional structure of the nucleon is possible, either under TMD (Transverse Momentum Dependent Distributions) formalism or under GPD (Generalized Parton Distributions) formalism.

- [Pro9] **IONIS (Indoor and Outdoor NITICSplus Solution for Dementia Challenges)**
 (System wsparcia osób z zaburzeniami funkcji poznawczych w środowisku domowym i poza domem).
Jerzy Kołakowski, J. Cichoński, M. Kołakowski, V. Djaja-Joško;
 Oct. 01, 2017 - Mar. 31, 2020
IONIS, AAL Joint Programme
Funded by the National Centre for Research and Development

The IONIS project addresses the needs people with cognitive impairment and their caregivers. Its main objective is a development of a fully integrated and validated platform for health monitoring, home automation, personal agenda with reminders, alerts, caregiver administrative tools. IONIS intends to exploit NITICS innovation and extend the platform with new technologies and services for both indoor and outdoor support. Localization of items, analysis of persons mobility or geofencing are examples of services dedicated to people with cognitive impairment.

- [Pro10] **INCARE (Integrated Solution for Innovative Elderly Care)** (Zintegrowany system innowacyjnych rozwiązań dla opieki nad osobami starszymi)
Jerzy Kołakowski, V. Djaja-Joško, J. Cichoński, M. Kołakowski;
 Oct. 01, 2018 - Sept. 30, 2021
IONIS, AAL Joint Programme
Funded by the National Centre for Research and Development

INCARE is designed to support seniors to live independently and reduce or optimize the amount of care they require. The goal of the project is to develop the INCARE platform that will be modular, highly configurable and adaptable such as to be easily adopted and used by elderly with various backgrounds, cultures and age related impairments. The platform will integrate technologies and services for both indoor and outdoor support developed within NITICS project with autonomous, intelligent and adaptable RAPP robotic platform.

- [Pro11] **The Standardization of Electromagnetic Measurements of Soil Moisture, in short BDS&Soil** (Standardyzacja pomiarów elektromagnetycznych wilgotności gleby).
Jerzy Krupka (IMIO, head of the project), **Paweł Kopyt** (IRITM, head of the research team), B. Salski, T. Karpisz;
 Dec. 01, 2018 - Nov. 30, 2020
NAWA Programme
Funded by the Polish National Agency for Academic Exchange

The project is elaborated in the co-operation with the Institute of Agrophysics, Polish Academy of Science, Utah State University (USA), the Institut Fresnel, Equipe HIPE, Centre Scientifique de Saint Jerome (France), Center for Ecology and Hydrology, James Cook University (UK), and the Institute of Optoelectronics and Microelectronics, WUT.

The main goal of the project will be the research on a method to measure the humidity of soil samples, which is based on a single-mode high-quality resonator operating in the microwave band. The humidity of a sample under test is recorded indirectly as the Q-factor of the cavity. With properly selected resonant mode excited within the resonator even samples of high water contents can be measured with the proposed set-up without problems with overdamping of the resonance.

4.2.2. Research grants

- [Pro12] **Development of a Prototype Radar Fire Control Multi-phase Scanning Beam in Two Planes for a Set of Medium-Range Missile OP, Codenamed Vistula** (Opracowanie prototypu radaru wielofunkcyjnego kierowania ogniem ze skanowaniem fazowym wiązki w dwóch płaszczyznach dla zestawu raketowego OP średniego zasięgu, kryptonim WISŁA).
Wojciech Wojtasiak, D. Gryglewski, D. Rosołowski, P. Korpas;
 Jan. 28, 2013 - Dec. 18, 2020
Funded by the National Centre for Research and Development

The main goal of this project is to design a conception and project of N/O module with 10 W element radiating at X band, considering the limitations of raster scanning antenna radiating elements in a wide.

- [Pro13] **Sub-THz Active 3D Scanner for Counterterrorism Purposes** (Aktywny sub-THz skaner 3D do zastosowań antyterrorystycznych).
Yevhen Yashchyshyn, P. Bajurko, S. Kozłowski, G. Bogdan, K. Godziszewski;
 Sept. 01, 2015 - Feb. 28, 2019
Funded by the National Centre for Research and Development

The aim of the project was to develop a demonstrator security scanner operating at sub-THz band for remote detection of dangerous objects carried by potential terrorists. The designed device was a multipixel active multi-static radar, built on silicon chips operating at a frequency of 120 GHz. The demonstrator system parameters were far beyond the current state of knowledge and techniques of the world.

Those parameters were achieved through innovative solutions of its individual components. The project implemented consortium consisting of leading Polish technical universities and research institutes, and the new Polish company (start-up) operating in the field of advanced microelectronic technologies. This cooperation enabled the efficient transfer of knowledge between universities and entrepreneurs.

- [Pro14] **Full-Wave Electromagnetic Modeling of Coherent Radiation in Electrically-Pumped Metal-Clad Semiconductor Micro-Lasers with a Folded Metallic Resonator** (Pełnofalowe modelowanie elektromagnetyczne zjawiska generacji promieniowania koherentnego w pompowanych elektrycznie laserach półprzewodnikowych z metalizowanym rezonatorem składanym).
Bartłomiej Salski, P. Kopyt, M. Kryszicki;
 Sept. 16, 2015 - Nov. 15, 2020
SONATA Programme
Funded by the National Science Centre

The main goal of the project was the research on a complete time-domain computational model of coherent radiation in electrically-pumped metal-clad semiconductor micro-lasers with a folded cavity. The model was accounted for the drift and diffusion of carriers, rate equations representing active material, and Maxwell curl equations solving radiation of generated electromagnetic fields. Coupling of all those phenomena in one computational algorithm was the novelty when compared to alternative solutions known in literature. The elaborated method was applied to the research on a new type of metal-clad semiconductor lasers with a prism-like folded micro-cavity.

- [Pro15] **Methods of Protection and Defense Against the HPM Impulses** (Metody i sposoby ochrony i obrony przed impulsami HPM).
Paweł Kopyt, B. Salski;
 Dec. 31, 2014 - Dec. 29, 2020
Funded by the National Centre for Research and Development

The project is elaborated in the co-operation with the Military University of Technology, Wrocław University of Technology, PIT – Radwar Stock Company, Radio Marketing Ltd., the Air Force Institute of Technology, and Pol-Spec-Tech-Service Company. In the frame of the project it is planned to conduct research on the development of methods and means of protection and defense equipment, military equipment and facilities from the destructive effects of HPM pulses particularly, in terms of security of communication equipment, radar equipment, and manned and unmanned facilities and platforms. The project involves testing the impact of the biological effects of HPM pulses of high-frequency and low-frequency microwave. Because of this work, the main objective of the project is to develop absorbers for different frequency ranges, in different forms and consistencies depending on the needs developed to protect and defend against HPM pulses. The first stage is to take place in the form of technology demonstrators, and in the second stage, in the context of development work is assumed to develop their prototypes, programs and methodologies qualification tests. Design qualification tests are complete absorbers, to develop methods and ways to protect and defend,

develop medical instructions concerning medical effects of HPM pulses, Norm Defense for absorbers, as well as user security communication equipment, radar equipment, and manned and unmanned facilities and platforms.

- [Pro16] **Microwave Stun Weapon** (Mikrofalowa broń obezwładniająca).
Piotr Bogorodzki, Y. Yashchishyn,
 E. Piątkowska-Janko, G. Domański,
 K. Godziszewski, M. Wieteska.
 Dec. 30, 2014 – Jul. 31, 2019
 Strategic research and development program
Funded by the National Centre for Research and Development

Project on microwave stun weapon (MBO) provides in its first stage of the development of a high-power demonstrator device generating pulses of microwave (HPM), acting on continuous wave in the frequency range 70-95 GHz, as a non-lethal weapon strength of living, as well as testing of biological and medical effects action and cognition side effects of the impact of this type of radiation on living organisms and implants. If these works are successful, a second phase is planned to begin development work in the context of which developed a prototype device. The next step will be to develop a conceptual design of the system of stun guns, his prototype, programs and research methodologies qualification. The project to complete the qualification tests of the system and the development of medical instruction and Standards Defence concerning the medical effects of pulses MBO. The leader of the project is the PIT-Radwar SA. and the partners of the consortium are the following entities: the Wrocław University of Technology, Warsaw University of Technology and Military University of Technology.

- [Pro17] **Semiconductor Technology for High Power Electronics and High Frequencies** (Technologie materiałów półprzewodnikowych dla elektroniki dużych mocy i wysokich częstotliwości).
Daniel Gryglewski, W. Wojtasiak,
 D. Rosołowski, P. Korpas, D. Kuchta,
 M. Góralczyk, D. Kołodziej, M. Lubiejewski;
 Jan. 03, 2018 - Nov. 30, 2020
 Strategic research and development program "Modern material technologies" – **WidePOWER**, in the frame of program **TECHMATSTRATEG** (Nowoczesne technologie materiałowe)
Funded by the National Centre for Research and Development

The main goal of the project is to develop silicon carbide homoepitaxy (SiC) and gallium nitride heteroepitaxy (GaN) technologies towards epitaxial production-quality structures for the production of dedicated semiconductor devices.

The Institute of Radioelectronics and Multimedia Technology, WUT is responsible for the implementation of demonstrators of power converters based on GaN-on-Si transistors. For this purpose, developed design procedures and made RF impulse generators on GaN / Si HEMT transistors for aerospace applications will be developed.

[Pro18] **Correlations Between Electromagnetic and Magnetoelastic Properties of Ferromagnetic Thin Films** (Korelacje pomiędzy właściwościami elektromagnetycznymi i magnetoelastycznymi cienkich warstw ferromagnetycznych).

Jerzy Krupka (IMI), **B. Salski** (heads of the research teams from IRiTM),
A. Pacewicz, P. Kopyt;

Jun. 18, 2019 - Jun. 17, 2022

OPUS 16

Funded by the National Science Centre

The project is realized in collaboration between the Warsaw University of Technology and the Institute of Physics, Polish Academy of Science. The main goal of the project is to find out correlations between magnetoelastic and magnetic damping properties of several groups of magnetic thin films. Rigorous quantitative study of various contributions to the magnetic damping occurring in thin films will be undertaken in a broad electromagnetic spectrum. Another goal will be to find the conditions for the excitation of a magnetic plasmon in the planar structures.

[Pro19] **Coma and Consciousness Disorders – New Prognostic and Diagnostic Indicators Based on EEG and MRI** (Śpiączka i zaburzenia świadomości – nowe wskaźniki prognostyczne i diagnostyczne oparte o EEG i MRI).

Piotr J. Durka (University of Warsaw, Faculty of Physics, head of the project),
P. Bogorodzki (head of the research team from WUT), P. Bogorodzki, E. Piątkowska-Janko, K. Lipiński;

Jul. 16, 2019 - Jul. 15, 2022

OPUS 16

Funded by the National Science Centre

Awareness-raising mechanisms are one of the greatest mysteries. Among the leading directions to their cognition are the study of patients in states of impaired consciousness (disorders of consciousness, DoC) - both in terms of hopes of broadening the basic knowledge of these processes, as well as the high demand for a method of diagnosis based on the results of these studies. Existing research in this area has shown promising results in the use of methods of Magnetic Resonance Imaging (MRI) and electroencephalography (EEG). However, the existing use of both methods in assessing the DoC are based on relatively weak methodological analyses of EEG and MRI signals, resulting in suboptimal sensitivity and less than achievable specificity. Furthermore, the absence of a combination of these two methods in the previous literature in longitudinal studies, conducted by all stages of the evolution of consciousness disorder, from the beginning of coma. The completion of these gaps in modern research is the basis of this project.

[Pro20] **Intelligent Decision Support System based on the Algorithmic Image Analysis in the Operations of the Justice System** (Inteligentny system wspomagania decyzji oparty na algorytmicznej analizie obrazu w działaniach służb wymiaru sprawiedliwości)

Piotr Biłski;

Dec. 20, 2019 – Dec. 20, 2022

Funded by the National Centre for Research and Development (BIO10 Programme)

The topic of the project is the design and implementation of the intelligent system monitoring behavior and actions of people held in the penitentiary institutions. Its aim is to enable detection and prevention of dangerous and unwanted situations, such as physical assault or drug abuse. The system is to be operating on multiple industrial cameras monitoring inmates in various locations. Based on the images and videos acquired from them the selected Artificial Intelligence method will be used to identify dangerous situations and warn the guards in the timely manner. The important feature is the ability to use information from multiple cameras and combine them into the complex system. In the project specialists in criminology, penitentiary system, image analysis and intelligent data processing methods are involved.

4.2.3. Grants for young researchers

[Pro21] **Modeling and Optimization of Four Wave Mixing in Microstructured Optical Fibers for Terahertz Radiation Generation** (Modelowanie i optymalizacja mieszania czterofalowego we włóknach światłowodowych na potrzeby generacji promieniowania terahercowego).

Adam Pacewicz, B. Salski;

Sept. 22, 2017 - Mar. 22, 2020

Diamond Grant

Funded by the Ministry of Science and Higher Education

Terahertz radiation has a great potential to be more widely applied and commercialized in areas such as spectroscopy, imaging, and telecommunications. A promising method of terahertz radiation generation is utilizing nonlinear optical effects, first and foremost four-wave mixing, arising in microstructured optical fibers pumped by laser pulses. The main goal of the project is electromagnetic numerical modeling of radiation generation using a newly proposed method formulated in the time domain. Moreover, both theoretical and experimental work on the implementation of a fiber in which effect radiation generation can occur will be undertaken, taking available technological capabilities into account.

[Pro22] **Accurate Methods of Materials Spectroscopy in mm-Wave and Sub-THz Frequencies** (Dokładne metody spektroskopii materiałów w paśmie milimetrowym i sub-terahercowym).

Jerzy Cuper, P. Kopyt;

Jul. 30, 2019 - Jul. 30, 2021

Diamond Grant

Funded by the Ministry of Science and Higher Education

The purpose of this project is to develop new, accurate and reliable methods for material characterization in mm-wave and sub-THz frequencies, where most of the high-tech industry is now carrying out researches for 5G and IoT. Work will be focused on resonant methods, especially on Fabry-Perot open resonator structure. Firstly, a dedicated setup for both low-loss materials and conductive samples will be considered at 50-110 GHz frequencies. Second task assumes coupling such resonator with 300-4000

GHz THz time-domain spectrometer (THz TDS) and perform measurements with unprecedented accuracy. Both setups will be designed, fabricated partly at the Warsaw University of Technology, and tested within this project.

[Pro23] **Fusion of Measurement Data from Impulse-Radar Sensors and Depth Sensors when Applied for Monitoring of Elderly and Disabled Persons** (Integracja danych z impulsowych czujników radarowych i czujników głębi w systemie monitoringu osób starszych i niepełnosprawnych).

Paweł Mazurek;

Feb 26, 2018 - Feb. 25, 2020

PRELUDIUM Programme

Funded by the National Science Centre

The project is oriented on testing the hypothesis that the ultra-low-power impulse-radar sensors and infrared depth sensors can be applied for non-invasive and non-intrusive monitoring of the movements of elderly and disabled persons in their home environment, and that fusion of measurement data acquired by means of these sensors can decrease the uncertainty of the estimation of position and other health-related quantities – thus, increase the reliability of the monitoring. The aim of the research is, therefore, to develop an effective algorithmic basis for fusion of measurement data acquired by means of impulse-radar sensors and infrared depth sensors, to assess the performance of the developed algorithms when applied for estimation of the position of a monitored person, and of other health-related quantities, and to formulate the recommendations of practical nature concerning, e.g., the placement of sensors and suitability of procedures of data fusion, taking into account the variety of health-related quantities to be monitored.

[Pro24] **Research and Simulations of Effects of HPM Impulses** (Badania i symulacje skutków oddziaływania impulsów HPM).

Bartłomiej Salski, M. Krysicki, P. Kopyt;

Feb. 13, 2019 - Dec. 28, 2023

Strategic research and development program

Funded by the National Centre for Research and Development

The project aims at developing an electromagnetic simulation platform dedicated to the analysis of the attack with high power microwave pulses.

[Pro25] **Preparations of Proceedings and Abstracts on Material Characterization and Millimeter Technique for Foreign Conferences** (Przygotowanie publikacji i komunikatów konferencyjnych dotyczących charakterystyki materiałów oraz techniki milimetrowej na konferencje zagraniczne).

Bartłomiej Salski (supervisor): J. Cuper M. Rytel, P. Czekala;

Jul. 07, 2018 - May 31, 2019

'Best of the Best 3.0' Program

Funded by the Ministry of Science and Higher Education in scope of EU Knowledge, Education, and Development Program

The project selected the largest and most significant conferences in the field of microwave techniques and characterization of microwave materials: *International*

Microwave Symposium 2018 (IMS), held every year in the United States. It was considered in the scientific community to be the largest and most important in the world. Then, *International Conference on Infrared, Millimeter and Terahertz Waves 2018* was devoted to millimeter, subtermere and far infrared wave technology. Another equally important event was the *10th International Conference on Microwave Materials and Their Applications* dedicated to materials used in microwave techniques. The last was *IEEE Radio and Wireless Symposium 2019*, a conference held as part of *Radio & Wireless Week* in January 2019 in Orlando, USA. Due to a more distant date, the team had the opportunity to prepare a publication and present it at this conference, gaining both experience in presenting their achievements on the international arena and gaining knowledge about the leading trends in this field.

4.3. Projects granted by the University

4.3.1. Statutory projects

[Pro26] **Intelligent, Scattering, Network Video Systems** (Inteligentne, rozproszone, sieciowe systemy wideo).

Krzysztof Ignasiak, W. Skarbek, G. Pastuszak, A. Buchowicz, G. Galiński, J. Naruńnic;

Jul. 30, 2018 - Dec 31, 2019

Intelligent, distributed, network multi-camera systems are an important class of multimedia systems. They play a key role in the research and teaching of the Television Division. Conducted as part of the statutory work, scientific and research activity covered all the above aspects. (1) High-throughput architectures for high-resolution video coding were analyzed as well as hardwired oriented algorithms and VLSI architectures for the same goal. (2) Stochastic Gradient Descent (SGD) and Adaptive Momentum (Adam) for were compared for the image-based Steganography. (3) The practicality of transfer learning regarding to the emotion recognition task was investigated, presenting superior performance of the transfer learning from the face identification, compared with the solutions of train-from-scratch feed-forward deep neural networks. (4) A massive tutorial on Convolutional Neural Networks (CNN) and its applications in digital media research, based on the concept of Symbolic Tensor Neural Networks was developed. It proposes symbolic representation of CNNs and illustrates it with six generic digital media applications (CREAMS): Compression, Recognition, Embedding, Annotation, 3D Modeling for human-computer interfacing, and data security.

[Pro27] **Anchor Nodes Synchronization Techniques in UWB Localization Systems** (Techniki bezprzewodowej synchronizacji węzłów w ultraszeroko-pasmowych systemach lokalizacyjnych).

Jerzy Kołakowski, J. Cichoński, V. Djaja-Joško, M. Kołakowski;

Jul. 30, 2018 - Dec. 31, 2019

The project dealt with new anchor node synchronization techniques intended for TDOA UWB positioning systems. Two synchronization methods were proposed: synchronization of anchor pairs and sequential, which consists in retransmission of synchronization signals by anchor nodes. Both techniques provide synchronization of anchor clocks and allow to

correct errors originating from clock signals frequency tolerance and stability. The proposed methods were tested using simulations, the results were verified with experiments.

- [Pro28] **Application of SDR Techniques in the Laboratory Model of Telemetry Data Transmitter for a Micro Satellite** (Zastosowanie technik radia programowalnego SDR do realizacji modelu laboratoryjnego nadajnika danych telemetrycznych mikro-satelity).
Krzysztof Kurek, J. Modelski, S. Kozłowski;
Jul. 30, 2018 – Sept. 30, 2019

The aim of the project was an implementation of the digital signal processing algorithms for software realization of the transmitter for telemetry data transmission from a satellite, compatible with CCSDS (Consultative Committee for Space Data Systems) and ECSS (European Cooperation for Space Standardization) standards. The laboratory set-up of the transmitter was created using SDR module (Ettus USRP X310) and personal computer, allowing to transmit signals with QPSK, 8PSK and 16APSK modulations.

- [Pro29] **Modern Techniques in Nuclear and Medical Electronics** (Nowoczesne techniki elektroniki jądrowej i medycznej).
Janusz Marzec, K. Zaremba, P. Bogorodzki, P. Brzeski, G. Domański, M. Dziewiecki, T. Jamrógiewicz, B. Konarzewski, R. Kurjata, J. Kryszyn, W. Obrębski, T. Olszewski, E. Piątkowska-Janko, D. Radomski, W. Smolik, M. Ziembicki, W. Gradkowski, B. Kossowski, A. Rychter, M. Stosio, D. Wanta, K. Werys, M. Wieteska, P. Wróblewski, P. Tor;
Jul. 30, 2018 - Sept. 30, 2019

fMRI examination of the motor system using a pneumatically controlled glove

The aim of the work was to design a fMRI compatible measuring system and prepare an application that allows optimization of fMRI research paradigms. An algorithm has been developed to increase the statistical power of fMRI challenging paradigms. In order to examine the impact of paradigm optimization on the obtained results, research was carried out on efferent copy on 19 persons.

Analysis of parameters of X-ray shields

As part of the work, software was developed for calculating the X-ray tube spectra and radiation doses. The effect of radiation spectrum, shield thickness and shielding material on the radiation dose was investigated. In the future, test results can be used to optimize shields in X-ray laboratories.

Dynamic, partial reconfiguration using software processors in data acquisition systems

The aim of the work was to develop a user-friendly method of run-time partial reconfiguration of electronic systems based on FPGA chips. The developed method should enable the reconfiguration of the data acquisition system for electrical capacitance tomography, which is being developed at our Division. The result of the work carried out is a new reconfiguration method of system based on FPGA programmable devices. Software processors were used to perform run-time partial reprogramming of the system. Run-

time reprogramming is achieved by providing access to the code segment of PicoBlaze processors. A dynamic version of the proposed reconfiguration method was also proposed for time-critical applications. Reprogramming extends the flexibility of the system by enabling it to work with different sensors and to perform various measurement cycles depending on the application. A reconfiguration procedure for a modular, multi-level system was elaborated.

- [Pro30] **Optimization of High-Efficiency Power Converters and Software Defined Receivers** (Doskonalenie rozwiązań w zakresie wysokosprawnego przetwarzania energii i komputerowo wspomaganego odbioru radiowego).
Mirosław Mikołajewski, H. Chaciński, W. Kazubski
Jul. 30, 2018 – Sept. 30, 2019

The project concerned optimisation of high-efficiency resonant Class E power amplifier operating with variable load impedance and frequency controlled output power. The analysis of the amplifier operation with variable load and frequency resulted in an analytical description of the circuit that enabled computing new characteristics e.g. of output power vs. load impedance and operating frequency. Theoretical results were verified experimentally by designing and building a Class E amplifier with maximum output power 100W and efficiency 95%. An experimental 300W induction heater with a Class E amplifier was also designed, built and tested. The heater was optimised to tolerate being loaded with various heating coils with different parameters and yet delivered required output power with high-efficiency. A laboratory model of homodyne detection SDR receiver for VHF range was also proposed, built and tested. The experimental circuit achieved parameters comparable with commercial solutions.

- [Pro31] **Methodological Aspects of Measurement Data Processing** (Metodologiczne aspekty przetwarzania danych pomiarowych).
Roman Z. Morawski, A. Miękina, A. Podgórski;
Jul. 30, 2018 - Sept. 30, 2019

The primary objective of this project has been a synthesis of methodological experience related to the use of measurement in the interdisciplinary research practice. Selected aspects of the resulting methodology have been illustrated with applications in the domain of preventive care and diagnostics of various health conditions. The results of the project have been presented in a monograph (*Technoscientific Research – Methodological and Ethical Aspects*), two journal articles and four conference papers.

- [Pro32] **Research on Multidimensional Signal Transformations and Mobile Data Transmission Systems** (Badania w dziedzinie najnowszych metod analizy i przetwarzania sygnałów wielowymiarowych oraz mobilnych systemów transmisji danych).
Kajetana Snopek, T. Kosiło;
Jul. 30, 2018 - Dec 31, 2019

The research was focused on theoretical and practical aspects: applications of the Cayley-Dickson algebras in color and grey-scale image processing; enve-

lope detection of 1-D and 2-D signals; narrow-band mobile data transmission and Machine-to-Machine Communication.

[Pro33] **Advancement of the Algorithms for the Monitoring and Diagnostics of Electrical Appliances and Analog Systems** (Rozwój algorytmów do systemów monitoringu i diagnostyki urządzeń elektrycznych i systemów analogowych).

Wiesław Winięcki, P. Bilski, R. Łukasze-wski, K. Mroczek, A. Wójcik, K. Dowalla; Jul. 30, 2018 - Sept. 30, 2019

Multiple measurement methods, software solutions and analysis techniques were developed for the non-intrusive monitoring of electrical appliances based on the selected parameters and features acquired from the analysis of current and voltage signals in the steady and transient states of the devices' operation modes. Multiple approaches and contraptions for the identification of the electrical appliances, their states and sources of the distortion were proposed. New method for the diagnostics of analog systems was developed. Research results have been presented in 5 papers published in journals (2 from the JCR list, 3 from the WoS-ESCI list), 2 reports presented in international conferences available in the Web of Science database. Also, 2 patents have been granted and 1 more filed to the Patent Office.

[Pro34] **Microwave, mm-wave, Sub-terahertz and Optoelectronic Devices Design and Measurements Aided Electromagnetic and Circuit Modelling and Digital Correction Techniques of Characteristics** (Projektowanie układów i metody pomiarowe na pasma mikrofalowe, fal milimetrowych i subterahercowych, wspomagane symulacjami z zakresu analizy polowej i obwodowej oraz cyfrową korekcją charakterystyk).

Wojciech Wojtasiak, S. Rosłonec, B. Salski, D. Rosołowski, D. Gryglewski, P. Kopyt, P. Korpas, P. Miazga, M. Sypniewski, M. Kryszicki, M. Góralczyk, D. Kuchta, T. Karpisz, M. Lubiejewski; Jul. 30, 2018 - Sept. 30, 2019

Research has been conducted in various scientific fields, including measurements of ferromagnetic materials, and development of broadband and resonant systems for characterization of materials in microwave and mm-wave, and sub-THz bands. The team continued the work on development of new high-power and high efficiency GaN HEMT amplifiers designed to smart high-power microwave sources which will use for precise microwave heating and plasma generation. Important part of the work was devoted to design GaN HEMT structure topology as well as characterization of fabricated transistors in the frame cooperation with ITE. The research on SDR implementation has been supplemented by digital correction techniques such as DPD for linearization of LTE transmitter amplifiers' characteristics. These works enable the cooperation with Telco company to be continued.

[Pro35] **Study of Adaptive Wireless Communication System Based on Software Defined Radio and Time-Modulated Antenna Array** (Badania możliwości połączenia

SDR oraz AMC w celu stworzenia adaptacyjnego systemu łączności bezprzewodowej).

Yevhen Yashchyshyn, P. Bajurko K. Derzakowski, K. Godziszewski, G. Bogdan, D. Nyzovets, P. Piasecki, J. Sobolewski Jul. 30, 2018 - Sept. 30, 2019

The aim of this statutory project was to investigate capabilities of the 2x2 adaptive MIMO system composed of a time modulated antenna array (TMAA), a software defined radio (SDR) and signal processing algorithms. The system was operating at the center frequency of 5.6 GHz and was transmitting digitally modulated samples. Performance of the systems was investigated experimentally inside a classroom with multipath fading for different locations of the TMAA. Directions of TMAA beams were changing in wide range of angles in order to determine configurations which are relevant to conditions of multipath propagation. Bit error rate (BER) was selected as the figure of merit. Its value was substantially decreased for certain range of angles proving, that performance of MIMO system can be adaptively improved by application of suitable antenna radiation patterns.

[Pro36] **New Methods for Testing and Processing of Sound** (Nowe metody badania i przetwarzania dźwięku).

Jan Żera, P. Bilski, G. Makarewicz, A. Pietrzak, M. Lewandowski, P. Bobiński; Jul. 30, 2018 - Sept. 30, 2019

The study comprised four research projects. The first project was a study of noise exposure among musicians done with the use of two-channel noise dosimetry (a project in continuation). The work was especially concentrated on measurements of the asymmetry of exposure between left and right ear during daily noise exposure for musicians playing woodwind and brass instruments. The purpose of the second project was to analyze the linear and nonlinear systems of audio processing with the nonstationary input signals of music and speech. Major line of research referred to the time-frequency analysis using Empirical Mode Decomposition (EMD) based methods, with specific algorithms in the time domain analysis with the use of first and second derivatives. The third project was devoted to prediction methods and elimination of delays in active noise reduction (ANR) systems. Delays in the ANR may cause the system to a non-causal. Algorithms were implemented in a model of noise propagation in a ventilation duct. The fourth project was dedicated to measurements of the Head Related Transfer Functions (HRTFs). The HRTFs were recorded for each of the ten subjects in 360 sound source positions in surrounding space. Data were analyzed in terms of left-right ear and front-back head differences.

- Projects indicated on this subsection have been funded by the Ministry of Science and Higher Education subvention from Jun. 24, 2019 to Dec. 31, 2019.

4.3.2. Projects granted by the Rector

[Pro37] **Development of a Communication System with Stratospheric Balloons using SDR Programmable Radio Technology** (Opracowanie systemu łączności z balonami stratosferycznymi z wykorzystaniem techniki radia programowalnego SDR).

Krzysztof Kurek, A. Dobrogowski,
N. Książek, H. Naimirski, M. Trębiński,
K. Wasilewski;
May 13, 2019 - Dec. 31, 2019

The project involved the development of a communication system designed to provide two-way data transmission between the stratospheric balloon and the ground station. The results were the communication modules for the balloon and ground station, together with software for transmitting and receiving data in a ground station using the SDR programmable radio technology.

4.3.3. Projects granted by the Dean

[Pro38] **Laboratory System for Investigation Non-Linear Audio Signal Processing Systems** (Stanowisko laboratoryjne przeznaczone do badania zjawisk nieliniowych i procesów niestacjonarnych w cyfrowych systemach przetwarzania i odtwarzania sygnałów fonicznych).

Marcin Lewandowski;

Jul. 05, 2018 - Mar 25, 2019

The aim of this work was to develop a system for analyzing digital audio processing algorithms and digital-to-analog converters in the scope of precise measurements and processing of output signals with time-frequency analysis methods based on signal decomposition (EMD, EEMD, VMD, ITD, SSA, HNSA) and Fourier transform (FDM, SSTFT). The proposed system was able to acquire and analyze digital signals processed in typical audio applications, such as signal processing for improved speech intelligibility, noise reduction, amplitude's quantization, multirate filtering, lossy and lossless coding and signals reproduced in digital-to-analog converters.

[Pro39] **Research on a Time-Modulated Antenna Array (TMAA) for Internet of Things (IoT) Wireless Networks** (Badania możliwości zastosowania anteny z modulacją czasową w czujnikach sieci bezprzewodowej LoRa dla Internetu Rzeczy).

Grzegorz Bogdan;

Jul 02, 2019 - Dec. 31, 2019

The main goal of the project was to design and investigate a time-modulated antenna array (TMAA) for Internet of Things (IoT) wireless networks and to achieve mitigation of interference in an unlicensed frequency band. Designed TMAA was composed of four bow-tie antennas connected to single-pole single-throw microwave switches. The periodical on-off switching provided beam-steering functionality for generated sidebands. Commercial IoT modules were used to examine interoperability with the TMAA. Experimental results confirmed that beam-steering has a substantial impact on the received signal strength indicator and the signal to noise ratio.

[Pro40] **Investigation of Two-Phase Flow Speed Using the EVT4 Electric Capacitance Tomograph** (Badanie prędkości przepływu mieszaniny dwufazowej elektrycznym tomografem pojemnościowym EVT4).

Jacek Kryszyn;

Jul 02, 2019 - Dec. 31, 2019

The aim of the project was to study two-phase flows, including determining the flow speed, using

the EVT4 electric capacitance tomograph created in the Institute of Radioelectronics and Multimedia Technology, Nuclear and Medical Electronics Division has a bubble column equipped with two 16-electrode capacitance sensors. The installation allows synchronous imaging of two cross-sections of two-phase liquid and gas flow (e.g. water and air). The EVT4 tomograph allows obtaining over 625 images per second for a 16-electrode probe, which allows to conclude that flow tests using this data acquisition system are possible and should give satisfactory results.

[Pro41] **Applicability of Impulse-Radar Sensors for Estimation of Person's Three-Dimensional Movement Trajectory** (Wykorzystanie impulsowych czujników radarowych ultramalej mocy do estymacji trójwymiarowej trajektorii ruchu osoby).

Paweł Mazurek

Jul 02, 2019 - Dec. 31, 2019

The project is oriented on testing the hypothesis that the ultra-low-power impulse-radar sensors can be applied for estimation of the three-dimensional position of a person in a system for unobtrusive monitoring of movements. Therefore, the research is focused on the development of new methods for pre-processing of measurement data from the impulse-radar sensors, including the methods for smoothing of the trajectories of the distance between the monitored person and the impulse-radar sensors, and the methods for transformation of the smoothed distance trajectories into the three-dimensional movement trajectory. The research is also aimed at the investigation of the influence of the positions of the impulse-radar sensors on the uncertainty of the estimation of the three-dimensional position of the monitored person.

4.4. Other projects

[Pro42] **Use of the Equipment with the Testing Instrumentation** (Udostępnienie aparatury badawczej do przeprowadzenia badań rozwojowych).

Wojciech Wojtasiak, D. Gryglewski,
P. Korpas, D. Rosołowski;

Jul. 01, 2017 - Nov. 30, 2019

Funded by IT Partners Telco sp.z.o.o.

The aim of this project was to develop a complete measurement setup for dielectric materials. IT Partners Telco Ltd. would participate in the research conducting at the Microwave and Radiolocation Engineering Division, Institute of Radioelectronics and Multimedia Technology. The result of project would be the device able to support modern measurement techniques for very high frequency ranges.

[Pro43] **Scientific Studies on the Intelligent Development European Fund „Electrical Tomograph for Innovative Imaging and Area Monitoring Using Node Potentials Map”** (Wykonanie usługi badawczej w projekcie z Funduszu Europejskiego Inteligentny Rozwój pt. "Tomograf elektryczny do innowacyjnego obrazowania i monitorowania obszaru z wykorzystaniem mapy potencjałów węzłowych").

Waldemar Smolik, P. Brzeski, J. Kryszyn, T. Olszewski, R. Szabatin, M. Stosio, D. Wanta, P. Wróblewski;
Jan. 01, 2018 - Jan. 01, 2020
Funded by NETRIX S.A.

The main goal of the project is to create a mobile tomographic system for 3D imaging and area monitoring using the node potential map. The system will consist of a mobile device that allows the simultaneous recording of electrical potentials of cardiac activity and lung ventilation.

[Pro44] **Research and Development of the Mobile Contactless Payments System Based on the Bluetooth Technology for Merchants, Billing Agents and Consumers Equipped with Mobile Device** (Wykonanie prac badawczych i rozwojowych związanych z systemem mobilnych płatności zbliżeniowych opartych o technologię Bluetooth przeznaczonych dla akceptantów, agentów rozliczeniowych oraz konsumentów dysponujących dowolnym urządzeniem mobilnym).
Andrzej Rychter, R. Kurjata, W. Obrębski, M. Ziembicki, G. Domański, M. Wieteska;
Dec. 20, 2018 - Sept. 15, 2019
Funded by Braintri sp.z.o.o.

Details of this project cannot be published due to non-disclosure agreement with the contractor.

[Pro45] **Imaging Studies of Small Animal Brain Using MRI Techniques** (Badania obrazowe mózgu małych zwierząt z wykorzystaniem techniki MRI).
Piotr Bogorodzki, E. Piątkowska-Janko, W. Obrębski, M. Wieteska;
Jun. 20, 2018 - Jun. 20, 2020
Funded by Neurovet Małgorzata Miłkuła.

The project was carried out in collaboration of Neurovet and the Faculty of Veterinary Medicine, Warsaw University of Life Sciences. The objective of it was to conduct researches on small animal brain by means of MRI techniques.

[Pro45a] Cooperation agreement with the Warsaw University of Life Sciences (WULS), Faculty of Veterinary Medicine, Small Animal Clinic (**E. Piątkowska-Janko**, **P. Bogorodzki** - the Warsaw University of Technology, Institute of Radioelectronics and Multimedia Technology, research activity from 2013).

Two doctoral dissertations in preparation:

1. *Relationships between the clinical state and magnetic resonance tomography of the spine in dogs with acute neurological symptoms in 2015-2019 in the Warsaw agglomeration*
vet. M. Miłkuła; supervisor D.Sc. vet. Jacek Sterna; auxiliary supervisor Ph.D. vet. J. Bonecka
2. *Epidemiology of morphological changes in magnetic resonance imaging of the brains of dogs and cats with specific central symptoms in the Warsaw agglomeration*
vet. R. Lengling; supervisor Prof. D.Sc. vet. R. Lechowicki; auxiliary supervisor Ph.D. vet. J. Bonecka

[Pro46] **Designing of High-Power Amplifiers with a Supplier** (Zaprojektowanie wzmacniczy dużej mocy z zasilaczem).
Daniel Gryglewski, W. Wojtasiak, P. Korpas, D. Rosołowski;
Feb. 13, 2019 - Aug. 30, 2019
Funded by the Institute of Electronic Systems, WUT.

The aim of the project was to design and construct amplifiers with a supplier. The project was realized in collaboration between the Institute of Radioelectronics and Multimedia Technology and Institute of Electronic Systems, Warsaw University of Technology.

[Pro47] **Expertise on Siemens Healthineers Tender Offer** (Ekspertyza dotycząca oferty przetargowej firmy Siemens Healthineers).
Michał Wieteska
Apr. 08 - Apr. 24, 2019
Funded by GE Medical Systems sp.z.o.o.

Details of this project cannot be published due to non-disclosure agreement with the contractor.

[Pro48] **Use of Equipment with the Testing Instrumentation** (Udostępnienie aparatury pomiarowej: do realizacji badań, pomiarów i projektów).
Wojciech Wojtasiak
May. 01, 2019 - Oct. 31, 2019
Funded by QWED sp.z.o.o.

The aim of this project was to develop a measurement setup for dielectric materials. The QWED company would participate in the research conducting at the Microwave and Radiolocation Engineering Division, Institute of Radioelectronics and Multimedia Technology. The device mentioned above was able to support modern measurement techniques for high frequency ranges.

[Pro49] **Acoustic Measurement at the Lublin Philharmony** (Przeprowadzenie pomiarów akustycznych sali symfonicznej Filharmonii Lubelskiej im. H. Wieniawskiego).
Jan Żera, M. Jasiński;
Jul. 09, 2019 - Aug. 26, 2019
Funded by Maufaktura Technologiczna sp.z.o.o.

The purpose of this project was to describe the present acoustical condition in the main Concert Hall and in the Chamber Concert hall at the H. Wieniawski Lublin Philharmonic.

[Pro50] **Measurement of the OPS Module Radio Parameters, and Antenna Radiation Matching Characteristics using the Traverse Method** (Pomiar parametrów radiowych modułu OPS, pomiar dopasowania i charakterystyki promieniowania anteny metodą poligonową).
Dawid Rosołowski
May 13, 2019 - Jun. 27, 2019
Funded by EBS sp.z.o.o.

The main goal of this project was to conduct measurement of radio parameters of the OPS module, measurement of matching and antenna radiation characteristics of the antenna using the traverse method.

- [Pro51] **Measurement Examination of Integrated Circuits of VCO Generator for 24 GHz and Generator for 96 GHz** (Pomiar charakterystyk układów scalonych generatora VCO na pasmo 24 GHz oraz generatora na pasmo 96 GHz).
Paweł Bajurko, S. Kozłowski
 Jun. 18 - Jun. 24, 2019
 Funded by SIRC sp.z.o.o.

Characteristics of the integrated circuits referred to in the title were determined using mm-wave on-wafer measurement system performing direct probe contact to the dice.

- [Pro52] **Measurement Examination of Integrated Receiver Circuit for 94 GHz** (Pomiar charakterystyk układów scalonych odbiornika na pasmo 94 GHz).
Paweł Bajurko
 Aug. 20, 2019 – Aug. 30, 2019
 Funded by SIRC sp.z.o.o.

A set of various characteristics of the integrated receiver circuit for 94 GHz was determined using mm-wave on-wafer measurement system performing direct probe contact to the dice.

- [Pro53] **Measurements of Antenna Arrays for 10 GHz Frequency Band** (Pomiar charakterystyk zestawu szyków antenowych na pasmo 10 GHz).
Grzegorz Bogdan
 Jun. 18 - Jun. 26, 2019
 Funded by Advanced Protection Systems S.A.

Six printed circuit boards with four separate microstrip antennas and one microstrip antenna array with corporate feed network were measured. Measurements were conducted in two frequency bands: 9.75-9.95 GHz and 10.4-10.6 GHz. Each of the antennas was measured in two planes. In total, 50 sets of characteristics were measured, and each set had 21 frequency points measured, resulting in 1050 radiation patterns.

4.5. Other activities

4.5.1. International Co-operation

CC-Link

Since 12 May 2005 the Institute of Radioelectronics and Multimedia Technology has been a formal member of the CC-Link Partner Association the worldwide organization of industrial and research institutions working on the development and applications of CC-Link (Control & Communication Link) – a field network system that processes both the control and information data at high speed, to provide efficient integrated factory and process automation. The collaboration with the Association is realized by the Division of Nuclear and Medical Electronics.

China – Poland Exchange Program

The Institute of Radioelectronics and Multimedia Technology (Nuclear and Medical Electronics Division) in collaboration with the Institute of Engineering Thermophysics (IET), Chinese Academy of Sciences, China, realized the new exchange program: "Advanced process monitoring technologies for multiphase flows". The aim of this program is to explore how to investigate the multi-phase flows based on process tomography and process CFD simulation to

analysis the complex flow characteristics. Exchange plan include scholars from IET visiting the Institute of Radioelectronics and Multimedia Technology, Warsaw University of Technology (WUT). Head of the research group: **Waldemar Smolik**

National Co-operation

IUSER

The new established science and technology platform: "Intelligent Devices and Systems for Distributed Power Generation" is carried out at Institute of Radioelectronics and Multimedia Technology, Military University of Technology, National Institute of Telecommunications, Military Communication Institute, National Chamber of Electronics and Telecommunications, TP SA., Institute of Electron Technology. The main aim of this project is to conduct the research on technologies and products, the implementation of which will create a market opportunity for the development of distributed generation based on renewable energy sources.

Intelligent Transport

The new established science and technology platform is carried out at Faculty of Electronics and Information Technology (Institute of Radioelectronics and Multimedia Technology, Institute of Telecommunications), Faculty of Transport, Faculty of Administration and Social Sciences, Faculty of Automotive and Construction Machinery Engineering. The main aim of this project is to realize the scientific researches in the field of telecommunication and information systems and methods of information in an intelligent transport.

CentriX

The new established science and technology platform CentriX is founded by European Regional Operation Fund 2014 – 2020 for Mazovian Voivodeship. This project is carried out at National Center for Nuclear Research, Institute of Radioelectronics and Multimedia Technology with co-operation of Imagine RT Ltd., and Eastern Wall Technologies Ltd. The main goal of this project is to establish the innovation and scientific center and realize researches in the field of industry radiation techniques. Head of the research group: **Waldemar Smolik**

Outstanding industrial project – co-operation with IT Partners Telco Ltd.

The Institute of Radioelectronics and Multimedia Technology (Microwave and Radiolocation Engineering Division) in collaboration with IT Partners Telco Ltd., realized the project called "Innovative at global level microcell LTE-Advanced working with high RF power in 3.4-3.8 GHz frequency range" founded from EU Innovative Development Operation Program. Institute of Radioelectronics and Multimedia Technology making the equipment available for IT Partners Telco Ltd. to conduct the research activities possible through this project.

4.5.2. Scientific networks

Subsystem Developed Through IMWP for Wireless Communication and Radar Functionalities – WG2 work group, IMWP for 5G – WG3 work group.
Yevhen Yashchshyn;

COST – European Cooperation in Science & Technology supported by EU Framework Programme HORIZON 2020
2018 - 2022

The WG2 and WG3 are realized in frame of the European Network for High Performance Integrated Microwave Photonics Project.

WG2: The goal is to define the main requirements for implementing IMWP communication and radar sub systems in terms of PIC models and monolithic integration.

WG3: The goal is to identify the IMWP opportunities in terms of generation, SWaP, bandwidth, and integration to unlock the future 5G communications.

Polish Network of Neutrino Physics (Polska Sieć Neutrinowa)

In 2006, the Faculty of Electronics and Information Technology joined the Polish Network of Neutrino Physics. The network comprises several institutes and laboratories working in the field of development of experimental neutrino physics. The Faculty is represented in the network by the Division of Nuclear and Medical Electronics, which has a long-term experience in collaboration with high energy physics (NMC, SMC, COMPASS) and neutrino physics (ICARUS, T2K) experiments.

Polish Network of Particle Astrophysics (Polska Sieć Astrofizyki Cząstek)

In 2006 the Faculty of Electronics and Information Technology joined the Polish Network of Particle Astrophysics. The main goal of the organization is to create a frame for the research collaboration of several institutes and laboratories in the field of development of advanced experimental methods for particle astrophysics. The Faculty is represented in the network by two research groups: from the Institute of Electronics Systems and from Institute of Radioelectronics and Multimedia Technology – namely from the Division of Nuclear and Medical Electronics.

HyperMR - European Network for Hyperpolarization Physics and Methodology in NMR and MRI – TD1103

In 2012 the Faculty of Electronics and Information Technology, Institute of Radioelectronics and Multimedia Technology (the Division of Nuclear and Medical Electronics) joined the project realized in the frame for the research collaboration of several Polish and foreign institutes. The main aim of this Action is to stimulate and accelerate collaborations and joint research efforts between European groups into hyperpolarization physics and methodology with the goal to develop robust strategies for sensitivity enhancement in NMR and MRI. Coordinated short-term scientific missions (STSMs) will make it possible to fully exploit the potential of unique scientific instrumentation which already exists in few European groups. The scientific programme is organised into 5 different working groups that focus on key issues related to the topic of the Action. The scientific programme is supported by a wide range of research groups thus generating a high added value for the European research landscape.

4.5.3. Student research groups

Space Engineering Student Research Group

Krzysztof Kurek – tutor.

Space Engineering Student Research Group – SKIK (in Polish Studenckie Koło Inżynierii Kosmicznej) was formed in 2004. Members of SKIK participated in different international and internal educational space projects. i.e. ESEO, PW-Sat, BOBAS balloon missions. Now, the group start activity with new members, preparing the next balloon mission. Now activity of the Group is focused on realization of stratospheric balloon missions to measure air pollution.

Biomedical and Nuclear Engineering Student Research Group

Grzegorz Domański – tutor.

Biomedical and Nuclear Engineering Student Scientific Group (in Polish: Studenckie Koło Inżynierii Biomedycznej i Jądrowej “Biomedyczni”) was formed in Dec. 2005 by a group of students from Biomedical Engineering. The group worked on software enabling determination of longitudinal relaxation time based of a series of images with different inversion time (TI). The "Arduino for biomedical applications" project has been initiated to develop student interests in the design of new electronic systems, software, and use them in biomedicine. The main objective of the project group is to get acquainted with the electronic platform Arduino programming environment for creating low-cost, flexible and easy-to-use devices. The acquired knowledge and skills will be use at a later stage of the project to develop and implement a multi-functional system for biomedical use, based on the Arduino platform and additional electronic components.

Innovative Information Technologies Student Scientific Group

Przemysław Miazga – tutor.

The scope of interest of the Students' Circle for Innovative Informatics Technologies (KNITI) is the application of .NET technologies in mobile devices programming. KNITI organized courses for students of our university, two courses on basics of C# programming language, and one course on advanced Windows 8 programming for mobile devices. Students of the Group participated in many programming events and contests eg. in Microsoft Imagine Cup, hackatone Night of The Living Devs. The Circle is the organizer of K-Night LAN Party programming marathon.

Radio Localization Student Research Group

Jerzy Kołakowski – tutor.

Radio Localization Student Research Group LORAD was established in 2016 at the Warsaw University of Technology. It brings together undergraduate and postgraduate students from Institute of Radioelectronics and Multimedia Technology. LORAD's main field of interest are radio localization systems, especially those intended for indoor localization. LORAD focuses mostly on ultrawideband localization techniques, however it is interested in inertial localization techniques and SLAM systems as well.

Members of the Radio Localization Student Research Group carry out various tasks, starting from PCB design and assembly, through microcontroller and PC applications programming ending with localization algorithms design and implementation. Additionally, unmanned, self-localizing indoor flying and driving vehicles are developed.

In its projects LORAD cooperates with UWB Systems Research group.

Electromagnetic Modelling Student Research Group

Bartłomiej Salski - tutor

Members of the Electromagnetic Modelling Student Research Group have realized the project: "System for characterization of materials at millimeter spectrum". One of the hurdles in the development of devices and systems working in the millimeter-wave band is that the electromagnetic properties of the materials used for their construction should be well known at the design stage. The goal of the project is to develop a practical and portable test-bench for free-space characterization of planar samples in the frequency range 18-40 GHz. Strengths of the chosen characterization method include a broad analysis bandwidth and non-destruction of the sample. It is hoped that students and faculty members will benefit from both building and utilizing the test-bench for research purposes.

3Z5PW Experimental Amateur Radio Station

Dawid Rosołowski – tutor.

The 3Z5PW is the callsign of the amateur radio club station set up in 2015 with the goal of developing interest in RF and microwave technology among students of The Faculty of Electronics and Information Technology and of the whole WUT. Due to the interdisciplinary character of the contemporary amateur radio, the Experimental Station activities focus on the practical use of the knowledge in the field of analog radio electronics - development of components for transceivers, designing simple and more complicated radio circuits and antennas for educational and experimental purposes, as well as applications of SDR technology and uC programming. All efforts allow the club members to make long distance wireless contacts with other stations in faraway places on the HF, VHF and SHF bands in more conscious way.

Current activities are concentrated on education and training of young radio operators (two editions of amateur radio courses), promotion of ham radio and the development of the radio shack. 3Z5PW station operators: Dawid Rosołowski (SQ5JQI), Grzegorz Grochowski (SP5QWG), Przemysław Korpas (SQ7JHV).

4.6. Instrumentation Investments

4.6.1. Centre for Biomedical Technology and Medical Physics

Nuclear and Medical Electronics Division
(**Krzysztof Zaremba** – head)
2008 - 2019

Founded by European Regional Development Fund (ERDF) in scope of Operational Programme Innovative Economy (POIG).

The project is a part of the CePT (Centre for Preclinical Research and Technology), the biggest biomedical and biotechnological undertaking in Central and Eastern Europe. The CePT project is coordinated by the Medical University of Warsaw in partnership with the University of Warsaw, the Warsaw University of Technology and seven research institutes of the Polish Academy of Sciences. The main objective of the Centre is to establish the network of biomedical engineering and biomaterial technology laboratories

which will form the base for scientific research and technology implementation. In this Project participates 8 faculties of Warsaw University of Technology.

4.6.2. Panda 2 Project

The Institute of Radioelectronics and Multimedia Technology together with the partners of the CePT Project participates in the implementation of the contract for the execution and financing of the Panda 2 Project, which aims to support the cost of maintaining the readiness of the research infrastructure. The contract was concluded in 2016 with a period of 4 years. According to The National Centre for Research and Development (NCBR) roles the program is aimed at supporting the costs of maintaining R & D infrastructure built or rebuilt thanks to the implementation of projects within the second axis of the Innovative Economy Programme (POIG), for which the final eligible costs was at least 50 million PLN.

4.6.3. Sub-terahertz Technology and Antenna Laboratory

Yevhen Yashchynshyn, P. Bajurko;
2010 – 2019

Funded by European Regional Development Fund (ERDF) in scope of Operational Programme Innovative Economy (POIG).

The project is a part of the Faculty Research Centre FOTEH (Photonics and Terahertz Technologies). The project encompasses modernizing of infrastructure of the Antenna Laboratory that enables research on spatial distributions of the electromagnetic field in the millimetre-wave and sub-terahertz range to develop and study of antennas, characterize parameter of materials and designing of the communication, imaging and radar system.

4.6.4. Fast-X Laboratory: Electrical Capacitance Tomograph (Laboratorium Fast-X: Elektryczny tomograf pojemnościowy).

Waldemar Smolik, J. Kryszyn, R. Szabatin (em.), M. Krzewski, T. Olszewski, B. Radzik, P. Wróblewski, D. Wanta, M. Stosio;
2019-2021

Funded by European Regional Development Fund (ERDF) in scope of Regional Operational Programme for Mazovian Voivodeship – PRO-WM

The project is elaborated in the co-operation with the National Center for Nuclear Research in Świerk, where has been set up a research and implementation centre for CentriX industrial radiation techniques. One of the key equipments in the centre, which is established at the National Centre for Research and Development, is the most modern modular accelerator capable of speeding up electrons up to energy of 30 MeV. The accelerator is a part of the Fast-X Laboratory within the CentriX project. In addition to generating high-energy X-rays and neutrons, it will also provide electrical capacitance tomography capabilities.

5. TITLES AND DEGREES AWARDED

5.1. D.Sc. Degrees

[DSc1] Jacek Naruniec: *“Metody, algorytmy i zastosowania analizy twarzy”* (Methods, algorithms and face analysis applications), Warsaw, Feb. 26, 2019.

5.2. Ph.D. Degrees

[PhD1] Grzegorz Bogdan: *“Adaptacyjne kształtowanie charakterystyki kierunkowej anteny z modulacją czasową”* (Adaptive beamforming in a time modulated antenna array), Prof. **Y. Yashchyshyn** (supervisor), Ph.D. degree with honours, Warsaw, Mar. 26, 2019.

[PhD2] Jakub Pach: *“Identyfikacja autora rękopisu łacińskiego z wykorzystaniem metod przetwarzania obrazów”* (Identification of author's Latin manuscripts using individual features of handwriting), Prof. **P. Bilski** (supervisor), Warsaw, Jun. 25, 2019.

5.3. M.Sc. Degrees

[MSc1] Robert Augustyniak: *“Opracowanie wielokanałowego odbiornika Bluetooth”* (Development of a multichannel Bluetooth receiver), Assist. Prof. **J. Kołakowski** (supervisor).

[MSc2] Szymon Jędrzej Borkowski: *“Zastosowanie techniki rezonansu magnetycznego w analizie funkcjonalnej mięśnia sercowego”* (Application of the magnetic resonance imaging in cardiac functional analysis), Prof. **P. Bogorodzki** (supervisor).

[MSc3] Maja Cudnok: *“Aplikacja webowa w chmurze do zarządzania sygnałami biologicznymi - analityka EMG w ćwiczeniach statycznych”* (Web application in cloud for management of biological signals - analytics of EMG signal during static exercises), Assist. Prof. **Z. Wawrzyniak** (supervisor).

[MSc4] Jerzy Cuper: *“Skalarny analizator widma do rezonansowych pomiarów materiałów”* (Scalar network analyzer for resonant measurement purposes), Assoc. Prof. **P. Kopyt** (supervisor), M.Sc. degree with honours.

[MSc5] Piotr Cyran: *“Pomiar poziomu dźwięku za pomocą urządzeń mobilnych”* (Sound level measurement using mobile devices), Assist. Prof. **M. Lewandowski** (supervisor).

[MSc6] Agnieszka Czaplicka: *“Uczenie maszynowe pod nadzorem w zastosowaniu do identyfikacji białek w badaniach proteomicznych”* (Application of supervised machine learning to protein identification in proteomic studies), Assist. Prof. **T. Rubel** (supervisor), M.Sc. degree with honours.

[MSc7] Emil Dmitruk: *“Tomograf EMG do badania aktywności mięśni przedramienia”* (EMG tomograph- device for forearm muscle activity examination), Assist. Prof. **G. Domański** (supervisor).

[MSc8] Magdalena Domagała: *“Wielokanałowy system do bezprzewodowego monitorowania sygnału EKG współpracujący z suchymi elektrodami”* (Multichannel system for wireless ECG signal monitoring with dry electrodes), Assist. Prof. **G. Domański** (supervisor).

[MSc9] Magdalena Dziarczykowska: *“Program do analizy i klasyfikacji sygnałów EKG metodą analizy załamków”* (Program for the analysis and classification of ECG signals by means of wave analysis), Assist. Prof. **G. Domański** (supervisor).

[MSc10] Kaja Etmanowicz: *“Prototyp analogowego urządzenia do akwizycji sygnału EMG”* (Prototype of an analog device for EMG signal acquisition), Assist. Prof. **Z. Wawrzyniak** (supervisor).

[MSc11] Piotr Fryś: *“Predykcja wykrywalności peptydów w tandemowej spektrometrii mas”* (Prediction of peptides observable by tandem mass spectrometry), Assist. Prof. **T. Rubel** (supervisor).

[MSc12] Marlena Gazda: *“Analiza własności algorytmu obrazujące do zastosowania w systemie MiMO wielkiej skali pracującym w paśmie subterahercowym”* (Properties analysing of imaging algorithm for use in large scale MIMO system operating in the subterahertz band), Assist. Prof. **P. Bajurko** (supervisor).

[MSc13] Kinga Greczkowska: *“Projekt modernizacji akustyki studia nagraniowego Zakładu Elektroakustyki”* (Modernization of recording studio in the Electroacoustics Division), Prof. **J. Żera** (supervisor).

[MSc14] Gabriela Grońska: *“Software for accelerometric cough detector and analysis of the signal”* (Oprogramowanie akcelerometrycznego detektora kaszlu i analiza sygnału), Assist. **R. Kurjata** (supervisor).

[MSc15] Weronika Jaczewska: *“Metody syntezy mikrofalowych filtrów tubularnych”* (Methods of synthesis of microwave tubular filters), Assoc. Prof. **B. Salski** (supervisor).

[MSc16] Adam Kaczor: *“Badanie perfuzji mózgowej metodą magnetycznego znakowania krwi (Arterial Spin Labelling)”* (Perfusion imaging of brain using Arterial Spin Labelling Technique), Prof. **P. Bogorodzki** (supervisor).

[MSc17] Kacper Kaźmierczak: *“Urządzenie do automatycznego wyznaczania energii promieniowania akceleratorów przemysłowych”* (Automation of the proces of determining the energy of an industrial accelerators), Assoc. Prof. **S. Wronka** (supervisor).

[MSc18] Klaudia Kaźmierska: *“Opracowanie interfejsu użytkownika systemu wspomaganie osób z demencją”* (User interface of the system supporting people with dementia), Docent **J. Cichoński** (supervisor).

TITLES AND DEGREES AWARDED

- [MSc19] Emilia Kiryk: „*Badania symulacyjne makromechaniki ślimaka ucha*” (Simulation studies of cochlear macromechanics), Assoc. Prof. **M. Kwacz** (supervisor).
- [MSc20] Robert Kołakowski: „*Opracowanie układu etykiety UWB/BLE do hybrydowego systemu lokalizacyjnego*” (Hybrid localization system UWB/BLE tag development), Docent, Prof. **J. Cichocki** (supervisor), M.Sc. degree with honours.
- [MSc21] Kamil Lipiński: „*Badanie dyfuzji techniką jądrowego rezonansu magnetycznego*” (Analysis of diffusion study in Magnetic Resonance Imaging), Prof. **P. Bogorodzki** (supervisor).
- [MSc22] Paweł Lipka: „*Tor nadawczy do satelity na pasmo X*” (Transmission track for microsatellite for X band), Assist. Prof. **D. Gryglewski** (supervisor), M.Sc. degree with honours.
- [MSc23] Natalia Lubojemska: „*Układ do rejestracji trasy ruchu osób z wykorzystaniem odbiornika GPS i modemu sieci komórkowej*” (The system for tracking people using a GPS receiver and a GSM/GPRS cellular modem), Assist. Prof. **J. Kołakowski** (supervisor).
- [MSc24] Mateusz Midura: „*Układ odczytu dla pozycyjnego detektora promieniowania gamma*” (Readout system for a position-sensitive gamma ray detector), Assist. Prof. **R. Szabatin** (supervisor).
- [MSc25] Mariusz Mróz: „*Urządzenie do akwizycji analogowych sygnałów biomedycznych z interfejsem Ethernet*” (Device for biomedical analog signal acquisition with Ethernet connection), Assist. Prof. **G. Domański** (supervisor).
- [MSc26] Małgorzata Maria Murach: „*Pomiar i analiza ciśnienia w płynie ślimakowym w stanie przed i po implantacji protezki komorowej*” (Measurement and analysis of pressure in cochlear fluid before and after the implantation of the chamber stapes prosthesis), Assoc. Prof. **M. Kwacz** (supervisor).
- [MSc27] Ewa Nieporęcka: „*System (aplikacja mobilna + serwer) do wspomaganie decyzji w dziedzinie kardiologii*” (System for supporting diagnosis and treatment of heart diseases), Assist. Prof. **A. Rychter** (supervisor).
- [MSc28] Mateusz Pałasz: „*Analiza zmian kształtu sygnału fotopletyzmoграфicznego w odpowiedzi na czynną próbę ortostatyczną*” (Analysis of changes in the shape of the photoplethysmographic signal in response to the active orthostatic test), Prof. **G. Cybulski** (supervisor).
- [MSc29] Michał Konrad Pędzimaż: „*Realizacja i badania cyfrowych filtrów decymacyjnych w fonicznym przetworniku analogowo-cyfrowym*” (Research and testing of the digital decimation filters dedicated to be implemented in the audio analog-to-digital converter), Senior Lecturer **P. Bobiński** (supervisor).
- [MSc30] Szymon Stefan Płotka: „*Analiza danych medycznych przy użyciu technik uczenia maszynowego w celu predykcji przedwczesnego porodu*” (Medical data analysis using machine learning techniques to predict birth preterm), Assist. Prof. **T. Trzcіński** (supervisor).
- [MSc31] Katarzyna Szeligowska: „*Analiza sieci połączeń w mózgu na podstawie badań MRI*” (Analysis of connections network in brain based on MRI examination), Assist. Prof. **E. Piątkowska-Janko** (supervisor).
- [MSc32] Kamil Szczypkowski: „*Bezprzewodowa metoda wyznaczania zysku anteny na podstawie jednowrotowego pomiaru fal rozproszonych na antenie*” (The wireless method of determining the antenna’s gain based on a one-port measurement of scattered waves), Assist. Prof. **P. Bajurko** (supervisor), M.Sc. degree with honours.
- [MSc33] Paweł Szulim: „*Metody poprawy zasięgu i transmisji w sieciach bezprzewodowych wewnątrz budynków*” (Methods to improve coverage and transmission in wireless networks inside buildings), Assist. Prof. **K. Kurek** (supervisor).
- [MSc34] Krzysztof Waclawik: „*Analiza i porównanie metod rozciągania dźwięku w czasie*” (Analysis and comparison of audio time-stretching methods), Assist. Prof. **M. Lewandowski** (supervisor).
- [MSc35] Michał Wierzbicki: „*Program do oceny narażenia na drgania miejscowe i ogólne z wykorzystaniem wielokanałowej przystawki pomiarowej*” (A program for assessing exposure to hand-arm and whole-body vibrations using multi-channel measuring adapter), Assist. Prof. **G. Makarewicz** (supervisor).
- [MSc36] Hanna Witulska: „*Rozpoznawanie dźwięków środowiskowych (wojskowych)*” (Recognition of natural (military) sounds), Prof. **J. Żera** (supervisor).
- [MSc37] Michał Właż: „*Opracowanie systemu do pomiaru jakości usług w sieciach telefonii komórkowej z wykorzystaniem urządzeń dostarczanych użytkownikom*” (Development of system for measurement of services quality in cellular networks utilizing user equipment), Assist. Prof. **J. Kołakowski** (supervisor).
- [MSc38] Inga Zacharska: „*Metoda śledzenia markerów akustycznych wykorzystująca wyniki segmentacji obrazów echokardiograficznych*” (Speckle tracking method with the use of echocardiographic image segmentation results), Assist. Prof. **S. Cygan** (supervisor), M.Sc. degree with honours.
- [MSc39] Aleksandra Ziółkowska: „*Platforma stabilograficzna - wykonanie i kalibracja urządzenia oraz analiza wyników badań posturo-*”

- graficznych*” (Stabilographic platform – construct and calibration of the device and analysis of posturographic research results), Assoc. Prof. **M. Kwacz** (supervisor).
- 5.4. M.Sc. Evening Studies on Radiocommunications – M.Sc. Degrees**
- [MSc40] Mikołaj Kolczyński: *“Badanie jakości łącza radiowego z wykorzystaniem radiostacji wojskowych”* (Research on the quality of radio transmission line with the use of military radio stations), Senior Lecturer **H. Chaciński** (supervisor).
- [MSc41] Paweł Szulim: *“Metody poprawy zasięgu i transmisji w sieciach bezprzewodowych wewnątrz budynków”* (Methods to improve coverage and transmission in wireless networks inside buildings), Assist. Prof. **K. Kurek** (supervisor).
- 5.5. B.Sc. Degrees**
- [BSc1] Bohdan Aksonov: *“Narzędzie do przygotowania i oceny jakości leczenia”* (A system for preparing and assessing the quality of treatment), Prof. **J. Mulawka** (supervisor).
- [BSc2] Anna Andruszkiewicz: *“Pomiar stratności nanocząsteczek superparamagnetycznych stosowanych w obrazowaniu medycznym MPI i hipertermii”* (Measurement of power loss of SPIONs applied in MPI and hyperthermia), Prof. **W. Smolik** (supervisor).
- [BSc3] Krzysztof ApolinarSKI: *“Archiwizacja danych z badań EEG na platformie XNAT”* (EEG Data archiving system on XNAT platform), Prof. **P. Bogorodzki** (supervisor).
- [BSc4] Marta Barańska: *“Opracowanie algorytmu analizy obrazów biomedycznych”* (Development of biomedical images analysis algorithm), Assist. Prof. **G. Nieradka** (supervisor).
- [BSc5] Mirosław Bogusz: *“Aplikacja do wizualizacji i przetwarzania wyników dynamicznej spektroskopii rezonansu magnetycznego”* (Application for visualizing and processing of dynamic magnetic resonance spectroscopy results), Assist. Prof. **E. Piątkowska-Janko** (supervisor), B.Sc. degree with honours.
- [BSc6] Aleksandra Brogowska: *“Oprogramowanie do zarządzania bazami danych sekwencji białek”* (Software for managing protein sequence databases), Assist. Prof. **T. Rubel** (supervisor).
- [BSc7] Daria Bronik: *“Zastosowanie macierzy rzadkich w symulacjach pola elektrycznego w elektrycznej tomografii pojemnościowej”* (The use of sparse matrixes in electrical field simulations in electrical capacitance tomography), Assist. Prof. **J. Kryszyn** (supervisor).
- [BSc8] Jakub Cekała: *“Elektroniczna dokumentacja medyczna”* (Electronic medical documentation), Assist. Prof. **J. Kryszyn** (supervisor).
- [BSc9] Dawid Cichocki: *“Odkrywanie wiedzy medycznej na podstawie profilu metabolicznego”* (Knowledge discovery based on metabolic profile), Prof. **J. Mulawka** (supervisor).
- [BSc10] Adam Cisak: *“System do zbierania i przetwarzania danych uczących dla potrzeb monitorowania noworodków”* (System for collecting and processing training data concerning infant movement monitoring), Prof. **J. Mulawka** (supervisor).
- [BSc11] Krzysztof Czechowicz: *“Półmostkowa przetwornica PWM”* (Half-bridge PWM converter), Assist. Prof. **M. Mikołajewski** (supervisor).
- [BSc12] Piotr Czekala: *“Analiza propagacji wiązki radiowej w atmosferze metodą śledzenia promieni”* (Analysis of radio wave propagation in atmosphere using ray tracing method), Prof. **B. Salski** (supervisor), B.Sc. degree with honours.
- [BSc13] Mikołaj Darek: *“Projekt filtra pasmowo-przepustowego do samochodowego radaru krótkiego zasięgu na pasmo 79 GHz w technologii mikropaskowej na podłożu LTCC”* (Design of bandpass filter for automotive short-range radar for 79 GHz band in microstrip technology on LTCC substrate), Assist. Prof. **P. Bajurko** (supervisor).
- [BSc14] Gabriela Domaradzka: *“Elektroniczna dokumentacja medyczna”* (Electronic medical records), Assist. Prof. **J. Kryszyn** (supervisor).
- [BSc15] Kajetan Drachal: *“Projekt przejścia: linia koplanarna-falowod na pasmo subterahercowe do zastosowania w technologii LTCC”* (Design of a coplanar waveguide to waveguide transition for subterahertz band intended for implementation in LTCC technology), Prof. **Y. Yashchyshyn** (supervisor).
- [BSc16] Jakub Fał: *“Implementacja algorytmu REPET wyodrębniania ścieżki dźwiękowej/wokalnej z utworów muzycznych”* (Implementation of the REPET algorithm to extract sound/vocal track from music tracks), Assoc. Prof. **K. Snopek** (supervisor).
- [BSc17] Damian Gabiec: *“Projekt i realizacja aplikacji mobilnej dla systemu zarządzania projektami studenckimi”* (Design and implementation of a mobile application for a student project management system), Assist. Prof. **G. Galiński** (supervisor).
- [BSc18] Szczepan Gabiec: *“Stanowisko pomiarowe do badania charakterystyk przetworników a/c i c/a”* (Measuring stand for testing the characteristics of A/C and C/A converters), Assist. Prof. **M. Lewandowski** (supervisor).
- [BSc19] Karolina Galant: *“System przeprowadzania testów”* (Testing system), Assist. Prof. **G. Galiński** (supervisor).

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- [BSc20] Kamila Glita-Tracz: *“Program do wyznaczania zmienności rytmu serca HRV”* (Software for determining HRV heart rate variability), Assist. Prof. **Sz. Cygan** (supervisor).
- [BSc21] Marianna Grabowska: *“Projektowanie biosensorów do adhezji białek”* (Designing biosensors for protein adhesion), Assoc. Prof. **W. Świąszkowski** (supervisor).
- [BSc22] Jan Jakub Grudziński: *“Miernik hałasu i kalkulator ekspozycji na hałas przystosowany do uruchamiania na urządzeniach mobilnych”* (Sound level meter and sound exposure calculator suitable for mobile devices), Assist. Prof. **G. Makarewicz** (supervisor).
- [BSc23] Grzegorz Gugala: *“Układ do detekcji ruchu wykorzystujący laserowe czujniki zbliżeniowe”* (Motion detection system based on laser-ranging sensors), Assist. Prof. **J. Kolański** (supervisor).
- [BSc24] Krzysztof Hibowski: *“Tuner gitarowy dla systemu Android”* (Guitar tuner for Android), Assist. Prof. **T. Rubel** (supervisor).
- [BSc25] Aleksandra Iskrzyńska: *“Optymalizacja rozmieszczenia włókien w poszczególnych warstwach metodą druku 3D”* (Optimization of fibres spacing of particular layers in 3D printing), Assoc. Prof. **W. Świąszkowski** (supervisor).
- [BSc26] Paweł Janicki: *“Aplikacja webowa do automatyzacji analizy relacyjnej bazy danych”* (Web application for automating the analysis of a relational database), Senior Lecturer **K. Ignasiak** (supervisor).
- [BSc27] Adam Jędrzejowski: *“Wieloplatformowa przeglądarka obrazów DICOM w C++”* (Multi-platform DICOM image viewer in C++), Prof. **W. Smolik** (supervisor).
- [BSc28] Anna Kędziora: *“Analiza danych obrazowych z badań MRI wykorzystujących znakowanie spinów krwi tętniczej (ASL)”* (Analysis of MRI images obtained by arterial spin labeling method (ASL)), Assist. Prof. **E. Piątkowska-Janko** (supervisor).
- [BSc29] Joanna Kiesiak: *“Regeneracja struktur ISFET po pomiarach”* (The regeneration of the structure ISFET after measurements with biological fluids), Assist. Prof. **P. Firek** (supervisor).
- [BSc30] Karolina Marta Kondzielnik: *“Projekt mobilnego asystenta muzycznego w systemie Android”* (Mobile music assistant in Android system), Prof. **P. Biłski** (supervisor).
- [BSc31] Paweł Kosowski: *“Realizacja systemu do przetwarzania obrazów w chmurze”* (Implementation of image processing system in the cloud), Prof. **A. Przelaskowski** (supervisor), Warsaw University of Technology Distant Learning Center (Ośrodek Kształcenia na Odległość PW).
- [BSc32] Krzysztof Kowalak: *“Wykorzystanie hurtowni danych do wsparcia procesów biznesowych przedsiębiorstwa”* (The benefits of using data warehouse to support business analysis and strategic decision-making in sales company), Prof. **P. Biłski** (supervisor).
- [BSc33] Wojciech Łukasz Kowalczyk: *“Aplikacja do śledzenia trasy dla systemu Android”* (Route tracking application for mobile devices with Android operating system), Assist. Prof. **G. Galiński** (supervisor).
- [BSc34] Bartosz Kowalski: *“Interfejs programistyczny aplikacji wspomagający proces gromadzenia wyników badań bazujących na medycynie opartej na faktach”* (Application programming interface for evidence based medicine research), Assist. Prof. **A. Rychter** (supervisor).
- [BSc35] Olga Krawczyk: *“Detekcja ścian i naroży metodami akustycznymi”* (Detection of walls and corners by acoustic methods), Assist. Prof. **M. Rupniewski** (supervisor).
- [BSc36] Dorota Anna Kubryń: *“Urządzenie do pomiaru temperatury oddechu”* (Device for measuring breath temperature), Assist. Prof. **G. Domański** (supervisor).
- [BSc37] Michał Macioła: *“Izolowana przetwornica napięcia stałego o szerokim zakresie napięć wejściowych”* (Wide input voltage range isolated DC/DC converter), Assist. Prof. **M. Mikołajewski** (supervisor).
- [BSc38] Radosław Bohdan Maksymiuk: *“Metody wykrywania zajętości widma dla potrzeb radia kognitywnego”* (Spectrum sensing methods for cognitive radio), Assist. Prof. **T. Kosiło** (supervisor).
- [BSc39] Piotr Malicki: *“Realizacja systemu wspomagającego zarządzanie oraz katalogowanie obiektów przy użyciu kodów QR”* (Implementation of a system for management and cataloging objects using QR codes), Senior Lecturer **K. Ignasiak** (supervisor).
- [BSc40] Katarzyna Marczuk: *“Oprogramowanie do analizy obrazów rentgenowskich na potrzeby stanowiska laboratoryjnego”* (X-ray image analysis software for laboratory use at laboratory standup), Assist. Prof. **A. Rychter** (supervisor).
- [BSc41] Marta Matraszek: *“Układ elektroniczny do pomiaru impedancji elektrycznej wybranych segmentów tkankowych”* (Electronic circuit for measuring the electrical impedance of selected tissue segments), Prof. **T. Pałko** (supervisor).
- [BSc42] Damian Matusik: *“Projekt system identyfikacji warstw geotechnicznych gruntu na potrzeby konstrukcji budowlanych”* (Project of soil layers identification system for the needs of building constructions), Prof. **P. Biłski** (supervisor).
- [BSc43] Anna Matyjanka: *“Akustyczne rozpoznawanie przeszkód w kształcie prętów”* (Acoustic recognition of obstacles in the shape

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- of rods), Assist. Prof. **M. Rupniewski** (supervisor).
- [BSc44] Jakub Mazurek: *“Oprogramowanie wbudowane elektrycznego tomografu pojemnościowego”* (Embedded software for electrical capacitance tomograph), Assist. Prof. **J. Kryszyn** (supervisor).
- [BSc45] Piotr Mróz: *“Tworzenie narzędzi informatycznych w leczeniu wrzodziejącego zapalenia jelita grubego”* (Creating software in the treatment of ulcerative colitis), Prof. **J. Mulawka** (supervisor).
- [BSc46] Katarzyna Muter: *„Holter EKG”* (ECG Holter), Prof. **T. Starecki** (supervisor).
- [BSc47] Magdalena Paczos (Rzepecka): *„Implementacja algorytmów roju i mrówkowego do rozwiązania symetrycznego i niesymetrycznego problemu komiwojażera”* (Particle swarm optimization and ant colony optimization to solve symmetric and asymmetric travelling salesman problem), Prof. **P. Biłski** (supervisor).
- [BSc48] Maciej Palmowski: *„Projekt i realizacja aplikacji mobilnej kalibratora mikrofonu”* (Design and implementation of mobile application of the microphone calibrator), Senior Lecturer **P. Bobiński** (supervisor).
- [BSc49] Miłosz Parszewski: *“Detekcja krawędzi na obrazach medycznych z wykorzystaniem algorytmu Canny’ego”* (Edge detection on medical images using the Canny algorithm), Assoc. Prof. **K. Snopek** (supervisor).
- [BSc50] Kinga Pękacka: *“Program do klasyfikacji sygnałów bioelektrycznych”* (Program for classification of bioelectric signal waveforms), Assist. Prof. **G. Domański** (supervisor).
- [BSc51] Jagoda Piechocka: *“Implementacja modelu transmisji sygnału wizyjnego z użyciem różnych wzorców szeregowania pikseli”* (Implementation of the vision signal transmission model using different pixel scan patterns), Prof. **G. Pastuszak** (supervisor).
- [BSc52] Karol Płatkowski: *“Opracowanie monitora sygnałów zgodnych ze standardem LoRa”* (Signal monitor compliant with the LoRa standard), Assist. Prof. **J. Kolański** (supervisor).
- [BSc53] Danyil Potoka: *„Stanowisko do analizy ruchliwości i geometrii mas części ciała człowieka”* (Workplace for analysis of mobility and mass geometry of human body parts), Assoc. Prof. **E. Ładyżyńska-Kozdraś** (supervisor).
- [BSc54] Joanna Radzimirska: *„Urządzenie do bezpośredniej stymulacji nerwowej kompatybilne ze środowiskiem tomografii jądrowej rezonansu magnetycznego”* (Device for direct neurostimulation compatible with the environment of the nuclear magnetic resonance tomography), Assist. **W. Obrebski** (supervisor).
- [BSc55] Magdalena Rusiecka: *“Odkrywanie wiedzy dla celów profilaktyki otyłości wśród dzieci”* (Data mining for preventing obesity in children), Prof. **J. Mulawka** (supervisor).
- [BSc56] Magdalena Segieda: *“System monitorujący zaburzenia równowagi u pacjenta, oparty na mikromechanicznych czujnikach przyspieszenia i przemieszczania kątownego - warstwa sprzętowa”* (Balance disorder monitoring system based on micromechanical acceleration sensors and angular rate sensors - hardware), Assist. Prof. **J. Jasiński** (supervisor).
- [BSc57] Michał Siwoszek: *„Program symulacyjny do modelowania spektrometrycznego przetwornika A/C”* (Simulation program for spectrometric modeling of the A/D converter), Assist. Prof. **B. Konarzewski** (supervisor).
- [BSc58] Kamil Składanek: *„Projekt dzielnika mocy na pasmo subterahercowe przeznaczonego do realizacji w technologii LTCC”* (Power divider project for the subterahertz band intended for implementation in LTCC technology), Assist. Prof. **P. Bajurko** (supervisor).
- [BSc59] Barbara Słojewska: *„Opracowanie sześciowrotnika na pasmo 24 GHz w technologii LTCC”* (Design of six-port device for 24 GHz in LTCC technology), Prof. **Y. Yashchysyn** (supervisor).
- [BSc60] Alicja Sowińska: *„Symulacja wybranych efektów akustycznych w środowisku Matlab”* (Simulation of chosen acoustic effects in Matlab environment), Assoc. Prof. **K. Snopek** (supervisor).
- [BSc61] Aleksandra Stempień: *„Filtry log-Gabora w przetwarzaniu obrazów medycznych”* (Log-Gabor filters in medical image processing), Assoc. Prof. **K. Snopek** (supervisor).
- [BSc62] Alina Stoska: *„System informatyczny dla pacjentów przychodni zgodny z WCAG 2.0”* (IT system for clinic patients compliant with WCAG 2.0), Assist. Prof. **J. Kryszyn** (supervisor).
- [BSc63] Jakub Sławomir Suchorab: *„Fuzz testing of programmable logic controllers used in nuclear applications”* (Fuzz testing programmable logic controllers used in nuclear applications), Assist. **R. Kurjata** (supervisor).
- [BSc64] Michał Trendak: *„Aplikacja mobilna do analizy danych geotechnicznych”* (Mobile application for geotechnical data analysis), Prof. **P. Biłski** (supervisor).
- [BSc65] Aleksandra Trociuk: *„Detekcja samochodowych tablic rejestracyjnych w sekwencji wideo”* (Number plates detection in the sequence of the video), Assist. Prof. **G. Galiński** (supervisor).

- [BSc66] Olga Walenciuk: "*Metoda rekonstrukcji obrazów z rzadkich pomiarów tomograficznych*" (Method for image reconstruction from sparse tomographic measurements), Prof. **A. Przelaskowski** (supervisor), B.Sc. degree with honours.
- [BSc67] Julia Wójcicka: "*Analiza statystyczna danych z badań neuroobrazowych*" (Statistical analysis of neuroimaging data), Assist. Prof. **E. Piątkowska-Janko** (supervisor).
- [BSc68] Aleksandra Zwierzchowska: "*Program do analizy rozkładu prądu w klatce piersiowej*" (Computer program to analyze current flow in the chest), Assist. Prof. **G. Domański** (supervisor), B.Sc. degree with honours.
- [BSc69] Michał Żbikowski: "*XNAT Commander - aplikacja do zarządzania plikami w platformie XNAT*" (XNAT Commander - application for files management on XNAT platform), Prof. **P. Bogorodzki** (supervisor).

5.6. B.Sc. Evening Studies on Radiocommunications – B.Sc. Degrees

- [BSc70] Robert Jurkowski: "*Aplikacja webowa do analizy relacyjnej bazy danych pod kątem optymalizacji wydajności MS SQL serwera*" (A web application to analyze a relational database for optimizing the MS SQL server performance), Senior Lecturer **K. Ignasiak** (supervisor).
- [BSc71] Piotr Kaczmarek: "*Radiowe łącze telemetryczne pracujące w paśmie 868 MHz*" (Radio telemetry link operating in the 868 MHz band), Senior Lecturer **H. Chaciński** (supervisor).
- [BSc72] Piotr Kuligowski: "*Przetwornica podwyższająca PWM*" (A PWM boost converter), Assist. Prof. **M. Mikołajewski** (supervisor).
- [BSc73] Piotr Mikołajczyk: "*Wzmacniacze mocy na częstotliwości 1,03 GHz – 1,09 GHz do radaru SSR*" (1,03 GHz-1,09 GHz power amplifiers for SSR radar), Assist. Prof. **D. Gryglewski** (supervisor).
- [BSc74] Krzysztof Macewicz: "*Cykliczna gęstość widmowa sygnałów zmodulowanych cyfrowo w obecności szumu*" (Cyclic spectral density of digital modulated signal in presence of a noise), Assoc. Prof. **K. Sнопек** (supervisor).

6. PUBLICATIONS

6.1. Scientific and technical books, chapters in books

- [Pub1] G. Pastuszak: „High-Throughput Architectures for High-Resolution Video Coding: System Architecture Analysis”, in: *VLSI Architectures for Future Video Coding*, M. Martina (ed.), IET Digital Library, e-book, book doi: 10.1049/PBCS053E, ISBN: 9781785617102, chapter 3, chapter doi: 10.1049/PBCS053E_ch3, pp. 79-110.
- [Pub2] G. Pastuszak: “High-Throughput Architectures for High-Resolution Video Coding: Hardwired Oriented Algorithms and VLSI Architectures”, in: *VLSI Architectures for Future Video Coding*, M. Martina (ed.), IET Digital Library, e-book, book doi: 10.1049/PBCS053E, ISBN: 97817856-17102, chapter 4, chapter doi: 10.10-49/PBCS053E_ch4, pp. 111-148.

6.2. Scientific and technical papers in journals

6.2.1. Part A

This subsection contains the list of papers published in the journals indicated on the list of the Ministry of Science and Higher Education including those listed in the Thomson-Reuters Journal Citation Reports. Papers authored by more than 10 persons from outside of the Faculty of Electronics and Information Technologies, WUT, have been specified in a simplified way, *viz.*: only the first author and all the authors from the Faculty have been listed and the number of other authors has been provided in brackets.

**Paper indicated on this subsection as [Pub24] has not been published in the Annual Report 2018.

- [Pub3] K. Abe (...), R. Kurjata, A. Rychter, K. Zaremba, M. Ziembicki (317 external authors): „Search for Light Sterile Neutrinos with the T2K Far Detector Super-Kamiokande at a Baseline of 295 km”, *Physical Review D*, 2019, vol. 99, pp. 071-103-1-071103-10.
- [Pub4] K. Abe (...), R. Kurjata, A. Rychter, M. Ziembicki, K. Zaremba (325 external authors): „Search for Neural-Current Induced Single Photon Production at the ND280 Near Detector in T2K”, *Journal of Physics G: Nuclear and Particle Physics*, 2019, vol. 46, no. 08LT01, 16 pp, published online.
- [Pub5] K. Abe (...), R. Kurjata, A. Rychter, K. Zaremba, M. Ziembicki (328 external authors): „Search for Heavy Neutrinos with the T2K Near Detector ND280”, *Physical Review D*, 2019, vol. 100, issue 5, pp. 05-2006-1-052006-10.
- [Pub6] K. Abe (...), R. Kurjata, A. Rychter, K. Zaremba, M. Ziembicki (323 external authors): „Measurement of the Muon Neutrino Charged-Current Cross Sections Water, Hydrocarbon and Iron, and their Ratios, with the T2K on-Axis Detectors”, *Progress*

of Theoretical and Experimental Physics, 2019, vol. 2019, issue 9, doi: 10.1093/ptep/ptz070, 30 pp.

- [Pub7] K. Abe (...), R. Kurjata, A. Rychter, M. Ziembicki, K. Zaremba (333 external authors): „Measurement of Neutrino and Antineutrino Neutral-current Quasielasticlike Interactions on Oxygen by Detecting Nuclear Deexcitation γ Rays”, *Physical Review D*, 2019, vol. 100, issue 11, pp. 112009-1-112009-18.
- [Pub8] R. Akhunzyanow (...), M. Dziewiecki, R. Kurjata, J. Marzec, A. Rychter, K. Zaremba, M. Ziembicki (225 external authors): „Transverse Extension of Partons in the Proton Probed in the Sea-Quark Range by Measuring the DVCS Cross Section”, *Physics Letters B*, 2019, vol. 793, pp. 188-194.
- [Pub9] M. G. Alexeev (...), M. Dziewiecki, R. Kurjata, J. Marzec, A. Rychter, K. Zaremba, M. Ziembicki (211 external authors): „Measurement of P_T -weighted Sivers Asymmetries in Leptoproduction of Hadrons”, *Nuclear Physics B*, 2019, vol. 940, doi: 10.1016/j.nuclphysb.2018.-12.024, pp. 34-53.
- [Pub10] A. Balcerak, A. Trębińska-Stryjewska, M. Wakuła, M. Chmielarczyk, U. Śmietanka, T. Rubel, R. Konopiński, E. Macech-Klicka, R. Zub, E. A. Grzybowska, J. Chernoff (monitoring editor): “HAX1 Impact on Collective Cell Migration, Cell Adhesion and Cell Shape is Linked the Regulation of Actomyosin Contractility”, *Molecular Biology of the Cell*, 2019, doi: 10.1091/mbc.E19-05-0304, pp. 3024-3060, published online.
- [Pub11] G. Bogdan, K. Godziszewski, Y. Yashchyshyn, Ch. Ho Kim, S. Bong Hyun: „Time Modulated Antenna Array for Real-Time Adaptation in Wideband Wireless Systems – Part I: Design and Characterization”, *IEEE Transactions on Antennas Propagation*, 2019, doi: 10.1109/TAP.2019.290-2755, 9 pp., published online.
- [Pub12] I. Chirikov-Zorin, N. Anfimov, M. Dziewiecki, V. Frolov, Z. Krumshteyn, R. Kurjata, A. Olchevski, T. Rezinko, A. Rybnikov, A. Selyunin, V. Tchalshev, M. Ziembicki: “Performance of the COMPASS II Shashlyk Calorimeter ECAL0 Read out by SiPMs”, *Nuclear Instruments and Methods in Physics Research A*, 2019, vol. 936, 2019, pp. 141-143.
- [Pub13] V. Djaja-Joško, J. Kotakowski, J. Modelski: „TDOA Estimation Using a Pair of Synchronized Anchor Nodes”, *International Journal of Microwave and Wireless Technologies*, 2019, 6 pp., published online.
- [Pub14] M. Góralczyk, W. Wojtasiak: „ISM 2.45 GHz Band High-Efficient 15 W GaN HEMT Power Amplifier: Design Validation”, *International Journal of Microwave and Wireless*

- Technologies*, 2019, vol. 11, no. 7, pp. 546-553.
- [Pub15] K. Jędrzejewski, D. Rosołowski, W. Wojtasiak: „Impact Evaluation of DC Operating Condition on DPD Linearizability and Power Efficiency in GaN-based Power Amplifiers”, *Inter Journal of Micro. and Wireless Technologies*, 2019, vol. 11, pp. 554-567.
- [Pub16] S. Kozłowski, K. Kurek, J. Skarzyński, K. Szczygielska, M. Darmetko: „Verifying a Concept of Adaptive Communication with LEO Satellites Using SDR-based Simulations”, *International Journal of Microwave and Wireless Technology*, 2019, vol. 11, special issue 7, pp. 602-608.
- [Pub17] T. Karpisz, B. Salski, P. Kopyt, J. Krupka: “Measurement of Dielectrics from 20 to 50 GHz with a Fabry-Pérot Open Resonator”, *IEEE Transactions on Microwave Theory and Techniques*, 2019, vol. 67, no. 5, doi: 10.1109/TMTT.2019.2905549, pp. 1901-1908.
- [Pub18] N. Koliass, J. Modelski: “IMS 2019 Opening and Closing Sessions”, *IEEE Microwave Magazine*, 2019, vol. 20, issue 4, doi: 10.1109/MMM.2019.2891799, pp. 24-25.
- [Pub19] M. Kołakowski: “Improving Accuracy and Reliability of Bluetooth Low-Energy-Based Localization Systems Using Proximity Sensors”, *Applied Sciences*, 2019, vol. 9, no. 19, doi: 10.3390/app9194081, pp. 1-23.
- [Pub20] P. Kopyt, B. Salski, A. Pacewicz, P. Zagrajek, J. Marczewski: „Measurements of the Responsivity of FET-Based Detectors of Sub-THz Radiation”, *Opto-Electronics Review*, 2019, vol. 27, no. 2, pp. 123-129.
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- [Pub101] A. Pietrzak: „Ekspozycja na dźwięki muzyczne – asymetryczne narażenie prawego i lewego ucha” (Exposure to Musical Sounds - Asymmetrical Exposure of the Right and Left Ear), *Mat. XVI Konferencji Akustyka w Audiologii i Foniatrii*

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- [Pub108] J. Sobolewski, P. Bajurko: "A 120 GHz Antenna for LTCC Package with Via-Less Contact Pads for Probe Measurements", *Proc. 13th European Conference on Antennas and Propagation: EuCAP* (Kraków, Poland, Mar. 31-Apr. 5, 2019), 5 pp.*)
- [Pub109] K. Szczypkowski (supervisor: P. Bajurko): "Bezprzewodowa metoda wyznaczania zysku anteny na podstawie jednowrotowego pomiaru fal rozproszonych na antenie" (The Wireless Method of Determining the Antenna's Gain Based on a One-Port Measurement of Scattered Waves), *Mat. 20 Seminarium – Radiokomunikacja i Techniki Multimedialne* (Proc. 20th Seminar- Radiocommunications and Multimedia Technologies) (Warsaw, Poland, Dec. 11, 2019).
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- [Pub113] Y. Yashchyshyn, K. Godziszewski: "New Opportunities in Quasi-Optical Materials Characterization in Far Infrared Region", *Proc. 21st International Conference on Transparent Optical Networks: ICTON 2019* (Angers, France, Jul. 9-13, 2019), 4 pp, published online.
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6.4. Abstracts and Posters

- [Pub115] N. Andrushchak, Y. Yashchyshyn, K. Godziszewski, O. Syrotynsky, A. Andrushchak, "Simplified Free-Space Method for Dielectric Permittivity Measurements of Low-Loss Crystalline Materials in 220-330 GHz Frequency Range", *1st Inter.I Conf. on Innovative Materials and NanoEngineering*: (Brenna, Poland, Aug. 27-29, 2019), 1 p.
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7. RESEARCH REPORTS

- [Rep1] K. Abe (...), M. Dziewiecki, R. P. Kurjata, J. Marzec, A. Rychter, K. Zaremba, M. Ziembicki (379 external authors): „*T2K ND 280 Upgrade- Technical Design Report*”, Final report for CERN, no. CERN-SPSC-2019-001, Genève, Switzerland, Jan. 2019.
- [Rep2] K. Abe (...), P. Kurjata, J. Marzec, A. Rychter, K. Zaremba, M. Ziembicki (354 external authors): „*J-PARC Neutrino Beamline Upgrade Technical Design Report*”, Final report for CERN, no. 1908.05141, Genève, Switzerland, Aug. 2019.
- [Rep3] P. Bajurko: „*Pomiar charakterystyk układów scalonych generatora VCO na pasmo 25 GHz oraz generatora na pasmo 96 GHz*” (Measurement Examination of Integrated Circuits of VCO Generator for 24 GHz and Generator for 96 GHz), Final report for SIRC sp.z.o.o., Warsaw, Jun. 2019.
- [Rep4] P. Bajurko: „*Pomiar charakterystyk układów scalonych odbiornika na pasmo 94 GHz*” (Measurement Examination of Integrated Receiver Circuit for 94 GHz), Final report for SIRC sp.z.o.o., Warsaw, Aug. 2019.
- [Rep5] G. Bogdan: „*Badania możliwości zastosowania anteny z modulacją czasową w czujnikach sieci bezprzewodowej LoRa dla Internetu Rzeczy*” (Research on a Time-Modulated Antenna Array (TMAA) for Internet of Things (IoT) Wireless Networks), Final report for the Dean grant, Warsaw, Dec. 2019.
- [Rep6] P. Bogorodzki, E. Piątkowska-Janko, B. Kossowski, J. Orzeł, M. Wieteska: „*Samonaprowadzające na receptory integrynowe „termicznie-aktywne” wielofunkcyjne nanocząsteczki magnetyczne enkapsulowane w kilku warstwach grafenu w molekularnym obrazowaniu MR przeciwnowotworowej terapii opartej na personalizowanej nanomedycynie czasu rzeczywistego*” (Self-Navigated Integrin Receptors Seeking „Thermally-Smart” Multifunctional Few-Layer Graphene-Encapsulated Magnetic Nanoparticles for Molecular MRI-Guided Anticancer Treatments in „Real Time” Personalized Nanomedicine), Final report for the National Centre for Research and Development, Warsaw, Nov. 2019.
- [Rep7] P. Bogorodzki, E. Piątkowska-Janko, B. Kossowski: „*Badania obrazowe mózgu małych zwierząt z wykorzystaniem techniki MRI*” (Imaging Studies of Small Animals Brain Using MRI Techniques), Final report for Neurovet Małgorzata Mikula, Warsaw, Sept. 2019.
- [Rep8] Ł. Gawliczek (...), T. Kosiło (11 external authors): „*Transport, logistyka i pojazdy autonomiczne*” (Transport, Logistics, and Autonomous Vehicles), Final report for the Ministry of Digital Affairs by the Working Group on IoT at the Polish Economy, Warsaw, Apr. 2019.
- [Rep9] S. L. Hahn: „On the Virtual Energy Aureole of Spherical Bodies”, Internal report no. 1, Institute of Radioelectronics and Multimedia Technology, Warsaw, May 2019.
- [Rep10] K. Ignasiak, W. Skarbek, G. Pastuszak, A. Buchowicz, G. Galiński, J. Naruniec: „*Inteligentne, rozproszone, sieciowe systemy wideo*” (Intelligent, Scattering, Network Video Systems), Final report for the statutory grant, Warsaw, Sept. 2019.
- [Rep11] J. Kołakowski, J. Cichocki, V. Djaja-Joško, M. Kołakowski: „*Techniki bezprzewodowej synchronizacji węzłów w ultraszerokopasmowych systemach lokalizacyjnych*” (Anchor Nodes Synchronization Techniques in UWB Localization Systems), Final report for the statutory grant, Warsaw, Sept. 2019.
- [Rep12] J. Krupka, P. Kopyt, D. Gryglewski, M. Piasecki, W. Wojtasiak: „*Dokładne metody charakteryzacji materiałów dla mikroelektroniki w paśmie fal milimetrowych i subterahercowych*” (Precision Technique of Millimeter and sub-THz Band Characterization of Materials for Microelectronics), Final report for Foundation for the Polish Science (TEAM-TECH, EU Framework Programme “Intelligent Development 2014-020”), Warsaw, Oct. 2019.
- [Rep13] J. Kryszyn: „*Badanie prędkości przepływu mieszaniny dwufazowej elektrycznym tomografem pojemnościowym EVT4*” (Investigation of Two-Phase Flow Speed Using the EVT4 Electric Capacitance Tomograph), Final report for the Dean grant, Warsaw, Dec. 2019.
- [Rep14] K. Kurek, A. Dobrogowski, N. Książek, H. Naimirski, M. Trębiński, K. Wasilewski: „*Opracowanie systemu łączności z balonami stratosferycznymi z wykorzystaniem techniki radia programowalnego SDR*” (Development of a Communication System with Stratospheric Balloons using SDR Programmable Radio Technology), Final report for the Rector grant, Warsaw, Dec. 2019.
- [Rep15] K. Kurek, J. Modelski, S. Kozłowski: „*Zastosowanie technik radia programowalnego SDR do realizacji modelu laboratoryjnego nadajnika danych telemetrycznych mikro-satelity*” (Application of SDR Techniques in the Laboratory Model of Telemetry Data Transmitter for a Micro Satellite), Final report for the statutory grant, Warsaw, Sept. 2019.
- [Rep16] M. Lewandowski: „*Stanowisko laboratoryjne przeznaczone do badania zjawisk nieliniowych i procesów niestacjonarnych w cyfrowych systemach przetwarzania i odtwarzania sygnałów fonicznych*” (Laboratory System for Investigation Non-Linear Audio Signal Processing Systems), Final report for the Dean grant, Warsaw, Mar. 2019.

- [Rep17] J. Marzec, K. Zaremba, P. Bogorodzki, P. Brzeski, G. Domański, M. Dziewiecki, T. Jamrógiewicz, B. Konarzewski, R. Kurjata, J. Kryszyn, W. Obrębski, T. Olszewski, E. Piątkowska-Janko, D. Radomski, W. Smolik, M. Ziembicki, W. Gradkowski, B. Kossowski, A. Rychter, M. Stosio, D. Wanta, K. Werys, M. Wieteska, P. Wróblewski, P. Tor: „*Nowoczesne techniki elektroniki jądrowej i medycznej*” (Modern Techniques in Nuclear and Medical Electronics), Final report for the statutory grant, Warsaw, Sept. 2019.
- [Rep18] P. Mazurek: „*Wykorzystanie impulsowych czujników radarowych ultramalej mocy do estymacji trójwymiarowej trajektorii ruchu osoby*” (Applicability of Impulse-Radar Sensors for Estimation of Person’s Three-Dimensional Movement Trajectory), Final report for the Dean grant, Warsaw, Dec. 2019.
- [Rep19] M. Mikołajewski, H. Chaciński, W. Kazubski: „*Doskonalenie rozwiązań w zakresie wysokosprawnego przetwarzania energii i komputerowo wspomaganego odbioru radiowego*” (Optimization of High-Efficiency Power Converters and Software Defined Receivers), Final report for the statutory grant, Warsaw, Sept. 2019.
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- [Rep21] D. Rosołowski: „*Pomiar parametrów radiowych modułu OPS, pomiar dopasowania i charakterystyki promieniowania anteny metodą poligonową*” (Measurement of the OPS Module Radio Parameters, and Antenna Radiation Matching Characteristics using the Traverse Method), Final report for EBS sp.z.o.o, Warsaw, Jun. 2019.
- [Rep22] A. Rychter, R. Kurjata, W. Obrębski, M. Ziembicki, G. Domański, M. Wieteska: „*Wykonanie prac badawczych i rozwojowych związanych z systemem mobilnych płatności zbliżeniowych opartych o technologię Bluetooth przeznaczonych dla akceptantów, agentów rozliczeniowych oraz konsumentów dysponujących dowolnym urządzeniem mobilnym*” (Research and Development of the Mobile Contactless Payments System Based on Bluetooth Technology for Merchants, Billing Agents and Consumers Equipped with Mobile Device), Final report for Braintri sp.z.o.o., Warsaw, May 2019.
- [Rep23] K. Snopek, T. Kosiło: „*Badania w dziedzinie najnowszych metod analizy i przetwarzania sygnałów wielowymiarowych oraz mobilnych systemów transmisji danych*” (Research on Multidimensional Signal Transformations and Mobile Data Transmission Systems), Final report for the statutory grant, Warsaw, Sept. 2019.
- [Rep24] K. M. Snopek, O. Błażejewska: „*Empirical Envelope Detection of Respiratory Sounds based on One-Sided Spectrum Decompositum*”, Internal report for the Institute of Radioelectronics and Multimedia Technology, no. 2, Warsaw, Oct. 2019.
- [Rep25] K. M. Snopek: „*Algebry kwaternionów i oktonionów w analizie i przetwarzaniu obrazów kolorowych – syntetyczny przegląd zastosowań*” (Quaternion and Octonion Algebras in the Analysis and Processing of Color Images - a Synthetic Overview of Applications), Internal report for the Institute of Radioelectronics and Multimedia Technology, no. 3, Warsaw, Oct. 2019.
- [Rep26] M. Wieteska: „*Ekspertryza dotycząca oferty przetargowej firmy Siemens Healthineers*” (Expertise on Siemens Healthineers Tender Offer), Final report for GE Medical Sytems sp.z.o.o., Warsaw, Apr. 2019.
- [Rep27] W. Winiecki, P. Bilski, R. Łukaszewski, K. Mroczek, A. Wójcik, K. Dowalla: „*Rozwój algorytmów do systemów monitoringu i diagnostyki urządzeń elektrycznych i systemów analogowych*” (Advancement of the Algorithms for the Monitoring and Diagnostics of Electrical Appliances and Analog Systems), Final report for the statutory grant, Warsaw, Sept. 2019.
- [Rep28] W. Wojtasiak, D. Gryglewski, P. Korpas, D. Rosołowski: „*Udostępnienie aparatury badawczej do przeprowadzenia badań rozwojowych*” (Use of the Equipment with the Testing Instrumentation), Final report for IT Partners Telco, Warsaw, Nov. 2019.
- [Rep29] W. Wojtasiak, S. Rośliniec, B. Salski, P. Kopyt, D. Gryglewski, P. Korpas, P. Miazga, D. Rosołowski, M. Sypniewski, M. Krysicki, M. Góralczyk, D. Kuchta, T. Karpisz, M. Lubiejewski: „*Projektowanie układów i metody pomiarowe na pasm mikrofalowe, fal milimetrowych i sub-terahercowych, wspomagane symulacjami z zakresu analizy polowej i obwodowej oraz cyfrową korekcją charakterystyk*” (Microwave, mm-wave, Sub-terahertz and Optoelectronic Devices Design and Measurements Aided Electromagnetic and Circuit Modelling and Digital Correction Techniques of Characteristics), Final report for the statutory grant, Warsaw, Sept. 2019.
- [Rep30] Y. Yashchyshyn, P. Bajurko, S. Kozłowski, G. Bogdan, K. Godziszewski: „*Aktywny sub-THz skaner 3D do zastosowań antyterrorystycznych*” (Sub-THz Active 3D Scanner for Counterterrorism Purposes), Final report for the National Centre for Research and Development, Warsaw, Feb. 2019.
- [Rep31] Y. Yashchyshyn, P. Bajurko, K. Derzakowski, K. Godziszewski, G. Bogdan, D. Nyzovets, P. Piasecki, J. Sobolewski: „*Badania możliwości połączenia SDR oraz AMC w celu stworzenia adaptacyjnego systemu łączności bezprzewodowej*” (Study of

Adaptive Wireless Communication System Based on Software Defined Radio and Time-Modulated Antenna Array), Final report for the statutory grant, Warsaw, Sept. 2019.

[Rep32] K. Zaremba, J. Marzec, R. Kurjata, M. Ziembicki, A. Rychter, A. Klekotko: „*Modernizacja zespołu detektorów CEDAR w eksperymencie COMPASS*” (Upgrade of the CEDAR Detectors for COMPASS Experiment at CERN), Final report for the National Science Centre, Warsaw, Jan. 2019.

[Rep33] J. Żera, P. Bilski, G. Makarewicz, A. Pietrzak, M. Lewandowski, P. Bobiński: „*Nowe metody badania i przetwarzania dźwięku*” (New Methods for Testing Sound Processing Quality), Final report for the statutory grant, Warsaw, Sept. 2019.

8. PATENTS AND PATENT APPLICATIONS

- [Pat1] M. Góralczyk: *“Dzielnik mikrofalowy trójdrożny”* (Three-way microwave divider), application no. P-432350, Dec. 31, 2019.
- [Pat2] R. Kowalik, **W. Winięcki**, K. Dowalla, R. Łukaszewski, A. Wójcik, P. Bilski, Ł. Nogał: *„Urządzenie do identyfikacji odbiorników w sieci zasilania oraz sposób identyfikacji odbiorników w sieci zasilania”* (Device for identification of receivers in the supply network and method for identification of receivers in the supply network), application no. P.425578, May 17, 2018, Polish patent no. PAT.232306, date of grant Feb. 06, 2019.
- [Pat3] R. Łukaszewski, A. Wójcik, **W. Winięcki**, R. Kowalik: *“Sposób identyfikacji w sieci zasilania włączanego odbiornika i urządzenie do identyfikacji w sieci zasilania włączanego odbiornika”* (Method and the device for identification the switched receiver), patent application no. P.430955, Aug. 27, 2019.
- [Pat4] **W. Winięcki**, R. Kowalik, A. Wójcik, R. Łukaszewski, K. Dowalla, P. Bilski, M. Januszewski: *„Urządzenie do detekcji zmian trybu pracy oraz identyfikacji odbiorników w sieci zasilania oraz sposób detekcji zmian trybu pracy oraz identyfikacji odbiorników w sieci zasilania”* (Device for detection of working mode changes and for identification of receivers in the supply network and method for identification of working mode changes and for identification of receivers in the supply network). application no. P.425576, May 17, 2018, Polish patent no. PAT.232305, date of grant Feb. 04, 2019.

9. SCIENTIFIC EVENTS

9.1. Scientific events co-organized by the Institute

- [Con1] *13th European Conference on Antennas and Propagation: EuCAP 2019* (Cracow, Poland, Mar. 31-Apr. 5, 2019), Y. Yashchyshyn (chair of the sessions, speaker), P. Bajurko (member of the Local Organizing Team, chair of session), G. Bogdan, K. Godziszewski, M. Kołakowski, J. Sobolewski, M. Sypniewski, T. A. Miś (speakers).

9.2. International scientific events

- [Con2] *The COMPASS DAQFEET 2019 Workshop* (München, Germany, Feb. 10-12, 2019), G. Pastuszak, M. Ziembicki (participants).
- [Con3] *EGU General Assembly 2019* (Vienna, Austria, Apr. 7-12, 2019), P. Kopyt (participant).
- [Con4] *2nd International Conference on Optics, Photonics and Lasers: OPAL 2019* (Amsterdam, the Netherlands, Apr. 24-26, 2019), A. Pacewicz, J. Cuper, M. Rytel (participants).
- [Con5] *European Microwave Conference in Central Europe* (Prague, Czech Republic, May 13-15, 2019), J. Modelski (speaker).
- [Con6] *2019 China Microwave Week International Wireless Symposium* (Guangzhou, China, May 19-22, 2019), J. Modelski (invited speaker).
- [Con7] *2019 IEEE International Instrumentation & Measurement Technology Conference: I2MTC 2019* (Auckland, New Zealand, May 20-23, 2019), P. Mazurek (speaker).
- [Con8] *Advanced Workshop on Modern FPGA Based Technology for Scientific Computing 2019* (Triest, Italy, May 21-23, 2019), G. Pastuszak (participant).
- [Con9] *VIII Międzynarodowa Konferencja Zwalczania Hałasu Noise Control* (International Conference on Noise Control) (Janów Podlaski, Poland, May 26-29, 2019), G. Makarewicz (speaker).
- [Con10] *2019 IEEE MTT-S International Conference on Numerical Electromagnetic and Multiphysics Modeling and Optimization: NEMO 2019* (Cambridge, Miami, USA, May 29-31, 2019), A. Pacewicz, J. Cuper, M. Rytel (participants).
- [Con11] *2019 IEEE MTT-S International Microwave Symposium* (Boston, USA, Jun. 2-7, 2019), J. Modelski (member of IEEE Microwave Theory and Techniques Society Board, member of the Steering Committee, plenary session chair), B. Salski, P. Kopyt, T. Karpisz, A. Pacewicz, J. Cuper, M. Rytel (speakers).
- [Con12] *International Workshop "SPD at NICA – 2019"* (Dubna, Russia, Jun. 5-7, 2019), G. Pastuszak (participant).

- [Con13] *The Summer XLIVth IEEE-SPIE Joint Symposium on Photonics, Web Engineering, Electronics for Astronomy and High Energy Physics Experiments* (Wilga, Poland, May 25 -Jun. 2, 2019), W. Skarbek, X. Chang, R. Pilarczyk, R. Protasiuk, A. Wójcik.
- [Con14] *Joint IMEKO TC1-TC7-TC13-TC18 Symposium 2019* (Sankt Petersburg, Russia, Jul. 2-5, 2019), R. Z. Morawski (member of the International Program Committee, invited lecturer "Measurement science in methodological instruction of Ph.D. students of technoscience"), P. Mazurek (member of the International Program Committee, speaker).
- [Con15] *19th International Conference on Numerical Simulation of Optoelectronic Devices* (Ottawa, Canada, Jul. 8-12, 2019), P. Kopyt, B. Salski, M. Krysicki (participants).
- [Con16] *21st International Conference on Transparent Optical Networks: ICTON 2019* (Angers, France, Jul. 9-13, 2019), Y. Yashchyshyn (invited speaker).
- [Con17] *Joint ITN CELTA & TeraApp Summer School 29th International Travelling Summer School on Microwaves and Lightwaves* (Frankfurt am Main, Germany, Jul. 13-19, 2019), Y. Yashchyshyn (invited lecturer), G. Bogdan, D. Nyzovets (participants).
- [Con18] *Contemporary Hearing Science Inspired by David M. Green*. Symposium at Knowles Hearing Center (Northwestern University, Evanston, USA, Jul. 25-26, 2019), J. Żera (invited lecture: "The Wald sequential test as a statistical criterion for the signal level change in adaptive staircase up-down procedures").
- [Con19] *The Fifteenth Advanced International Conference on Telecommunications: AICT 2019* (Nice, France, Jul. 28-Aug. 2, 2019), K. Snopek (member of the Programme Committee).
- [Con20] *1st International Conference Innovative Materials and Nanoengineering: IMNE 2019* (Brenna, Poland, Aug. 27-29, 2019), Y. Yashchyshyn, P. Bajurko, J. Sobolewski (participants).
- [Con21] *44th International Conference on Infrared, Millimeter, and Terahertz Waves: IRMMW 2019* (Paris, France, Sept. 1-5, 2019), P. Kopyt (participant).
- [Con22] *27th European Signal Processing Conference: EUSIPO 2019* (A Coruña, Spain, Sept. 2-6, 2019), G. Bogdan (speaker).
- [Con23] *International Conference on Simulation of Semiconductor Processes and Devices: SISPAD* (Sept. 4-6, 2019), M. Krysicki (speaker).
- [Con24] *23rd International Congress on Acoustics integrating 4th EAA Euroregio 2019* (Aachen, Germany, Sept. 9-13, 2019), J. Żera, A. Pietrzak, M. Jasiński (speakers).

- [Con25] *Arbeitskreis Hochschullehrer für Messtechnik Symposium* (Erlanger-Nürnberg, Germany, Sept. 12-13, 2019), R. Z. Morawski (participant).
- [Con26] *IMEKO Joint TC1-TC2 International Symposium on Photonics and Education in Measurement Science* (Jena, Germany, Sept. 17-19, 2019), P. Mazurek (member of the Technical Committee).
- [Con27] *The 23rd International Conference on Signal Processing: Algorithms, Architectures, Arrangements, and Applications: SPA 2019* (Poznań, Poland, Sept. 18-20, 2019), Z. Kulka, W. Skarbek (members of the Scientific Committee), P. Mazurek (speaker).
- [Con28] *10th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications: IDAACS 2019* (Metz, France, Sept. 18-21, 2019), P. Bilski (speaker).
- [Con29] *49th European Microwave Week 2019* (Porte de Versailles, Paris, France, Sept. 29-Oct. 4, 2019), J. Modelski (session co-chair, member of the Technical Programme Committee, member of the General Assembly European Microwave association: EuMA).
- [Con30] *46 Międzynarodowa Konferencja i Wystawa PIKE 2019* (46th International Conference and Exhibition PIKE) (Jachranka, Poland, Oct. 7-9, 2019), J. Modelski (president of the Programme Council).
- [Con31] *27th Telecommunications Forum: TELFOR 2019* (Belgrade, Serbia, Nov. 26-26, 2019), V. Djaja-Joško, M. Kołakowski (speakers).
- [Con32] *2019 Asia-Pacific Microwave Conference: Microwaves Bridging Smart Cities* (Singapore, Republic of Singapore, Dec. 10-13, 2019), B. Salski, T. Karpisz, A. Pacewicz (speakers).
- 9.3. National scientific events**
- [Con33] *6 Ogólnopolska Studencka Konferencja Akustyków: OSKA 2019* (Kielce, Poland, Mar. 7-9, 2019), M. Jasiński (speaker).
- [Con34] *The Seminar of the Division of Philosophy and Ethics in Administration* (Warsaw University of Technology, Faculty of Administration and Social Sciences May 14, 2019), "Methodological and ethical contents in the curricula of Ph.D. studies", the invited lecture given by R. Z. Morawski.
- [Con35] *Workshop Opportunities and challenges for Polish publishing houses and scientific journals*, organized by The Conference of Rectors of Academic Schools in Poland (Warsaw University of Technology, May 21, 2019), R. Z. Morawski – speaker in the discussion panel "Impact of the introduced legal regulations on the functioning of publishing houses and sustainable development of science".
- [Con36] *XVIII Krajowa Konferencja Elektroniki: KKE 2019* (XVIIIth National Conference on Electronics) (Darłowo, Poland, Jun. 2-6, 2019), D. Gryglewski, M. Mikołajewski (participants).
- [Con37] *Krajowa Konferencja Radiokomunikacji, Radiofonii i Telewizji: KKRRiT 2019* (National Conference on Radiocommunications and Broadcasting XXVth) (Wrocław, Poland, Jun. 25-27, 2019), J. Modelski (vice-chair of the Program Committee), J. Cichocki, W. Skarbek, Y. Yashchyshyn (members of the Program Committee), P. Bajurko, G. Bogdan, V. Djaja-Joško, K. Godziszewski, J. Kołakowski, T. Kosiło, K. Kurek, W. Kazubski, P. Korpas, K. Radecki, B. Salski, M. Kołakowski, P. Pia-secki, J. Sobolewski (speakers).
- [Con38] *XXXV Krajowe Sympozjum Telekomunikacji i Teleinformatyki: KSTiT 2019* (National Symposium on Telecommunications and Teleinformatics) (Wrocław, Poland, Jun. 26-28, 2019), J. Modelski, W. Skarbek (members of the Programme Committee).
- [Con39] *66 Otwarte Seminarium z Akustyki: OSA 2019* (66th Open Seminar on Acoustics) (Boszkowo, Poland, Sept. 17-20, 2019), J. Żera, M. Lewandowski, A. Pietrzak, (speakers).
- [Con40] *XXI Polska Konferencja Biocybernetyki i Inżynierii Biomedycznej: PCBBE* (Polish Conference on Biocybernetics and Biomedical Engineering) (Zielona Góra, Poland, Sept. 25-27, 2019), P. Bogorodzki, W. Smolik, G. Domański, J. Kryszyn, D. Wanta, P. Wróblewski (participants).
- [Con41] *1st InterBioMed Young Scientists Forum* (Warsaw, Poland, Oct. 14-15, 2019), J. Kryszyn, D. Wanta, P. Wróblewski (participants).
- [Con42] *Conference: Transformation of Polish Higher Education in 1989–2019*, organized by The Conference of Rectors of Academic Schools in Poland (Warsaw University of Technology, October 28–29, 2019), "Evolution of the model of scientific career and ethical dilemmas of scademic milieu" – the invited lecture given by R. Z. Morawski.
- [Con43] *XI Konferencja Naukowo-Techniczna "Otwarty Rynek Kolejowy w Polsce". Krajowy program kolejowy – nadzory inwestorskie.* (XIst Scientific-Technical Conference „Open Railway Market in Poland) (Warsaw, Poland, Nov. 5, 2019, J. Modelski (member of the Programme Board), T. Kosiło, J. Modelski: "System mobilny 5G" (5G Mobile System, oral presentation).
- [Con44] *Open Scientific Seminar Man–Business–Technologies*, Faculty of Management and Production Engineering, Lodz University of Technology (Lodz, Dec. 9, 2019), "Methodological and ethical aspects of technoscientific research" - the invited lecture given by R. Z. Morawski.

- [Con45] *20 Seminarium – Radiokomunikacja i Techniki Multimedialne* (20 Seminar: Radiocommunications and Multimedia Technologies) (Warsaw, Poland, Dec. 11, 2019), Y. Yashchyshyn – chair of the session, J. Cuper, V. Djaja-Joško, J. Gawlik, T. Karpisz, R. Kołakowski, N. Lubojemska, N. Osiadała, A. Pietrzak, K. Szczyrkowski (speakers)

10. AWARDS AND DISTINCTIONS

State Medals

Srebrny Krzyż Zasługi (Silver Cross of Merit).

Piotr Bogorodzki, D.Sc., WUT Prof.

Medal Złoty za Długoletnią Służbę (Golden Medal for Long-lasting Service).

**Mirosław Mikołajewski, Ph.D.,
Ewa Piątkowska-Janko, Ph.D.,
Tomasz Krzymień, M.Sc.**

Medal Komisji Edukacji Narodowej (Medal of the National Education Committee).

Wojciech Wojtasiak, D.Sc.

Awards granted by international bodies

MTT Society Honorary Life Member given to **Józef Modelski, Prof. D.Sc.** by the MTT Society Administrative Committee.

Awards granted by national bodies

Full Member of the Polish Academy of Science

Józef Modelski, Prof. D.Sc.

Mieczysław Pozarski Medal granted by Association of Polish Electrical Engineers (SEP)

Józef Modelski, Prof. D.Sc.

100th Anniversary of the Association of Polish Electrical Engineers Medal

Józef Modelski, Prof. D.Sc.

'*ICT Ambassador on Science and Education*' title granted by the four Polish Chambers of IT and Telecommunications during *11 Economic Forum TIME* (Warsaw, Poland, Mar. 4, 2019).

Józef Modelski, Prof. D.Sc.

Diploma - award granted by the Forest Sciences and Wood Technology Committee

Piotr Bilski, D.Sc.,

Piotr Bobiński, Ph.D.

Awards of the Rector

Individual I^o award for the scientific achievements

Józef Modelski, Prof. D.Sc.

Individual II^o award for the scientific achievements

Piotr Bilski, D.Sc., WUT Prof.

Individual III^o award for the Ph.D. thesis

Paweł Mazurek, Ph.D.

Team I^o award for the scientific achievements

Yevhen Yashchyshyn, prof. D.Sc.,

Bartłomiej Salski, D.Sc., WUT Prof.,

Paweł Kopyt, D.Sc.,

Grzegorz Bogdan, Ph.D.,

Konrad Godziszewski, Ph.D.,

Tomasz Karpisz, M.Sc.,

Adam Pacewicz, M.Sc.,

Przemysław Piasecki, M.Sc.,

Marcin Rytel, M.Sc.,

Jerzy Cuper, B.Sc.

Individual I^o award for the organizational achievements

Roman Z. Morawski, Prof. D.Sc.

Team III^o award for the organizational achievements

Józef Modelski, Prof. D.Sc.,

Bartłomiej Salski, D.Sc., WUT Prof.

Awards in ICA-ASA Young Scientist Conference Attendance Grants

The grant given to **Agnieszka Paula Pietrzak, M.Sc.**, has been established to help young acousticians attend *International Congresses on Acoustics*.

Awards of the Foundation for the Development of Radiocommunications and Multimedia Technologies

The Best Ph.D. Thesis

IIIrd award for the Ph.D. dissertation titled: "Lokalizacja i śledzenie punktów charakterystycznych twarzy" (Localization and Tracking of Facial Landmarks).

Marek Kowalski, Ph.D.,

The Young Authors' Competition

IInd award for the paper titled: "Opracowanie sześciowrotnika w technologii LTCC na fale milimetrowe" (Design of Millimetre-Wave Six-Port Device for LTCC Technology), *Krajowa Konferencja Radiokomunikacji, Radiofonii i Telewizji: KKRRiT 2019* (National Conference on Radiocommunications and Broadcasting) (Wrocław, Poland, Jun. 25-27, 2019).

Barbara Słojewska

The distinguished paper titled: "Wykorzystanie technologii LTCC w projekcie filtra pasmowo-przepustowego do samochodowego radaru krótkiego zasięgu na pasmo 79 GHz" (Application of LTCC Technology in Development of Bandpass Filter for Automotive Short-Range Radar Operating in 79GHz Band), *Krajowa Konferencja Radiokomunikacji, Radiofonii i Telewizji: KKRRiT 2019* (National Conference on Radiocommunications and Broadcasting) (Wrocław, Poland, Jun. 25-27, 2019).

Mikołaj Darek

The distinguished paper titled: „*Adaptacyjna metoda RSSD w systemie lokalizacyjnym BLE*” (Adaptive RSSD Based Method in BLE Localization System), *Krajowa Konferencja Radiokomunikacji, Radiofonii i Telewizji: KKRRiT 2019* (National Conference on Radiocommunications and Broadcasting) (Wrocław, Poland, Jun. 25-27, 2019).

Marcin Kołakowski, M.Sc.

Scholarships of the Foundation for the Development of Radiocommunications and Multimedia Technologies granted in 2019

For preparing B.Sc. Thesis

Piotr Czeaka

For preparing M.Sc. Thesis

Jerzy Cuper

Jakub Gawlik

Natalia Lubojemska

Natalia Osiadała

Kamil Szczykowski

Robert Kołakowski

For preparing Ph.D. Thesis

Vitimir Djaja-Joško

Tomasz Karpisz

Agnieszka Pietrzak

11. STATISTICAL DATA (as of Dec. 31st of each year)

SPECIFICATION	2016	2017	2018	2019
academic staff [posts]				
total	63,58	60,33	57,5	54,5
professors	5,5	4,5	4	4
University professors	8,5	9,5	9	9
associate professors	3	2	3	2
assistant professors	32,25	29,5	24,5	26,5
readers	1	1	1	1
senior lecturers	5,33	4,33	5,5	5
assistants	8	9,5	10,5	7
Ph.D. students [persons]				
total	38	37	37	38
with scholarship	31	23	25	30
without scholarship	7	14	12	8
technical and administrative staff [posts]				
total	16,75	15,5	14,25	16,65
senior R&D associates	1	1	1,5	1,5
R&D associates	5	4	2	4,75
administrative associates	8,75	8,5	8,75	8,4
service workers	2	2	2	2
temporary staff [persons]	2	2	2	5
teaching activities				
basic courses	62	63	58	50
advanced courses	30	28	32	28
other courses	50	38	26	23
international projects, courses and lectures	1	1	3	4
research projects				
total	50	50	48	53
International granted by EU	3	3	4	4
granted by the Ministry	19	17	17	21
granted by the University	15	14	14	16
other	13	16	13	12
titles and degrees awarded				
Prof. titles	1	1	0	0
D.Sc. degrees	0	1	0	1
Ph.D. degrees	7	2	4	2
M.Sc. degree (regular studies + evening studies)	48+1	48+1	42+1	39+2
M.Sc. degree (studies in English)	1	3	3	0
B.Sc. degrees (regular studies + evening studies)	72+7	80+2	76+5	69+5
B.Sc. degrees (studies in English)	0	2	0	0
B.Sc. degrees e-learning	3	1	1	1
publications				
total	208	149	153	123
sci.-tech. books and chapters in books	2	7	2	2
sci.-tech. papers in journals - total	66	73	57	37
JCR-ICI list (IF>0)	37	40	33	31
MSHE list	28	30	17	6
in other journals	9	3	7	14
sci.-tech. papers in conference proceedings	107	55	89	55
other publications	24	11	5	12
patents and patent applications	4	5	4+2	2+1
international	1	0	0	0
national	3	5	4+2	3
research reports	21	28	25	3
scientific events attended by the staff	41	40	35	45

APPENDIX:

EXPLANATORY NOTE ON POLISH ACADEMIC AND PROFESSIONAL TITLES, DEGREES AND POSTS

This note contains the definitions of academic and professional titles, degrees and posts held by the staff of the Institute of Radioelectronics and Multimedia Technology.

The following professional titles are awarded by Polish higher-education institutions:

- the *inżynier (inż.)* title, translated here as **B.Sc.**, is awarded to the students completing undergraduate studies in the fields of study related to engineering and technology;
- the *magister (mgr)* title, translated here as **M.Sc.**, is awarded to the students completing graduate studies in the fields of study related to sciences;
- the *magister (mgr)* title, translated here as **M.A.**, is awarded to the students completing graduate studies in arts and humanities;
- the *magister inżynier (mgr inż.)* title, translated here as **M.Sc.**, is awarded to the students completing graduate studies in the fields of study related to engineering and technology.

The academic degrees, the *doctor* and *doctor habilitowany* degrees, are awarded by the scientific councils of higher-education institutions or other scientific institutions.

The degree of *doktor (dr)*, translated here as **Ph.D.**, is conferred on a person who:

- is the holder of the professional title of *magister* or *magister inżynier*;
- has successfully passed doctoral examinations in a selected research discipline;
- has submitted and successfully defended a doctoral thesis, favorably assessed by two reviewers.

The doctoral thesis, prepared under the supervision of a research adviser, should provide an original solution of a research problem and demonstrate general theoretical knowledge of the candidate in a given research discipline, as well as confirm his/her skills to conduct research work autonomously.

The degree of *doktor habilitowany (dr hab.)*, translated here as **D.Sc.**, is conferred on a person who:

- is the holder of the academic degree of *doktor*;
 - has remarkable scientific achievements;
 - has significantly contributed to the development of a given research discipline;
- and his/her contribution has been favorably assessed by four reviewers and approved by the scientific council of a higher-education institution or other scientific institution. The holder of the *doktor habilitowany* degree is authorized to be the advisor of Ph.D. students.

The academic title of *profesor (prof.)* is conferred by the President of the Republic of Poland. This title may be conferred on a person who:

- is the holder of the degree of *doktor habilitowany*;
- has scientific achievements significantly exceeding those required of *doktor habilitowany*;
- has remarkable academic achievements, including formation of academic staff.

The combination of the *profesor* title and the *doktor habilitowany* degree (**profesor doktor habilitowany – prof. dr hab.**) is translated here as **Prof. D.Sc.**

The minimum requirements concerning the academic posts are as follows:

- for the post of *asystent*, translated here as **Assistant** – the professional title of *magister* or *magister inżynier*;
- for the post of *starszy wykładowca*, translated here as **Senior Lecturer** – the *doktor* degree;
- for the post of *docent*, translated here as **Reader** – the *doktor* degree;
- for the post of *adiunkt*, translated here as **Assistant Professor** – the *doktor* degree;
- for the post of *wykładowca*, translated here as **Lecturer** – the professional title of *magister* or *magister inżynier*;
- for the post of *profesor uczelni*, translated here as **University Professor** – the *doktor habilitowany* degree;

More details concerning academic and professional titles, degrees and posts may be found in the Act on Higher Education from 2018 (with further addendments)

