



**INSTITUTE OF RADIODEVICE
AND MULTIMEDIA TECHNOLOGY**
WARSAW UNIVERSITY OF TECHNOLOGY

FACULTY OF ELECTRONICS AND INFORMATION TECHNOLOGY



ANNUAL REPORT

2021

Warsaw, January 2022

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From the Director

Dear Friends and Colleagues!

We have another difficult Year behind us, which was full of surprises and challenges for our Institute. The continuing pandemic limited mobility of our staff and decreased the number of international events, usually fruitful for the scientific cooperation. However, in the dawn of the new Year 2022 we feel confident that after adjusting to new environment we are able to return to the wide range of our activities, exactly as two years ago.

Operations of the Institute in the new organizational structure have been expanded since the previous Year. Each of five divisions is now involved in scientific and educational activities. This involves participation in the research projects (funded by the National Centre of Research and Development and European Commission). The outcome of the deep involvement in the projects is the decent number of papers published in journals from the JCR list (which was 39 overall). Unfortunately, we continue to record decline in the conference proceedings papers (only 17), which is caused by the much smaller number of events organized (even virtually) worldwide. On the other hand, the Institute was granted two new patents (with more coming soon). Also, dr Tomasz Karpisz was the winner of the LIDER program, promoting young researchers with outstanding ideas.

As our University has the status of the Research University, there are numerous activities we are involved in. These include, most of all, grants executed by our research groups within the Excellence Initiative Research University (IDUB). Also, our employees have been winners of the Best Paper competition (2nd edition) awards for the outstanding papers published in journals from the Journal Citation Reports list (evaluated for 200 points by Polish Ministry of Education and Science). On the other hand, prof. Bartłomiej Salski won the apparatus grant organized by our University. We are confident the new equipment will allow for new important discoveries.

Another outcome of the scientific activities is the steady number of new persons holding the PhD degree. This Year we have welcome five new doctors (three with honors) in both Automatic Control, Electronics and Electrical Engineering as well as Technical Computer Science and Telecommunications disciplines, all of them either already being the staff of the institute, or expressing interest in becoming members of scientific groups. We are also happy to communicate that our distinguished professor Roman Z. Morawski was announced being on World's TOP 2% Scientists 2020 (prepared by the Stanford University) list, as one of the most cited researchers worldwide.

Our educational activities were aimed at expanding offer for students on all levels of studies. This included our involvement into the newly created specializations, like Internet of Things Engineering (in cooperation with the Institute of Telecommunications), and proposing new courses for the PhD students. As this was the last Year of operating 5 different PhD schools in our University (since next September there will be only one), we are all preparing to act in the new environment, which includes proposing new topics for incoming PhD candidates and modifying educational offer. Also, our involvement in the NERW initiatives led to a much richer offer of courses, laboratories and projects for the students.

The cooperation with the industry is maintained, despite problems caused by pandemic to many companies. The Institute stays in touch with multiple high-tech firms operating on the market. This includes the cooperation during the projects implementation (such as JAS Technologie and Axtel), or broader involvement into the educational-research framework (including Samsung and Huawei). Thanks to the new Artificial Intelligence laboratory, we have enough computational power to process large data sets for the various applications involving machine learning and decision support systems.

Unfortunately, last Year was also a sad one. We bid farewell to our two Professors Emeriti: Professor Tadeusz Morawski – Director of the Institute in years 1981-1996, passed away at the age of 81 and Associate Professor Waldemar Kielek passed away at the age of 91. They will be deeply missed and will remain in our memory.

In conclusion of this preface to the Annual Report 2021, let me express my appreciation for the huge amount of work accomplished by the whole academic, technical and administrative staff of the Institute. Although the pandemic has significantly changed our work regime, we remain optimistic and look into the future with high hopes.

Professor Józef Modelska

Warsaw, January 2022

Classification of publications presented in this Report
is in accordance with the rules in force in 2021

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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.

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.

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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

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Secretariat

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Secretariat

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Director's Representative for Economy & Administration

Piotr Brzeski, Ph.D., Didactic Assistant Professor (0.5)
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1.3. Organisation of the Institute

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

- Electroacoustics Division;
- Nuclear and Medical Electronics Division;
- Radiocommunications and Radiolocation Engineering Division;
- Subterahertz Technology Division;
- Multimedia Engineering Division.

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

1.3.1. Electroacoustics Division

Head of Division

Jan Żera, Prof. D.Sc., Full Professor
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Senior academic staff

Piotr Bilski, D.Sc., Associate Professor
Piotr Bobiński, Ph.D., Assistant Professor
Marcin Lewandowski, Ph.D., Assistant Professor
Robert Łukaszewski, Ph.D., Assistant Professor
Grzegorz Makarewicz, Ph.D., Assistant Professor (0.5)
Agnieszka Pietrzak, Ph.D., Assistant Professor (from Feb. 2021)
Krzysztof Mrocze, Ph.D., Assistant Professor

Junior academic staff

Maciej Jasiński, M.Sc., Assistant (0.5 till Apr. 2021, 1 from Jun. 2021)

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
Karolina Podel-Sycz, M.Sc., from Oct. 2021
Jakub Tkaczuk, M.Sc., from Oct. 2020
Katarzyna Wynamko, 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

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- 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. Nuclear and Medical Electronics Division

Head of Division

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Senior academic staff

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Piotr Bogorodzki, D.Sc., Associate Professor
Waldemar Smolik, D.Sc., Associate Professor
Grzegorz Domański, Ph.D., Assistant Professor
Bogumił Konarzewski, Ph.D., Assistant Professor (till Sept. 2021, Didactic Assistant Professor from Oct. 2021)
Jacek Kryszyn, Ph.D., Assistant Professor
Robert Kurjata, 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
Marcin Ziembicki, Ph.D., Assistant Professor (1 till Apr. 2021, 0.7, from May 2021)
Piotr Brzeski, Ph.D., Didactic Assistant Professor (0.5)

Junior academic staff

Wojciech Obrebski, M.Sc., Assistant (0.5)
Tomasz Olszewski, M.Sc., Didactic Assistant (0.5)
Damian Wanta, M.Sc., Assistant (0.5, from Jan. 2021)
Michał Wieteska, M.Sc., Assistant (0.5)
Przemysław Wróblewski, M.Sc., Assistant

Technical staff

Tomasz Olszewski, M.Sc., R&D Engineer (0.5)
Andrzej Wasilewski, Worker

Ph.D. students

Monika Drabik, M.Sc. from Oct. 2016
Krzysztof Dygnarowicz, M.Sc. from Feb. 2021
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

Przemysław Wróblewski, M.Sc., from Oct. 2021

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.

1.3.3. Radiocommunications and Radiolocation Engineering Division

Head of Division

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Senior academic staff

Józef Modelska, Prof. D.Sc., Full Professor
Wojciech Wojtasiak, D.Sc., Associate Professor
Jacek Cichocki, Ph.D., Reader (till Sept. 2021, Didactic Assistant Professor 0,5 from Oct. 2021)
Daniel Gryglewski, Ph.D., Assistant Professor
Wojciech Kazubski, Ph.D., Assistant Professor
Jerzy Kołakowski, Ph.D., Assistant Professor
Przemysław Korpas, Ph.D., Assistant Professor
Sebastian Kozłowski, Ph.D., Assistant Professor
Krzysztof Kurek, Ph.D., Assistant Professor
Przemysław Miazga, Ph.D. Senior Lecturer (till Feb. 2021, Didactic Assistant Professor from Mar. 2021)
Mirosław Mikołajewski, Ph.D., Assistant Professor
Dawid Rosołowski, Ph.D., Assistant Professor

Junior academic staff

Vitomir Djaja-Joško, Ph.D., Assistant
Marcin Kołakowski, M.Sc., Assistant (0.5 till Sept. 2021, 1 from Oct. 2021)

Technical staff

Mirosław Lubiejewski, Foreman

Ph.D. students

Marcin Kołakowski, M.Sc., from Oct. 2016
Tomasz A. Miś, M.Sc., from Oct. 2017
Adam Raniszewski, M.Sc., from Feb. 2015
Marcin Wiśniewski, M.Sc., from Oct. 2021

Temporary Staff

Dariusz Kołodziej, M.Sc., Support Enginner (0.5)

Retired

Jan Ebert, Prof. D.Sc.,
Wojciech Gwarek, Prof. D.Sc.,
Tadeusz Morawski, Prof. D.Sc.,
Stanisław Rosłoniec, Prof. D.Sc.
Waldemar Kiełek, D.Sc.,

Tomasz Kosiło, Ph.D.,
Karol Radecki, Ph.D.
Henryk Chaciński, M.Sc.

The Radiocommunications and Radiolocation Engineering Division conducts scientific and applied research around microwave theory and techniques, radio communication systems and networks, radar systems, and measurement techniques in the field of microwaves and millimeter waves. This includes the subjects of computer-aided design and signal processing. Specific research topics included:

- radiocommunication systems and networks – cellular networks, satellite systems and broadband access networks, and propagation channel analysis and modeling,

- Internet of Things technology and applications – methodologies for the antenna design and embedded software for the Single Board Computer-based systems,
- UWB – wireless ultra-wideband systems – methods and systems for communication and localization, re-configurable and software-defined radio systems,
- design of front-ends for wireless systems with power amplifiers linearized using signal processing such as digital pre-distortion techniques,
- design of transmitter/receiver modules for radar applications,
- development of high-power high-frequency stability sources for microwave heating,
- methods of synthesis and computer-aided design of passive and active microwave circuits and devices (couplers, power combiners and dividers, switches, transistor circuits, oscillators, synthesizers, modulators, amplifiers) and microwave semiconductor device modelling,
- design of accurate Q-Factor determination equipment applicable in material characterization using resonant techniques,
- development of 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, and high-efficiency AC-DC and DC-DC converters.

1.3.4. Subterahertz Technology Division

Head of Division

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Senior academic staff

Yevhen Yashchyshyn, Prof. D.Sc., Full Professor
Paweł Kopyt, D.Sc., Associate Professor
Bartłomiej Salski, D.Sc., Associate Professor
Paweł Bajurko, Ph.D., Assistant Professor
Grzegorz Bogdan, Ph.D., Assistant Professor
Krzysztof Derzakowski, Ph.D., Assistant Professor
Konrad Godziszewski, Ph.D., Assistant Professor
Maciej Sypniewski, Ph.D., Senior Lecturer (till Feb. 2021, Didactic Assistant Professor from Mar. 2021, 0.5)

Junior academic staff

Tomasz Karpisz, Ph.D., Assistant
Mateusz Krysiński, M.Sc., Research Assistant

Technical Staff

Adam Pacewicz, Ph.D., Senior R&D Engineer, from Jun. 2021

Ph.D. students

Jerzy Cuper, M.Sc., from Oct. 2019
Piotr Czeała, M.Sc., from Oct. 2021
Jakub Sobolewski, M.Sc., from Feb. 2017
Maciej Soszka, M.Sc., from Oct. 2018

Temporary Staff

Marcin Karpisz, B.Sc., R&D Engineer (0.5)

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

- sub-terahertz technology;
- antenna measurements;
- antenna design and fabrication;
- accurate, repeatable measurements on-wafer up to 500 GHz;

This includes of measurements in the wide frequency range thanks to a unique set consisted of four-port PNA-X Vector Network Analyzers from Agilent Technologies and six pairs of Frequency Extenders for measurements up to 500 GHz. Each pair of Frequency Extenders is designed for single band of standard rectangular waveguide and allows to measure full two-port scattering matrix (amplitude and phase) with a very high dynamic range (above 100 dB). The wide frequency range and large number of measurement points (up to 32001 points) enables further processing of the measured data in the time domain. This set is used for measurements of antenna parameters, and is a part of the quasi-optical setup for the characterization of materials in the millimeter-wave and sub-terahertz ranges.

The research and teaching activities are also performed at the Antenna and Sub-terahertz Technology laboratory. The laboratory was partly funded by European Development Fund (ERDF) in scope of Operational Programme Innovative Economy (POIG) as a part of the Faculty Research Centre FOTEH (Photonics and Terahertz Technologies). The Antenna Laboratory enables research on spatial distributions of the electromagnetic field up to sub-terahertz range to develop and study of antennas, characterization of materials and designing of communication, imaging and radar systems.

The research topics of the Laboratory of Field Methods in the Microwave and Sub-Terahertz Techniques include characterization of low-loss dielectric materials and conductive materials in the range 1–110 GHz by various resonance methods, including the use of a Fabry-Perot open resonator, and ferromagnetic materials in the range 1–30 GHz by resonance methods, electromagnetic modeling of problems related to microwave heating, propagation of electromagnetic waves in the atmosphere, electromagnetic modeling and measurements of the effective reflection surface of absorption panels, designing frequency synthesizers operating in the microwave and millimeter bands, and frequency multipliers operating in the microwave and millimeter bands.

1.3.5. Multimedia Engineering Division

Head of Division

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Kajetana Snopek, D.Sc., Associate Professor
Andrzej Buchowicz, Ph.D., Assistant Professor
Grzegorz Galiński, Ph.D., Assistant Professor
Krystian Ignasiak, Ph.D., Senior Lecturer (till Feb. 2021,
Didactic Assistant Professor from Mar. 2021)
Paweł Mazurek , Ph.D., Assistant Professor
Andrzej Miękina, Ph.D., Assistant Professor
Jakub Wagner, Ph.D., Assistant Professor (0.5 till Sept. 2021, 1 from Oct. 2021).

Junior academic staff

Grzegorz Gwardys, M.Sc. , Assistant (0.5)

Technical staff

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

Ph.D. students

Xin Chang, M.Sc., from Oct. 2018

Michał Daniuk, M.Sc., from Oct. 2020

Daniel Mostowski, M.Sc., from Oct. 2020

Rafał Protasiuk, M.Sc., from Oct. 2016

Mikołaj Wieczorek, M.Sc., from Oct. 2020

Retired

Marek Rusin, Ph.D.

Scientific and teaching activities of the Division cover most of the modern television aspects, beginning with the basics to the leading and fastest developing areas: digital image processing in multimedia, high resolution TV (HDTV), cable TV (CATV), industrial television. Besides basic television courses, the division teaches microcontrollers, PLD and the selected aspects of the microwaves. Multimedia aspects such as compression, object recognition, hardware technologies (MPEG coders) and software technologies (Java, Python) are gaining recently more attention.

Division consists of 3 groups:

- Deep Neural Network in Digital Media;
- Hardware Algorithms in Digital Media;
- Digital Processing and Measurement Systems.

1.4. Evening Studies and Continuing Education

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

Head

Władysław Skarbek, Prof. D.Sc., Full Professor

Secretariat

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1.5. Other Institute's Units

1.5.1. Accounting Department

Head

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Staff

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Janina Nowak, Senior Accounting Clerk room: 420, phone: +48 22 2347645 e-mail: janina.nowak@pw.edu.pl

Beata Rosłon, Accounting Clerk

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1.5.2. Supply Section

Staff

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[Edu131], [Edu133]; [Pro2], [Pro39], [Pro42], [Pro43], [Pro44]; [MSc5]; [BSc41], [BSc66]; [Pub37], [Pub59].

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[Edu26], [Edu116]; [Pro11], [Pro23], [Pro41]; [PhD4], [PhD5]; [Pub24], [Pub25], [Pub30], [Pub36], [Pub45], [Pub48], [Pub52].

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[Edu1], [Edu14], [Edu71], [Edu78], [Edu89], [Edu131], [Edu133]; [MSc12]; [BSc6], [BSc57].

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[Edu34]; [Pro17], [Pro18]; [BSc3]; [Pub39], [Pub49].

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[Edu94], [Edu102], [Edu130], [Edu132]; [Pro10], [Pro21]; [BSc49]; [Pub16], [Pub17].

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[Edu5], [Edu6], [Edu15], [Edu29], [Edu42], [Edu52], [Edu93], [Edu108], [Edu130], [Edu132].

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[Edu8], [Edu10], [Edu29], [Edu74], [Edu92], [Edu93], [Edu121], [Edu131], [Edu133]; [Pro1], [Pro20]; [BSc25], [BSc47]; [Pub11], [Pub48].

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[Edu12], [Edu23], [Edu57], [Edu61], [Edu125], [Edu131]; [Pro6], [Pro7].

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[Edu7], [Edu41]; [Pub14], [Pub15], [Pub38], [Pub58].

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zation Student Research Group (LORAD), Member of the Management Board of the Foundation for the Develop. of Radiocom. and Multi. Technology ('02-); Recipient of a team award of the Rector ('21). [Edu23], [Edu39], [Edu44], [Edu76], [Edu105], [Edu133]; [Pro6], [Pro7]; [BSc7], [BSc45].

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[Edu36], [Edu37], [Edu69], [Edu95], [Edu133]; [Pro3], [Pro9], [Pro12], [Pro15], [Pro19], [Pro25]; [Pub20], [Pub23], [Pub31], [Pub32], [Pub33], [Pub34], [Pub50], [Pub54], [Pub58].

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[Edu72], [Edu73], [Edu80], [Edu87], [Edu131], [Edu133]; [Pro26]; [MSc10], [MSc14], [MSc19], [BSc37]; [Pub57].

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[Edu12], [Edu85], [Edu109], [Edu131]; [Pub22].

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[Edu11], [Edu70], [Edu82], [Edu91], [Edu111], [Edu131], [Edu133]; [Pro23]; [BSc1], [BSc54]; [Pub48].

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[Edu19], [Edu84], [Edu133]; [Pro33]; [BSc9], [BSc17].

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[Edu21], [Edu22], [Edu92], [Edu93], [Edu106], [Edu130], [Edu132]; [Pro20]; [Pub6], [Pub7], [Pub10], [Pub11], [Pub19].

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[Edu16], [Edu53], [Edu54], [Edu131]; [Pub66].

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[Edu30], [Edu130]; [MSc18]; [BSc10], [BSc27]; [Pub60].

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[Edu25], [Edu27], [Edu28], [Edu38]; [Pub27].

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[Edu130], [Edu132]; [Pro10], [Pro38]; [Pub17].

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[Edu70], [Edu133]; [Pro23]; [PhD3]; [BSc8], [BSc65].

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[Edu130], [Edu132]; [Pro28]; [Pub43].

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[Edu47], [Edu112], [Edu131], [Edu133]; [Pro5], [Pro8]; [BSc18], [BSc28], [BSc42], [BSc44].

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[Edu17], [Edu97], [Edu99], [Edu101], [Edu130], [Edu132]; [MSc6], [MSc23]; [Pub8], [Pub70].

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[Edu46], [Edu130]; [Pro1], [Pro4], [Pro20], [Pro34], [Pro39]; [BSc36], [BSc40]; [Pub2], [Pub3], [Pub4], [Pub6], [Pub7], [Pub11], [Pub19].

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[Edu36], [Edu37], [Edu58]; [Pro9], [Pro12], [Pro19], [Pro24], [Pro25], [Pro27], [Pro32]; [PhD2]; [MSc4]; [Pub13], [Pub20], [Pub23], [Pub24], [Pub28], [Pub31], [Pub32], [Pub33], [Pub34], [Pub50], [Pub51], [Pub54], [Pub58], [Pub71].

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[Edu81], [Edu90], [Edu103], [Edu118], [Edu131], [Edu133]; [Pub12].

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tion ('16-); Member of the Scientific Council for Biomedical Engineering, WUT ('19-); Member of the Steering Committee - *Intelligent Decision Support System based on the Algorithmic Image Analysis in the Operations of the Justice System* - BIO10 Programme. [Edu29], [Edu86], [Edu100], [Edu130], [Edu132]; [Pro11], [Pro21], [Pro22], [Pro35]; [BSc29], [BSc59]; [Pub35], [Pub40], [Pub68], [Pub72].

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[Edu16], [Edu35], [Edu54], [Edu123], [Pub44], [Pub64].

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M.Sc. ('84), Ph.D. ('98), D.Sc. ('15); microwave technique; **Associate Professor**, Radiocommunications and Radiolocation Division, Head of Division ('20-).

Member of IEEE ('96-); Member of the Scientific Council for Automatic Control, Electronics and Electrical Engineering, WUT ('19-); Golden Cross of Merit ('21).

[Edu29], [Edu47], [Edu66], [Edu131], [Edu133]; [Pro14], [Pro26], [Pro37]; [BSc46], [BSc50]; [Pub29], [Pub63].

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M.Sc. ('79), Ph.D. ('86), D.Sc. ('06), Prof. Title ('16); telecommunications; **Full Professor**, Sub-Terahertz Technology Division.

Head of Division ('20-). Member of the Com. on Elec-

tronics and Telecommunications PAN ('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 *Izwestiya 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 Automatic Control, Electronics, and Electrical Engineering, WUT ('19-); Recipient of a team award of the Rector ('21).

[Edu3], [Edu83], [Edu133]; [Pro2], [Pro36]; [BSc15], [BSc71]; [Pub9], [Pub37], [Pub38], [Pub39], [Pub49].

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M.Sc. ('81), Ph.D. ('90), D.Sc. ('03), Prof. Title ('12), biomedical engineering, nuclear electronics; **Full Professor**, Rector of the WUT ('20-); Nuclear and Medical Electronics Division.

Member of CERN ('89-); 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 Automotive Industry Institute ('17-); Member of the Scientific Board of the Institute of the Nuclear Chemistry and Technology ('17-); Member of the Scientific Council for Automatic Control, Electronics and Electrical Engineering, WUT ('19-); Head of the Committee on Education, the Conf. of Rectors of Academic Schools in Poland, ('20-); Member of the Plan for Work and Development Council ('21-).

[Pro4], [Pro20]; [Pub2], [Pub3], [Pub4], [Pub5], [Pub6], [Pub7], [Pub11], [Pub19].

Marcin Ziembicki

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M.Sc. ('02), Ph.D. ('20); nuclear and medical electronics; **Assistant Professor**, Nuclear and Medical Electronics Division; Recipient of an individual award of the Rector ('21).

[Pro1], [Pro4], [Pro20]; [Pub2], [Pub3], [Pub4], [Pub5], [Pub6], [Pub7], [Pub11], [Pub19].

Jan Żera

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M.Sc. ('76), Ph.D. ('90), D.Sc. ('04); acoustics, Prof. Title ('17); electroacoustics, psychoacoustics, noise control; **Full 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-); Vice-President of the Scientific Council of Central

Institute for Labour Protection – National Research Institute ('21-); Member of the Scientific Council for Automatic Control, Electronics, and Electrical Engineering, WUT ('19-).
 [Edu50], [Edu98], [Edu128], [Edu131], [Edu133]; [PhD3]; [MSc9], [MSc15]; [BSc11], [BSc12], [BSc23]; [Pub65].

2.2. Junior academic staff

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 1 from Jun. 2021)
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Marcin Kołakowski, M.Sc., Assistant (0.5 till
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2.3. Ph.D. students (the third-level studies)

Ph.D. Student (tutor)

Xin Chang, M.Sc.	(W. Skarbek)
Jerzy Cuper, M.Sc.	(P. Kopyt)
Piotr Czechała, M.Sc.	(B. Salski)
Michał Daniluk, M.Sc.*	(G. Pastuszak)
Krzysztof Dowalla, M.Sc.	(P. Bilski)
Monika Drabik, M.Sc.	(P. Bogorodzki)
Krzysztof Dymnarowicz	(J. Marzec)
Salomea Grodzicka, M.Sc.	(P. Bilski)
Maciej Jasiński, M.Sc.	(J. Żera)
Marcin Kołakowski, M.Sc.	(J. Modelska)
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. Modelska)
Daniel Mostowski, M.Sc.*	(G. Pastuszak)
Katarzyna Orzechowska, M.Sc. (P. Bogorodzki)	(P. Bilski)
Bartosz Połok, M.Sc.	(W. Skarbek)
Rafał Protasiuk, M.Sc.	(W. Gwarek)
Adam Raniszewski, M.Sc.	(Y. Yashchyshyn)
Jakub Sobolewski, M.Sc.	(Y. Yashchyshyn)
Maciej Soszka, M.Sc.*	(W. Smolik)
Mateusz Stosio, M.Sc.	(P. Bilski)
Jakub Tkaczuk, M.Sc.*	(G. Pastuszak)
Mikołaj Wieczorek, M.Sc.*	(W. Wojtasiak)
Marcin Wiśniewski, M.Sc. *	(W. Smolik)
Przemysław Wróblewski, M.Sc. (W. Smolik)	(J. Żera)
Katarzyna Wynimko, M.Sc.	(J. Żera)
Bartosz Żłobiński, M.Sc.	(J. Żera)

*) implementation doctorate

2.4. Technical and administrative staff

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Anna Smenda, Administrative Clerk
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Administrative Clerk (0.6, till Dec. 2021)
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*) temporary research staff for the projects: OPUS 16
**) WidePOWER

3. TEACHING ACTIVITIES

(the summer semester of the academic year 2020/2021 and the winter semester of the academic year 2021/2022)

3.1. Regular studies – main fields of study:

Electronics

Specialization: Electronics and Computer Science in Medicine

Head

Andrzej Rychter, Ph.D., Assistant Professor
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e-mail: andrzej.rychter@pw.edu.pl

Informatics

Specialization: Computer Science in Multi-media

Head

Grzegorz Pastuszak, D.Sc., Associate Professor
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e-mail: grzegorz.pastuszak@pw.edu.pl

Biomedical Engineering

Specialization: Biomedical Apparatus

Head

Grzegorz Domański, Ph.D., Assistant Professor
room: 61, phone: +48 22 2347626
e-mail: grzegorz.domanski@pw.edu.pl

Specialization: Biomedical Information Technology

Head

Jacek Kryszyn, Ph.D., Assistant Professor
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e-mail: jacek.kryszyn@pw.edu.pl

Telecommunications

Specialization:

- **Radiocommunications and Multimedia Techniques**
- **Wireless and Multimedia Technologies (I^o studies)**

Head

Jacek Cichocki, Ph.D., Didactic Assistant Prof.
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Specialization:

- **Wireless and Multimedia Techniques (II^o studies)**

Head

Andrzej Buchowicz, Ph.D., Assistant Prof.
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3.1.1. Basic courses

- [Edu1] *Acquisition and Data Processing Using LabVIEW* (Akwizycja i przetwarzanie danych z wykorzystaniem LabVIEW – LABV); 30h/sem; P. Bobiński.
- [Edu2] *Analysis of Measurement Data in Medicine* (Analiza danych pomiarowych w medycynie – ADP); 45 h/sem.; B. Konarzewski.
- [Edu3] *Antennas* (Anteny – ANT); 45 h/sem.; Y. Yashchyshyn.

- [Edu4] *Basics of Image Techniques* (Podstawy techniki obrazowej – PTO); 45 h/sem.; G. Galiński.
- [Edu5] *Basics of Medical Imaging* (Podstawy obrazowania medycznego – POMED); 45 h/sem.; P. Brzeski.
- [Edu6] *Basics of Medical Imaging Techniques* (Podstawy technik obrazowania w medycynie – PTOM); 60 h/sem.; P. Brzeski.
- [Edu7] *Basics of Microprocessor Technique* (Podstawy techniki mikroprocesorowej – TMIK); 60 h/sem.; K. Derzakowski.
- [Edu8] *Basics of Multimedia* (Podstawy multimediów – PMUT); 30 h/sem.; A. Buchowicz.
- [Edu9] *Basics of Programming* (Podstawy programowania – PPR); 60 h/sem.; K. Ignasiak, R. Kurjata.
- [Edu10] *Basics of Programming 1* (Podstawy programowania – PRM1T); 60 h/sem.; A. Buchowicz.
- [Edu11] *Basics of Programming 2* (Podstawy programowania – PRM2T); 55 h/sem.; K. Ignasiak, M. Lewandowski.
- [Edu12] *Basics of Radiocommunications* (Podstawy radiokomunikacji – PR); 45 h/sem.; J. Cichocki, K. Kurek
- [Edu13] *Basics of Radiolocation and Radionavigation* (Podstawy radiolokacji i radionawigacji – PRIR); 45 h/sem; D. Gryglewski.
- [Edu14] *Basics of Sound Techniques* (Podstawy techniki dźwiękowej – PTD); 60 h/sem.; P. Bobiński.
- [Edu15] *Biomedical Accelerators* (Akceleratory biomedyczne – ABM); 30 h/sem.; P. Brzeski, S. Wronka.
- [Edu16] *Computing in Engineering* (Obliczenia inżynierskie – OINT); 30 h/sem.; R. Z. Morawski, P. Mazurek, A. Miękina, J. Wagner.
- [Edu17] *Computer Graphics* (Grafika komputerowa – GRK); 30 h/sem.; K. Ignasiak, T. Rubel.
- [Edu18] *Continuous-time and Discrete-time Systems* (Systemy czasu ciągłego i dyskretnego – SYST); 45 h/sem.; K. Snopek (Faculty coordinator: Institute of Telecommunications).
- [Edu19] *Construction of High Quality Audio Equipment* (Konstrukcja urządzeń audio wysokiej jakości – KUA); 30 h/sem.; G. Makarewicz.
- [Edu20] *Data Security in Medical Information Systems* (Bezpieczeństwo medycznych systemów informacyjnych – BEMSI); 30 h/sem.; R. Kurjata.
- [Edu21] *Detection of Ionizing Radiation* (Detekcja promieniowania jonizującego - DEPJ);

TEACHING ACTIVITIES

	30 h/sem.; J. Marzec.	[Edu41] <i>Influence of Electromagnetic Waves on Living Organisms</i> (Oddziaływanie fal elektromagnetycznych na organizmy żywego – OFE); 30 h/sem.; K. Derzakowski.
[Edu22]	<i>Detection of Nuclear and Biomedical Signals</i> (Detekcja sygnałów biomedycznych i jądrowych – DSBJ); 60 h/sem.; J. Marzec.	[Edu42] <i>Introduction to Medical Science</i> (Wprowadzenie do nauk medycznych – WNM); 45 h/sem.; P. Brzeski, R. Jóźwiak.
[Edu23]	<i>Digital Cellular Systems</i> (Cyfrowe systemy komórkowe – CSK); 45 h/sem.; J. Cichocki, J. Kołakowski.	[Edu43] <i>Introduction to Multimedia</i> (Wstęp do multimedii – WMM); 24 h/sem.; G. Pasztusak, K. Snoperek.
[Edu24]	<i>Digital Circuits</i> – EDC1; 60 h/sem.; P. Miazga (English-medium studies).	[Edu44] <i>IoT Radio Interfaces</i> (Interfejsy radiowe systemów internetu rzeczy – IRI); 45 h/sem.; J. Kołakowski.
[Edu25]	<i>Digital Circuits</i> (Technika cyfrowa – TECY), 70 h/sem.; K. Mroczek (Faculty coordinator: Institute of Telecommunications).	[Edu45] <i>Measurement Systems</i> (Systemy pomiarowe – SPOM); 60 h/sem.; R. Łukaszewski.
[Edu26]	<i>Digital Communications</i> – EDICO; 60 h/sem.; P. Bilski (English-medium studies).	[Edu46] <i>Medical Electronic Instrumentation</i> (Elektroniczna aparatura medyczna – EAME); 60 h/sem.; A. Rychter.
[Edu27]	<i>Digital Systems</i> (Systemy cyfrowe – SYCYF), 20 h/sem.; K. Mroczek (Faculty coordinator: Institute of Telecommunications).	[Edu47] <i>Microwave Technique</i> (Technika mikrofalowa – TMO); 45 h/sem.; D. Rosołowski, W. Wojtasik.
[Edu28]	<i>Digital Systems</i> (Układy cyfrowe – UCYF), 12 h/sem.; K. Mroczek (Faculty coordinators: Institute of Microelectronics and Optoelectronics, Institute of Telecommunications).	[Edu48] <i>Microprocessor Technique</i> (Technika mikroprocesorowa – TEMI); 45 h/sem.; G. Domański.
[Edu29]	<i>Diploma Seminar for Undergraduate Students</i> (Seminarium dyplomowe inżynierskie – SDI); 30 h/sem.; P. Brzeski, A. Buchowicz, W. Smolik, W. Wojtasik.	[Edu49] <i>Multi-service and Multimedia Networks</i> – EMSMN; 60 h/sem.; S. Kozłowski (English-medium studies).
[Edu30]	<i>DC/DC Power Converters Supply</i> (Zasilanie układów elektronicznych - ZUE); 45 h/sem.; M. Mikołajewski.	[Edu50] <i>Musical Acoustics</i> (Akustyka muzyczna – AM); 30 h/sem.; J. Żera.
[Edu31]	<i>Electronic Circuits</i> (Układy elektroniczne – UEL); 60 h/sem.; W. Obrębski.	[Edu51] <i>Neural Networks in Biomedical Applications</i> (Sieci neuronowe w zastosowaniach biomedycznych – SNB), 45 h/sem.; P. Mazurek.
[Edu32]	<i>Electronic Circuits and Systems</i> (Elementy i układy elektroniczne – UKEL); 60 h/sem.; D. Gryglewski.	[Edu52] <i>Nuclear Medicine Techniques</i> (Techniki medycyny nuklearnej – TMENU); 30 h/sem.; P. Brzeski, T. Olszewski.
[Edu33]	<i>Event-Driven Programming</i> (Programowanie zdarzeniowe – PROZE); 45 h/sem.; K. Ignasiak.	[Edu53] <i>Numerical Methods</i> (Metody numeryczne – MNUB); 45 h/sem.; A. Miękina, P. Mazurek, R. Z. Morawski.
[Edu34]	<i>Evolutionary Algorithms</i> (Algorytmy ewolucyjne – AE); 45 h/sem.; G. Bogdan, P. Miazga, A. Raniszewski.	[Edu54] <i>Numerical Methods</i> – ENUME; 60 h/sem.; R. Z. Morawski, A. Miękina, P. Mazurek, J. Wagner (English-medium studies).
[Edu35]	<i>Ethical Aspects of Research and Engineering</i> – EEARE; 30 h/sem.; R. Z. Morawski, P. Mazurek, J. Wagner (English-medium studies).	[Edu55] <i>Object-oriented Programming</i> (Programowanie obiektowe – PROBI); 60 h/sem.; J. Kryszyn.
[Edu36]	<i>Fields and Waves</i> (Pola i fale – POFA); 60 h/sem.; P. Kopyt, M. Krynicki, B. Salski	[Edu56] <i>Object-oriented Programming of Multimedia Applications in Java</i> (Java – obiektowe programowanie aplikacji multimedialnych – OPA); 45 h/sem.; K. Ignasiak.
[Edu37]	<i>Fields and Waves</i> (Pola i fale – POFAT); 56 h/sem.; P. Kopyt, B. Salski.	[Edu57] <i>Orientation</i> (Orientacja - ORIT); 8 h/sem.; J. Cichocki.
[Edu38]	<i>Fundamentals of Digital Circuits</i> (Podstawy techniki cyfrowej – PTCY), 120 h/sem., K. Mroczek (Faculty coordinators: Institute of Control, Computation Engineering and the Institute of Computer Science).	[Edu58] <i>Physics 2 – EPHY2</i> ; 60 h/sem.; B. Salski, M. Sypniewski (English-medium studies).
[Edu39]	<i>Fundamentals of Wireless Communication</i> (Podstawy transmisji bezprzewodowej – PTB); 57 h/sem.; J. Kołakowski.	[Edu59] <i>Programming of Geoinformation Applications</i> (Programowanie aplikacji geoinformacyjnych – 1-4002); 30 /sem.; K. Ignasiak (for Faculty of Geodesy and Cartography).
[Edu40]	<i>Image Techniques</i> (Technika obrazowania TO); 60 h/sem.; G. Galiński	[Edu60] <i>Radiocommunication Systems</i> (Systemy radiokomunikacyjne – SRKO); 45 h/sem.;

TEACHING ACTIVITIES

	K. Godziszewski, W. Kazubski, K. Radecki.	3.1.2. Advanced courses
[Edu61]	<i>Radioelectronics Measurements</i> (Miernictwo radioelektroniczne – MR); 45 h/sem.; J. Cichocki.	[Edu81] <i>Adaptive Image Recognition</i> – EADIR; 60 h/sem.; W. Skarbek (English-medium studies).
[Edu62]	<i>Radio Networks and Systems</i> (Systemy i sieci radiowe- SISR); 45 h/sem.; K. Godziszewski.	[Edu82] <i>Advanced Multimedia Signal Processing</i> (Zaawansowane przetwarzanie danych multimedialnych – ZPDM); 60 h/sem.; M. Lewandowski.
[Edu63]	<i>Radio Transmission</i> (Transmisja radiowa – TRRA); 57 h/sem.; K. Godziszewski.	[Edu83] <i>Antennas</i> (Anteny – EANTE); 45 h/sem.; Y. Yashchyshyn (English-medium studies).
[Edu64]	<i>Radiological Apparatus in Medical Diagnostics</i> (Aparatura radiologiczna w diagnostyce medycznej – ARDM); 30 h/sem.; G. Domański.	[Edu84] <i>Audio Equipment Investigation</i> (Badania urządzeń audio – BUA); 45 h/sem.; G. Makarewicz.
[Edu65]	<i>Radiology and Nucleonics</i> (Radiologia z nukleoniką – RN); 45 h/sem.; B. Konarzewski.	[Edu85] <i>Basics of Space Systems Design</i> (Podstawy projektowania systemów kosmicznych – PPSK); 60 h/sem.; K. Kurek
[Edu66]	<i>RF & Microwave Engineering in Telecommunications</i> (Technika mikrofalowa w telekomunikacji – TMI); 45 h/sem.; W. Wojtasiak.	[Edu86] <i>Computed Tomography</i> (Tomografia komputerowa – TOM); 60 h/sem.; W. Smolik.
[Edu67]	<i>Signals and Systems</i> (Sygnały i systemy – SYGSY); 60 h/sem.; K. Snopk.	<i>Computer - Aided Medical Image Diagnostics</i> (Komputerowe wspomaganie obrazowej diagnostyki medycznej – KWOD); 45 h/sem.; A. Przelaskowski
[Edu68]	<i>Signals, Modulations and Systems</i> (Sygnały, modulacje i systemy – SYMSE); 45 h/sem.; K. Snopk.	[Edu87] <i>Computational Electromagnetics for Telecommunications</i> – ECOET; 60 h/sem.; P. Korpas (English-medium studies).
[Edu69]	<i>Simulations of Radioelectronics Circuits</i> (Symulacja układów radioelektronicznych – SUREL); 45 h/sem.; D. Gryglewski, P. Kopyst.	[Edu88] <i>Data Compression</i> (Kompresja danych – KODA); 45 h/sem.; G. Galiński, G. Pasztuszak.
[Edu70]	<i>Sound Recording Technique</i> (Dźwiękowa technika studyjna – DTS); 45 h/sem.; M. Lewandowski, A. Pietrzak.	[Edu89] <i>Design of Audio Devices and Systems</i> (Projektowanie urządzeń i systemów audio – PUSA); 60 h/sem.; P. Bobiński.
[Edu71]	<i>Sound Technique</i> (Technika dźwiękowa – TD); 45 h/sem.; P. Bobiński.	[Edu90] <i>Deep Neural Networks for Digital Media</i> (Głębokie sieci neuronowe w mediach cyfrowych – GSN); 45 h/sem.; W. Skarbek.
[Edu72]	<i>Team Project 1</i> (Projekt grupowy 1 – PROJ1); 13 h/sem.; P. Korpas.	[Edu91] <i>Digital Audio Signal Processing</i> (Cyfrowe przetwarzanie sygnałów fonicznych – CPSF); 45 h/sem.; M. Lewandowski.
[Edu73]	<i>Team Project 2</i> (Projekt grupowy 2 – PROJ1); 30 h/sem.; P. Korpas.	[Edu92] <i>Diploma Seminar for Graduate Students 1</i> (Seminarium dyplomowe magisterskie 1 – SDM1); 30 h/sem.; A. Buchowicz, J. Marzec, J. Modelska.
[Edu74]	<i>Television Systems</i> (Systemy telewizyjne – SYTE); 45 h/sem.; A. Buchowicz.	[Edu93] <i>Diploma Seminar for Graduate Students 2</i> (Seminarium dyplomowe magisterskie 2 – SDM2); 30 h/sem.; P. Brzeski, A. Buchowicz, J. Marzec, J. Modelska.
[Edu75]	<i>Ultrasonography Instrumentation</i> (Aparatura ultrasonograficzna – AUS); 30 h/sem.; R. Jóźwiak.	[Edu94] <i>Dynamic Medical Image Data Analysis</i> (Analiza medycznych obrazowych danych dynamicznych – AMDD); 45 h/sem.; P. Bogorodzki.
[Edu76]	<i>UMTS and LTE Systems</i> (Systemy UMTS i LTE – ULTE); 45 h/sem.; J. Kołkowski.	[Edu95] <i>Electromagnetic Compatibility</i> – EEMC; 45 h/sem.; P. Kopyst (English-medium studies).
[Edu77]	<i>User Interface Design</i> (Projektowanie interfejsu użytkownika – PIU); 15 h/sem.; K. Ignasiak.	[Edu96] <i>Embedded Programming for Medical Devices</i> (Programowanie wbudowane w urządzenia medycznych – PWUM); 45 h/sem.; G. Domański.
[Edu78]	<i>Web Applications</i> (Programowanie aplikacji internetowych – PAINT); 45 h/sem.; P. Bobiński, R. Łukaszewski.	[Edu97] <i>Genetic Engineering</i> (Inżynieria genetyczna – INGE); 15 h/sem.; T. Rubel.
[Edu79]	<i>Wireless Transmission and Antennas</i> (Transmisja bezprzewodowa i anteny – TBAT); 60 h/sem.; K. Godziszewski.	
[Edu80]	<i>Wired and Wireless Communication</i> (Kommunikacja przewodowa i bezprzewodowa – PBL3); 180h/sem.; P. Korpas.	

TEACHING ACTIVITIES

- [Edu98] *Hearing and Sound Perception* (Słyszenie i percepcja dźwięku – SPD); 45 h/sem.; J. Żera.
- [Edu99] *High-Throughput Methods in Molecular Biology* (Wielkoskalowe metody pomiarowe w biologii molekularnej – MPB); 45 h/sem.; T. Rubel.
- [Edu100] *Information Systems in Medicine* (Systemy informatyczne w medycynie – SIM); 45 h/sem.; W. Smolik.
- [Edu101] *Machine Learning in Bioinformatics* (Uczenie maszynowe w bioinformatyce – UMB); 60 h/sem.; T. Rubel.
- [Edu102] *Magnetic Resonance Imaging* (Tomografia rezonansu magnetycznego – TRM); 45 h/sem.; P. Bogorodzki.
- [Edu103] *Mathematics in Multimedia* (Matematyka w multimediacach – MATMU); 60 h/sem.; W. Skarbek.
- [Edu104] *Methodological and Ethical Aspects of Research* – EMAR); 45 h/sem.; R. Z. Morawski (English-medium studies).
- [Edu105] *Microcontrollers in Wireless Transmission Systems* (Mikrokontrolery w systemach transmisji bezprzewodowej – MSTB); 45 h/sem.; J. Kołakowski.
- [Edu106] *Noise and Electromagnetic Interference in Electronic Devices* (Szумy i zakłócenia w aparaturze elektronicznej – SZAЕ); 45 h/sem., J. Marzec.
- [Edu107] *Modern Radio Transmission Techniques* (Nowe techniki transmisji radiowej – NTTR); 45h/sem.; S. Kozłowski.
- [Edu108] *Nuclear Medicine Techniques* (Techniki medycyny nuklearnej – TMN); 60 h/sem.; P. Brzeski, T. Olszewski, R. Szabatin.
- [Edu109] *Radiocommunication System Design* (Projektowanie systemów radiokomunikacyjnych – PSRK); 60 h/sem.; K. Kurek.
- [Edu110] *Semantic Image Analysis* (Analiza semantyczna obrazu – ASO); 45 h/sem.; P. Garbat.
- [Edu111] *Spatial Audio System* (Systemy dźwięku przestrzennego – SDP); 60 h/sem.; M. Lewandowski.
- [Edu112] *SRD Technology in Applications* (Techniki radia programowego w zastosowaniach – TRPZ), 60 h/sem.; D. Rosołowski.
- [Edu113] *Telemedical Systems* (Systemy telemedyczne - TELM); 45 h/sem.; R. Kurjata.

3.1.3. Doctoral School Courses

- [Edu114] *Ethical Aspects of Technoscientific Research* (EEATR); 15 h/sem., R. Z. Morawski.
- [Edu115] *Methodological Aspects of Technoscientific Research* (EMATR); 30 h/sem., R. Z. Morawski.

- [Edu116] *Biology – Inspired Computations* (Obliczenia inspirowane biologią - OIB); 60 h/sem., P. Bilski.

3.2. Special courses

3.2.1. Post-graduated studies: “Deep neural networks at digital media”

- [Edu117] *Compression and Immersion of Digital Objects* (Kompresja i zanurzanie obiektów cyfrowych – KZO); 12 h/sem.; R. Protasiuk.
- [Edu118] *3D Modeling – Face and Body Image Analysis* (Modelowanie 3D – analiza obrazu twarzy i sylwetki osoby – M3D), 24 h/sem.; G. Gwardys
- [Edu119] *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.
- [Edu120] *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.
- [Edu121] *Deep Neural Networks-Basics* (Głębokie sieci neuronowe – podstawy – GSP); 24 h/sem.; W. Skarbek.
- [Edu122] *Digital Objects Indexing* (Indeksowanie obiektów cyfrowych – IOC); 24 h/sem.; R. Pilarczyk.
- [Edu123] *Digital Objects Recognition* (Rozpoznawanie obiektów cyfrowych – ROC); 24 h/sem.; R. Pilarczyk.
- [Edu124] *Security in Digital Media* (Bezpieczeństwo w mediach cyfrowych – BMC); 12 h/sem.; A. Buchowicz.

3.2.3. Engineer Degree Evening Studies on Radiocommunications and Multimedia Technology

- [Edu125] *Diploma Seminar 2* Seminariusz dyplomowe – SD2M); 30 h/sem.; semester 8; J. Cichocki.
- [Edu126] *Ergonomics and Safety* (Ergonomia i bezpieczeństwo pracy – EBPZ); 30 h/sem.; semester 8; L. Kryst.
- [Edu127] *Seminar: Knowledge and Information Society* (Seminarium: Społeczeństwo wiedzy i informacji – SWM); 30 h/sem.; semester 8; P. Stacewicz.

3.3. International co-operation

- [Edu128] Upon completion of the degree requirements, the candidate will be awarded a single degree issued jointly by both institutions. Within the **Advanced Higher Education Network / Socrates (ATHENS)**, the course “*Sound: Hearing and Acoustical Measurements*” was given by **Jan Żera**. The 29 students who attended this course were from the following EU institutions of

higher education: Agro ParisTech (3), Chimie ParisTech (1), Czech Technical University in Prague (1), Ecole des Ponts ParisTech (2), Katholieke Universiteit Leuven (5), Mines ParisTech (11), Politecnico di Milano (1), Telecom ParisTech (4), Technische Universität München (1).

- [Edu129] **Collaboration between the Warsaw University of Technology and the University of Western Australia.**
Agreement on joint supervision and joint doctoral conferment process.
 2020 -2023

The agreement allows to undertake a joint Ph.D. subject to **Jerzy Cuper** M.Sc., he was registered as a doctoral student at the Doctoral School no. 3.

3.4. Educational projects

- [Edu130] **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, J. Marzec, R. Z. Morawski, M. Mikołajewski, P. Bogorodzki, K. Snopek, P. Brzeski, G. Domański, B. Konarzewski, S. Kozłowski, J. Kryszyn, R. Kurjata, P. Mazurek, E. Piątkowska-Janko, D. Radomski, T. Rubel, A. Rychter, W. Obrębski, P. Wróblewski;
 Feb. 01, 2018 – Jan. 01, 2022
Funded by the National Centre for Research and Development EU Operational Programme Knowledge – Education – Development - Cooperation 2014-2021-

The main goal of this project was 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.

- [Edu131] **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. Bajurko, P. Bobiński, A. Buchowicz, G. Galiński, K. Godzięcki, K. Ignasiak, W. Kazubski, P. Korpas, S. Kozłowski, K. Kurek, M. Lewandowski, R. Łukaszewski, A. Miękina, R. Z. Morawski, D. Rosołowski, W. Skarbek, W. Wojtasiak, J. Żera.
 Feb. 01, 2018 – Dec. 01, 2021
EU Operational Programme Knowledge – Education – Development - Cooperation 2014-2021
Funded by the National Centre for Research and Development

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

and Multimedia Technologies using new teaching methods.

- [Edu132] **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, J. Marzec, R. Z. Morawski, P. Bogorodzki, K. Snopek, P. Brzeski, G. Domański, 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 Develop. EU Operational Programme Knowledge – Education – Development - Cooperation 2014-2020

The main goal of this project is to modificate 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.

- [Edu133] **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).
Andrzej Buchowicz (head from Institute of Radioelectronics and Multimedia Technology), P. Bajurko, P. Bobiński, K. Godzięcki, K. Ignasiak, M. Jasiński, J. Kołakowski, P. Kopyt, P. Korpas, S. Kozłowski, M. Lewandowski, R. Łukaszewski, G. Makarewicz, A. Pietrzak, D. Rosołowski, W. Skarbek, W. Wojtasiak, Y. Yashchyn, J. Żera.
 Mar. 01, 2019 – Feb. 28, 2023
EU Operational Programme Knowledge – Education – Development - Cooperation 2014-2021
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. Scholarship for the outstanding young scientist granted by the Ministry of Education and Science

Piotr Czeała (supervisor: Prof. B. Salski);
 Feb. 19, 2021

4. RESEARCH ACTIVITIES

4.1. International projects

- [Pro1] **Super-Kamiokande to Hyper-Kamiokande (SK2HK)**
Marcin Ziembicki, R. Kurjata, A. Rychter, A. Klekotko, W. Obrębski, G. Pastuszak, 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 fulfill these goals while working with World leading experts.

- [Pro2] **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 - Jul. 31, 2023
IMAGE, Horizon 2020, 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 electro-acousto- 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.

- [Pro3] **High-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 (Institute of Microelectronics and Optoelectronics, WUT),
Paweł Kopyt (head on behalf of the Institute of Radioelectronics and Multimedia Technology); M. Piasecki;
 Nov. 01, 2016 – Oct. 31, 2021
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

- [Pro4] **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, Warsaw University, 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.

RESEARCH ACTIVITIES

- [Pro5] **Radar inerative navigation assistance system based on on-board surface imagery using SAR technology** (Radarowy system wspomagania nawigacji inercyjnej w oparciu o pokładowe zobrazowania powierzchni ziemi z wykorzystaniem technologii SAR).
Damian Gromek (Institute of Electronic Systems, WUT), D. Rosołowski;
Jul. 16, 2018 – Jul. 15, 2021
Funded by the National Centre for Research and Development
- The aim of the project was to create and test a demonstrator of a system for developing corrections for inertial navigation based on radar imaging of the earth's surface in the synthetic aperture SAR (Synthetic Aperture Radar) technique.
- [Pro6] **Integrated solution for innovative elderly care** (Zintegrowany system innowacyjnych rozwiązań dla opieki nad osobami starszymi)
Jerzy Kołakowski, V. Djaja-Jośko
J. Cichocki, M. Kołakowski;
Oct. 01, 2018 - Sept. 30, 2021
INCARE, IONIS AAL Joint Programme
Funded by the National Centre for Research and Development
- INCARE was designed to support seniors to live independently and reduce or optimize the amount of care they require. The goal of the project was to develop the INCARE platform that would 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 would integrate technologies and services for both indoor and outdoor support developed within NITICS project with autonomous, intelligent and adaptable RAPP robotic platform.
- [Pro7] **Personalized ICT solution to reduce re-hospitalization rates in heart failure elderly patients suffering from comorbidies** (Zastosowanie spersonalizowanej technologii ICT w celu zmniejszenia ponownych hospitalizacji u starszych pacjentów z niewydolnością serca cierpiących na choroby współistniejące).
Jerzy Kołakowski, V. Djaja-Jośko
J. Cichocki, M. Kołakowski;
Sept. 01, 2020 – Mar. 31, 2023
ERA PerMed Program
Funded by the National Centre for Research and Development
- Heart failure (HF) is a major and growing medical and economic problem, 70% of the elderly patients are readmitted to hospital within one year, making re-hospitalization an ongoing medical challenge. In this context, the PerHeart project is employing Information and Communication Technology with the main goal of reducing re-hospitalization rates in HF patients. The PerHeart ICT platform will integrate in a modular design functionalities dedicated to HF patients and their professional caregivers. The underlying artificial intelligence software will adapt to the patient's needs while collected data in three countries (Poland, Denmark, Italy) will help elucidate specific risk factors for readmission while taking gender and socio-economic aspects into account and help interpretation and prediction of complex multifactorial disease while also providing input for focused intervention.
- 4.2.2. Research grants**
- [Pro8] **An innovative alarm system with integrated SmartHome solutions and operation via mobile applications** (Innowacyjny system alarmowy umożliwiający integrację z rozwiązaniami SmartHome oraz obsługę przez aplikacje mobilne).
D. Rosołowski (head on behalf of the Institute of Radioelectronics and Multimedia Technology, WUT).
Jul. 16, 2018 – Jul. 15, 2021
Project in the frame of **NAVSAR** project realized in the Institute of Electronic Systems, Faculty of Electronics and Information Technology, WUT.
Funded by the National Centre for Research and Development
- The main goal of the project was to conduct expertises, measurements and modifications including radio communication modules, antennas and algorithms. Design of a testbed for measuring radiation pattern of alarm sensors as well as preliminary tests in electromagnetic compatibility. The project covered a total of 17 separate tasks.
- [Pro9] **Correlations between electromagnetic and magnetoelastic properties of ferromagnetic thin films** (Korelacje pomiędzy właściwościami elektromagnetycznymi i magnesotwierdzącymi cienkich warstw ferromagnetycznych).
Jerzy Krupka (Institute of Microelectronics and Optoelectronics), **B. Salski** (head on behalf of the Institute of Radioelectronics and Multimedia Technology, WUT), 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.
- [Pro10] **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 (Warsaw University, Faculty of Physics), P. Bogorodzki (head on behalf of the Institute of Radioelectronics and Multimedia Technology, 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.

- [Pro11] **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 Bilski, W. Smolik, K. Snopek (members of the Steering Committee);
 Dec. 20, 2019 – Dec. 20, 2022
BIO10 Programme
Funded by the National Centre for Research and Development

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.

- [Pro12] **Research and simulations of effects of HPM impulses** (Badania i symulacje skutków oddziaływanego 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.

- [Pro13] **Development and implementation of an artificial intelligence system for virtual characters allowing simulation of their realistic behavior and interaction with the player on the basis of autonomous image analysis of game participants in real time** (Opracowanie i implementacja systemu sztucznej inteligencji wirtualnych

postaci pozwalającego na symulację ich realistycznych zachowań i interakcji z graczem na podstawie autonomicznej analizy obrazu uczestników gry w czasie rzeczywistym).

Maciej Lasocki (WA PW), G. Galiński, P. Garbat (IMiO), M. Bieniek (WMEiL), M. Żakowski, M. Szymkowski (IMiO);
 Aug. 01, 2020 – Jun. 30, 2023

Funded by the National Centre for Research and Development
Operational Programme Intelligent Development 2014-2020

The aim of the project is to create a platform for creating multiplayer AR games using cloud rendering and machine learning. The result of the project, i.e. the new Pirxon platform, will be implemented directly in the consortium leader's business. The platform will be based on algorithms developed together with the consortium partner – the Warsaw University of Technology – and equipped with the first vision system supporting multiplayer games in augmented reality in real time.

- [Pro14] **Project implemented for the defence and security of the state of code name GRANIT**
Wojciech Wojtasik, D. Gryglewski;
 May, 19, 2021 – Dec. 22, 2022
Funded by the National Centre for Research and Development

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

4.2.3. Grants for young researchers

- [Pro15] **Accurate methods of materials spectroscopy in mm-wave and sub-THz frequencies** (Dokładne metody spektroskopii materiałów w paśmie milimetrowym i subterahercowym).
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 was to develop new, accurate and reliable methods for material characterization in mm-wave and sub-THz frequencies, where most of the high-tech industry was carrying out researches for 5G and IoT. Work would be focused on resonant methods, especially on Fabry-Perot open resonator structure. Firstly, a dedicated setup for both low-loss materials and conductive samples would 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 would be designed, fabricated partly at the Warsaw University of Technology, and tested within this project.

- [Pro16] **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, 2021

PRELUDIUM

Funded by the National Science Centre

The project was oriented on testing the hypothesis that the ultra-low-power impulse-radar sensors and infrared depth sensors could 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 could 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 was, 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.

[Pro17] **START 2020 Program**

Grzegorz Bogdan;

May 13, 2020 – May 13, 2021

Scholarship

Funded by the Foundation for Polish Science

The START scholarship of the Foundation for Polish Science had been granted for a scientific contribution to the field of adaptive beamforming in time-modulated antenna arrays. It was directed to young researchers, at the outset of their career, who have already achieved some success in their field. The stipends served as recognition of the scientific attainments so far by these young scholars and as an incentive for further growth by enabling them to devote themselves fully to their research.

[Pro18] **Feasibility study of time-modulation for antenna arrays in millimetre wave band**
(Ocena możliwości zastosowania metody modulacji czasowej do szyków antenowych w zakresie fal milimetrowych).

Grzegorz Bogdan;

Nov. 18, 2020 – Nov. 18, 2021

MINIATURA

Funded by the National Science Centre

The main goal of this project was to conduct a preliminary research on a time-modulated antenna array (TMAA) operating in the millimeter wave band. The TMAA with switches and a control circuitry would be designed and the whole system would be measured in the anechoic chamber. Excepted outcomes of the project include a qualitative examination of feasibility and determination of effects which appear at the millimetre range and affect the TMAA performance. The project is funded by the National Centre of Science under MINIATURA programme.

4.3. Projects granted by the University

4.3.1. Priority Research Area Grants

[Pro19] **Effective methods for electromagnetic coupling with Fabry-Perot Open resonator in THz frequency band** (Opracowanie

efektywnych metod dostarczania energii pola elektromagnetycznego do wnęki otwartego rezonatora Fabry-Perot pracującego w paśmie terahercowym).

Paweł Kopyt, B. Salski, J. Cuper,
A. Pacewicz, T. Karpisz;

Jul. 21, 2020 – Jun. 30. 2022

Project granted by the Scientific Council for Automatic Control, Electronics and Electrical Engineering, WUT.

The main goal of this project is to elaborate and optimize two alternative methods of coupling of electromagnetic wave with Fabry-Perot open resonator's cavity. The effort will be divided into two tasks aimed at obtaining a set of numerical and mechanical models of structures with couplings, which provided as weak loss of cavity's Q-factor as possible. Each measurement and numerical analysis will be taken in sub-THz and THz frequency band.

[Pro20] **Modern electronics, digital signal processing and data compression algorithms for high energy physics experiments** (Nowoczesna elektronika oraz algorytmy przetwarzania sygnałów i kompresji danych dla fizyki wysokich energii).

R. Kurjata, A. Rychter, J. Marzec,
K. Zaremba, W. Obrebski, G. Pastuszak,
A. Buchowicz, G. Galiński, M. Ziembicki,
A. Klekotko;

Jul. 01, 2020 – Jun. 30. 2022

Project granted by the Scientific Council for Biomedical Engineering, WUT.

The goal of the project is the integration and growth of a research team involve in several physical experiments within the process of the implementation of the planned research program. It covers various issues related to the competence of team members, ranging from test stands for the development of the ND280 near detector in the T2K experiment, through the characterization of photomultipliers for the HYPER-K experiment and its intermediate IWCD detector (Intermediate Water Cherenkov Detector), tests and analysis of test data of elements detectors (IWCD, ND280, AMBER, SPD @ NICA), ending with unique solutions in the field of signal analysis and data stream compression in the HYPER-K, COMPASS ++ / AMBER and SPD @ NICA experiments. In particular, the latter task presented the generality of the proposed solutions and the ability to easily adapt to changing requirements.

[Pro21] **The combined NMR-MPS method for studying application of magnetic nanoparticles for hyperthermia** (Skojarzona metoda NMR-MPS do badania nanocząstek w hipertermii).

Piotr Bogorodzki, W. Smolik, T. Płociński,
G. Domański, J. Kryszyn;

Jan. 26, 2021 – Jun. 30, 2022

Project granted by the Scientific Council for Biomedical Engineering, WUT.

In this project, we propose a two-stage measurement. The first stage involves broadband (2 kHz – 1 MHz) measurement of complex magnetic susceptibility by Magnetic Particle Spectroscopy (MPS) method. For this purpose the system for measuring complex magnetic susceptibility in function of frequency will be created. In the second stage measurement of the diffusion coefficient by Nuclear Magnetic Resonance

(NMR) method will be conducted. The third part includes imaging of nanoparticles samples using electron microscopy methods (TEM, SEM). Nanoparticle diameter distribution will be determined on the basis of image segmentation.

[Pro22] **Capacitively coupled electrical tomography for anatomical and functional imaging** (Elektryczna tomografia ze sprzężeniem pojemnościowym do obrazowania anatomicznego i funkcjonalnego).

Waldemar Smolik, J. Kryszyn, M. Wanta, P. Wróblewski;

Jan. 26, 2021 – Jun. 30, 2022

Project granted by the Scientific Council for Biomedical Engineering, WUT.

Jan. 26, 2021 – Dec. 31, 2022

Electrical tomography allows to visualize a spatial distribution of electrical parameters of tested objects. Until now, electrical impedance tomography (EIT) with sinusoidal excitation was considered to have the greatest potential for application in diagnostic medical imaging, but impedance of electrode-skin contact, which is a major challenge in this imaging technique, limits the practical use of EIT. In this project, an alternative approach with non-contact electrodes and pulse excitation will be investigated.

The aim is to verify the properties of capacitively coupled electrical tomography in the context of diagnostic medical imaging. Studies will be performed using numerical and physical lung phantom, taking into account regional ventilation distribution. Measurement sensitivity, contrast and spatial-temporal resolution of images could be assessed.

[Pro23] **Dynamic sound source detection and localization with a microphone arrays using machine learning and prediction algorithms** (Detekcja i lokalizacja ruchomych źródeł dźwięku za pomocą matrycy mikrofonowej i algorytmów uczenia maszynowego oraz predykcji).

Piotr Bilski, M. Lewandowski, G. Markiewicz, A. Pietrzak, M. Jasiński;

Jan. 28, 2021 - Dec. 31, 2022

Project granted by the Scientific Council for Artificial Intelligence and Robotics, WUT.

The main goal of the project is to develop and verify by simulation tests, algorithms that enable to analyze the acoustic field occurring in the area where the autonomous robot is located based on sound signals. Unlike other works, this project focuses on sound, due to the fact that sound can provide important information as much as image, but nowadays in many works it receives much less attention. In the past, one of the reasons for this was a kind of deficit in the ability to detect signals reaching the robot.

[Pro24] **Light-matter interaction of dielectric micro-resonators with microwave photons in a Fabry-Perot open resonator** (Oddziaływanie światło-materia mikrorezonatorów dielektrycznych z fotonami mikrofalowymi w otwartym rezonatorze Fabry-Perot).

Bartłomiej Salski, T. Karpisz, P. Czeała;

Jan. 27, 2020 – Dec. 31, 2022

Project granted by the Scientific Council for Automatics, Electronics and Electrical Engineering, WUT.

The goal of this project will be at first to develop a rigorous electromagnetic model of the Fabry-Perot open resonator with a dielectric micro-resonator located inside. The model will combine a newly proposed model of the Fabry-Perot open resonator based on the scattering matrix approach and a mode matching method that will be applied to solve the micro-resonator.

[Pro25] **Frequency extenders integrated electronically with a vector network analyzer in a single-sweep mode operating in the 50-120 GHz frequency band** (Ekstendery częstotliwości zintegrowane elektronicznie z wektorowym analizatorem obwodów do pracy w trybie single-sweep w paśmie 50-120 GHz).

Bartłomiej Salski, T. Karpisz; P. Kopyt, A. Pacewicz, J. Cuper;

Nov. 08, 2021 – Nov. 08, 2023

Project granted in the competition for projects aiming to purchase equipment.

Excellence Initiative, Research University.

The competition aims to enhance the research potential of the Warsaw University of Technology through the purchase of specialist research equipment. The aim of this project is the purchase of dedicated frequency extenders that allow expanding the operating range of the existing VNA analyzer in such a way that it will be possible to work in single-sweep mode over the entire measuring frequency range, i.e. from 10 MHz to 120 GHz. The purchase of this equipment will enable the characterization of dielectric materials in the previously unavailable frequency range, i.e. 20-120 GHz.

[Pro26] **Chemical reactor vessel using intelligent microwave source** (Reaktor chemiczny z wykorzystaniem inteligentnego źródła mocy mikrofalowej).

Przemysław Korpas, K. Jankowski, W. Wojtasik, D. Gryglewski, S. Kozłowski;

Mar. 01, 2021 – Feb. 28, 2023

Excellence Initiative, Research University

Two processes have been planned to be examined in the project: synthesis of nanofertilizer and separation of nanohybrid. The first selected process consists in a 2-step synthesis of a nanofertilizer based on metal oxides (copper, magnese, iron, zinc) in the presence of microwave energy. First, a dispersion of metal hydroxides is obtained, which is then dehydrated. The second process is a 1-step preparation of nanohybrid composed of hydroxyapatite and urea, characterized by a long period of nitrogen release to the soil. The chemical reactor vessel proposed in the project works in a double feedback loop to control the current temperature in the reactor and to track the minimum return loss depending on the frequency.

4.3.2. Internal grants

[Pro27] **A Fabry-Perot open resonator with a Bragg gratings made by 3D printing** (Otwarty rezonator Fabry-Perot z siatką Bragga wykonaną metodą druku 3D).

Bartłomiej Salski, M. Kryscicki;

Jul. 27, 2020 –Dec. 31, 2021

Project granted by the Scientific Council for Automatics, Electronics and Electrical Engineering, WUT.

The goal of this project would be research on the application of Bragg gratings increasing spectral resolution of a Fabry-Perot open resonator operating in the 20-110 GHz range. It would open the way for more accurate electromagnetic characterization of low-loss materials for 5G applications.

- [Pro28] **Analysis of selected obstetric factors influence on the bioelectric uterine activity signal parameterization** (Analiza wpływu wybranych czynników położniczych na sposób parametryzacji sygnału bioelektrycznej aktywności macicy).
Dariusz Radomski;
 Jul. 21, 2020 – Dec. 31, 2021
 Project granted by the Scientific Council for Biomedical Engineering, WUT.

The aim of the study was to assess selected maternal health factors on the values of the most frequently described EHG signal parameters. Factors to be analyzed would include: maternal age, sequence of pregnancy, smoking, gestational diabetes, placenta location, BMI, previous cesarean section. For EHG signal parameterization, the mean signal power, mean frequency, median frequency, dominant frequency, approximate entropy value, and some parameters of the image of the distribution of excitations measured with a 16-channel electrohysterograph would be used.

- [Pro29] **Hospital information system based on openEHR system – analysis of efficiency** (Szpitalny system informacyjny oparty na standardzie openEHR – analiza wydajności).
Jacek Kryszyn;
 Jul. 21, 2020 – Dec. 31, 2021
 Project granted by the Scientific Council for Biomedical Engineering, WUT.

The purpose of the project was to create a hospital information system using the openEHR standard and to analyze the efficiency of such a solution. The project would result in a comparison of the performance of a classic hospital information system based on a proprietary relational database and one based on the openEHR standard. The average user considered an application functional if the content appears within 2 seconds or less. It can be expected that a user such as a doctor cannot afford to wait too long due to the nature of his work. Therefore, the conditions under which this requirement was met (the amount of data in the system, parameters of the machine on which the system operates) would be determined. The results would be summarized in a scientific article.

- [Pro30] **Research on magnetic nanoparticles for hyperthermia by means of MPS method** (Badanie nanocząsteczek magnetycznych w zastosowaniu do hipertermii metodą MPS).
Przemysław Wróblewski, M. Midura;
 Jul. 21, 2020 – Dec. 31, 2021
 Project granted by the Scientific Council for Biomedical Engineering, WUT.

The aim of the project was to develop a measurement system to determine the magnetic losses of particles based on the analysis of their complex magnetic susceptibility and to conduct preliminary experiments for selected magnetic nanoparticles.

- [Pro31] **Measurement the hydrodynamic diameter of nanoparticles by means of nuclear**

magnetic resonance (NMR) (Pomiar średnic hydrodynamicznych nanocząsteczek metodą jądrowego rezonansu magnetycznego (NMR)).

Michał Wieteska, K. Lipiński;
 Jul. 21, 2020 – Dec. 31, 2021
 Project granted by the Scientific Council for Biomedical Engineering, WUT.

Interest in magnetic nanoparticles and their potential use in medicine had been increasing in recent years. Those particles may serve as contrast agents in Magnetic Resonance Imaging (MRI), Myocardial Perfusion Imaging (MPI) or be used for cancer treatment (hypertermia). In recent years many manufacturers started producing various types of magnetic nanoparticles (they differ in regards such as core and shell material). Although the market was vast, the datasheets for this products often lack information required for calculating their magnetic properties. Optimizing the power loss of those particles is crucial in aforementioned diagnostics and hypertermia therapy. In MRI and MPI we want to minimize the power loss to protect the patient, whereas in cancer treatment we wish to maximize the power for more efficient elimination of cancerous cells. Power loss in magnetic nanoparticles was strongly correlated with their hydrodynamic diameter. In this study we would perform Spin-Echo (SE) and Inversion-Recovery (IR) experiments, calculate the T1 and T2 relaxation times of nanoparticles, perform Diffusion Weighted Imaging (DWI) and use Stokes-Einstein law to calculate their diameters. In the future we would combine our method with electromagnetic method of measuring the hydrodynamic diameter, compare the results and propose a reliable method for such measurement.

- [Pro32] **Methods of increasing the sensitivity of measuring the properties of dielectric substrates in the Fabry-Perot resonator in the subterahertz frequency range** (Metody zwiększenia czułości pomiaru własności podłoży dielektrycznych w rezonatorze Fabry-Perot w zakresie częstotliwości subterahercowych).
Adam Pacewicz, B. Salski, T. Karpisz, J. Cuper;
 Jul. 27, 2021 – Dec. 31, 2022
 Project granted by the Scientific Council for Automatics, Electronics and Electrical Engineering, WUT.

Due to the dynamic development of 5G technology, there is a great demand for characterization of low-loss dielectric materials in the microwave and wave range millimeters. One of the best solutions in this regard is the Fabry open resonator (Fabry-Perot open resonator, FPOR). Measurement method consists in placing the tested material in the resonator and determining the frequency changes resonance of axisymmetric Gaussian types TEM0.0, q and their quality factor. The comparison of the experiment results with the electromagnetic model of the resonator allows determine the complex electric permittivity, ϵ , of the tested material in a wide range frequency.

4.4. Other projects

- [Pro33] **Performing R&D tasks and creating a prototype of an innovative handset equipped with predictive active noise reduction (pANC) technology, which au-**

tomatically adjusts to the working environment (Przeprowadzenie prac B+R and stworzeniem prototypu innowacyjnej słuchawki wyposażonej w technologię predykcyjnej aktywnej redukcji hałasu (ANC), która automatycznie dostosowuje się do środowiska pracy).

Grzegorz Makarewicz;

Jun. 01. 2021 – Aug. 31, 2023

Funded by the AXEL sp.z.o.o.

The topic of the project is to perform Research and Development tasks in the field of active noise reduction/compensation (ANC) to create the prototype of innovative headphones equipped with predictive Active Noise Reduction/Compensation (pANC) technology, which automatically adjusts the parameters of the active headphones to the changing parameters of the operating environment.

The idea of the project is to develop new algorithms for the synthesis of the compensating signal by predicting its parameters on the basis of already measured values. It should then be possible to use systems with lower computing powers for calculations and to apply more complex and efficient adaptive algorithms, increasing the effectiveness of active reduction. This will meet the expectations of the target group (consumers interested in high-quality ANC-equipped headphones), who expect more effective noise isolation to improve the quality of sound reproduced in the headphones. Optimizing the process of parameters' calculation to compensate signal will allow for functional improvements, such as inclusion in the algorithm implemented in the control system of signals and messages with an important informative role, e.g. warning signals, in order to extract them from the active reduction operation. During the project, subsequent versions of the headphones prototype will be developed along with the software to achieve the highest possible noise reduction parameters.

[Pro34] **Designing RF circuits for LTE 450 MHz base station for critical applications** (Projektowanie obwodów RF do stacji bazowej LTE 450 MHz do zastosowań krytycznych).

Daniel Gryglewski

Jul. 01, 2020 – Dec. 31, 2022

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

The aim of this work is to design and test RF circuits for the newly developed LTE base station intended for critical applications. The system are to operate in the LTE 450 MHz band (B31).

The Institute of Radioelectronics and Multimedia Technology acts as a sub-contractor of IT Partners Telco. The contract is carried out as a part of the National Centre for Research and Development project "LTE -Advanced 450 MHz Micro Base Station for Critical – Mission Systems", implemented under the "Path for Mazovia" program.

[Pro35] **Realization of research and development expert works** (Realizacja prac o charakterze badawczo-rozwojowym i eksperckim).

Waldemar Smolik, A. Rychter, J. Kryszyn, D. Wanta;

Aug. 12, 2020 – Nov. 30, 2021

Funded by Giełda Papierów Wartościowych w Warszawie S.A. (Warsaw Stock Exchange).

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

[Pro36] **BST/polymer composites tunability studies in the frequency range up to 500 GHz** (Badania przestralalności kompozytów BST/polimer w zakresie częstotliwości do 500 GHz).

Yevhen Yashchyshyn, K. Godziszewski;

Oct. 19, 2020 – Jul. 31, 2022

Funded by the Faculty of Chemistry, WUT.

The project is carried out as part of NCN's project **SHENG 1 – Polish-Chinese Funding Initiative**. SHENG-1 is focused on the cooperation between Warsaw University of Technology and Northwestern Polytechnical University to jointly elaborate BST/polymer dielectric tunable functional composites by tape casting. The main emphasis is putted on the influence of BST particles, polymer type, BST/polymer interactions and composite structure on the microstructure and dielectric properties of materials. The important parameter will be the dielectric tunability of composite materials in sub-THz frequencies. Dielectric tunability theoretical model of ceramics/polymer functional composites is the key issue of the project. It allows to design and test high dielectric tunable composites. Testing BST/polymer composites under the microwave and sub-THz frequencies is the main goal of the part of the project that is done in Antennas and sub-THz Technology Group as the subtask.

[Pro37] **Analysis of the impact of buildings in the area Wirażowa/ Osińskiego/Bennetta to identify the radars of the Polish Air Navigation Services Agency in the Okęcie airport** (Analiza wpływu planowanej zabudowy w rejonie Wirażowa/ Osińskiego/Bennetta na wskazania radarów będących w gestii Polskiej Agencji Żeglugi Powietrznej w rejonie lotniska Okęcie).

Wojciech Wojtasiak, D. Gryglewski;

Jan. 25, 2020 – Mar. 31, 2021

Funded by JEMS ARCHITEKCI sp.z.o.o.

The aim of the project was to predict the influence of the buildings on the existing air-traffic control facilities.

[Pro38] **Analysis of structural data from image studies using FreeSurfer software** (Analiza danych strukturalnych z badań obrazowych z wykorzystaniem oprogramowania FreeSurfer).

Ewa Piątkowska-Jankó;

Jan. 29, 2021 – Feb. 11, 2021

Funded by SWPS University.

The aim of this project was analyzed the structural data from image investigations using FreeSurfer software. FreeSurfer is a tool for the analysis and visualization of structural and functional neuroimaging data from cross-sectional and longitudinal studies. The investigations analysis and visualization of structural and functional neuroimaging data from cross-sectional or longitudinal studies.

[Pro39] **Examination of broadband mixer, low noise amplifier and receiver** (Badanie szerokopasmowego mieszacza wzmacniacza niskoszumowego oraz odbiornika).

Paweł Bajurko, J. Sobolewski;

Apr. 26, 2021 – May 15, 2021

Funded by SIRC sp.z.o.o.

Characteristics of various microwave devices were examined during this work.

- [Pro40] **Development of an innovative service - platform for secure mobile communication based on trusted identity confirmation** (Opracowanie innowacyjnej usługi – platformy do bezpiecznej mobilnej komunikacji opartej na zaufanym potwierdzeniu tożsamości).
Andrzej Rychter, R. Kurjata, J. Kryszyn, M. Trokielewicz, E. Bartuzi, K. Dygnerowicz
M. Hałon;
Jun, 01, 2021- Dec. 31, 2021
Funded by NEONTRI sp.z.o.o.

The project aimed to design a software library for mobile applications that would ensure that the data provided by the user in the KYC process (Know Your Customer) was of appropriate quality, corresponded to the set of documents required in a given business process, and assesses their credibility at the earliest stage of processing initially. The library would be a suite of algorithms and assessment tools for image data quality, designation features of compliance with different pattern methods, and anonymization carried out on the user's phone side without transmission of confidential data to the server to be processed. In addition, biometric identity identification techniques would automatically verify the user's identity based on the data sent by him. The project would be elaborated in the co-operation with the Institute of Control and Computation Engineering, WUT.

- [Pro41] **Lecture on artificial intelligence and machine learning for MBA Kaizen Industry 4.0 students** (Wykład ze sztucznej inteligencji i nauczania maszynowego dla studentów studiów MBA Kaizen Industry 4.0).
Piotr Bilski, P. Mazurek, M. Jasiński;
Jul. 13, 2021
Funded by Instytut Industry 4.0. sp.z.o.o.

Three-term postgraduate studies that were established in the partnership of WUT BS with Kaizen Institute Poland and Institute of Industry 4.0. The main purpose of the programme was to provide our students with practical knowledge of organization and management of a modern production company, which effectively operate on global market. The studies were addressed to middle and senior managers as well as directors.

- [Pro42] **Contact-probe examination of broadband mixers and low noise amplifiers** (Badania ostrzowe szerokopasmowych mieszaczów i wzmacniaczy niskoszumowych).
Paweł Bajurko, J. Sobolewski;
Jul. 19, 2021 – Jul. 31, 2021
Funded by SIRC sp.z.o.o.

Characteristics of the broadband mixers and low noise amplifiers were determined using mm-wave on-wafer measurement system.

- [Pro43] **Examination of Track & Hold amplifier** (Badanie wzmacniacza typu Track & Hold).
Paweł Bajurko, J. Sobolewski;
Nov. 08, 2021 – Nov. 30, 2021
Funded by SIRC sp.z.o.o.

Characteristics of a novel Track & Hold Amplifier were examined during this work.

[Pro44] **Examination of scattering parameters of a set of circuits in the 60-75 GHz frequency range** (Badanie parametrów rozproszenia zestawu obwodów w zakresie częstotliwości 60-75 GHz).

Paweł Bajurko;
Nov. 15, 2021- Dec. 31, 2021
Funded by THORIUM SPACE sp. z o.o.

Scattering parameters of circuits operating in 60-75 GHz were examined in this work by means of a two-port waveguide-base measurement system.

4.5. Other activities

4.5.1. Partnership

4.5.1.1. 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 world-wide 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**

4.5.1.2. 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 Construc-

tion 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.

Microwave Microscopy for Advanced and Efficient Materials Analysis and Production

Przemysław Korpas;

MMAMA Project - research and innovation programme under European Union **Framework Programme - HORIZON 2020**

2017-2021

Cooperation with QWED company focused on development of accurate microwave Q-Meter device for 10 GHz Split-Post Dielectric Resonators and algorithms for special resolution improvements of scans performed with such a resonator.

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 Yashchyshyn;

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 subsystems 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 Neutrino)

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 starts 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 on 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 used 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 Kołkowski – 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 IoT 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 - 2021

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 Yashchyshyn, P. Bajurko;
2010 – 2021

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, 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.

5. TITLES AND DEGREES AWARDED

5.1. Ph.D. Degrees

- [PhD1] Vitomir Djaja-Joško: "Nowe metody bezprzewodowej synchronizacji w ultraszerokopasmowych systemach lokalizacyjnych" (Novel methods for the wireless synchronization in ultrawideband localization systems), Prof. **J. Modelska** (supervisor), Ph.D. degree with honours, Warsaw, Dec. 10, 2021.
- [PhD2] Adam Pacewicz: "Resonance methods for microwave characterization of microwave spheres", Assoc. Prof. **B. Salski** (supervisor), Ph.D. degree with honours, Warsaw, May 05, 2021.
- [PhD3] Agnieszka Paula Pietrzak: „Ocena ekspozycji muzyków na dźwięk z wykorzystaniem dwukanałowej dozymetrii hałasowej” (Estimation of musicians' sound exposure by two-channel sound dosimetry), Prof. **J. Żera** (supervisor), Ph.D. degree with honours, Warsaw, Feb. 04, 2021.
- [PhD4] Daniel Andrzej Piętak: "Metoda oceny jakości wyników eksperymentów wzbudzeń kolumbowskich z wykorzystaniem algorytmu genetycznego" (Method of assessing the quality of the results of Columbus excitation experiments using a genetic algorithm), Assoc. Prof. **P. Bilski** (supervisor), Warsaw, Sept. 2, 2021.
- [PhD5] Augustyn Wójcik: "Zastosowanie metod czasowo-częstotliwościowych do analizy stanów nieustalonych odbiorników energii elektrycznej" (Application of time-frequency methods for the analysis of transient states of electricity consumers), Assoc. Prof. **P. Bilski** (supervisor), Warsaw, Aug. 31, 2021.

5.2. M.Sc. Degrees

- [MSc1] Mateusz Baryłka: "Oprogramowanie do analizy i klasyfikacji zmian chorobowych w rentgenodiagnostyce płuc" (Software for analysis and classification of lesions in x-ray lung diagnostics), Assist. Prof. **R. Kurjata** (supervisor).
- [MSc2] Dominik Bożek: "Wielokanałowy odbiór sygnałów bioelektrycznych" (Multichannel recording of bioelectric signals), Assist. Prof. **G. Domański** (supervisor).
- [MSc3] Kamil Cywoniuk: "Ocena wydajności szpitalnego systemu informacyjnego opartego na standardzie openEHR" (Performance evaluation of a hospital information system based on openEHR standard), Assist. Prof. **J. Kryszyn** (supervisor), M.Sc. degree with honours.
- [MSc4] Piotr Tomasz Czekała: "Pomiary wilgotności i zasolenia ziemi metodami mikrofalowymi" (Measurements of soil moisture and salinity via microwave methods), Assoc. Prof. **B. Salski** (supervisor), M.Sc. degree with honours.
- [MSc5] Mikołaj Darek: "Wykorzystanie sygnałów UWB do pomiaru grubości warstwy lodu na zbiornikach wodnych" (Usage of UWB signals to measure ice thickness on water reservoirs), Assist. Prof. **P. Bajurko** (supervisor).
- [MSc6] Amelia Drożdzikowska: "Zastosowanie technik redukcji wymiarowości do selekcji genów na podstawie danych z mikromacierzy DNA" (Application of the dimensionality reduction technique to the selection of genes on the basis of DNA microarray data), Assist. Prof. **T. Rubel** (supervisor).
- [MSc7] Jakub Fąk: "Synteza dźwięku na podstawie cyfrowego obrazu partytury" (Sound synthesis based on digital score image), Assoc. Prof. **K. Snopk** (supervisor), M.Sc. degree with honours.
- [MSc8] Patrycja Haraburda: „System wspomagania diagnostyki chorób oczu” (Eye diseases diagnostics support system), Assist. Prof. **L. Dąbała** (supervisor).
- [MSc9] Piotr Harakop: „Pomiar współczynnika pochłaniania dźwięku metodą *in statu*” (In-situ measurements of sound absorption coefficient), Prof. **J. Żera** (supervisor).
- [MSc10] Radosław Helon: "Rejestrator sygnałów radiofonicznych wykonany w technice SDR" (SDR - based radio signal acquisition system), Assist. Prof. **P. Korpas** (supervisor).
- [MSc11] Dominika Jagieło: „Urządzenie do badania poziomu utlenowania krwi i analizy fali pulsu ze sterowaniem mikrokontrolerowym” (Device for testing the level of blood oxygenation and analyzing the pulse wave with microcontroller control), Assist. Prof. **G. Domański** (supervisor).
- [MSc12] Tomasz Junker: „Akustyczna adaptacja wnętrz przy ich nagłośnieniu z wykorzystaniem liniowych systemów głośnikowych” (Acoustic adaptation of interiors when using line array loudspeaker systems), Assist. Prof. **P. Bobiński** (supervisor).
- [MSc13] Paweł Kaniewski: „Model systemu pomiarowo – kontrolnego typu „Smart Home” (Model of the Smart Home measurement and control system), Assist. Prof. **R. Kurjata** (supervisor).
- [MSc14] Jędrzej Wojciech Klocek: „Aplikacja webowa służąca do diagnostyki mikrostacji bazowej LTE” (A web-based application for LTE base station diagnostics), Assist. Prof. **P. Korpas** (supervisor).
- [MSc15] Anna Ramona Kotkowska: „Lokalizacja dźwięku z zastosowaniem funkcji HRTF” (Sound localization with function of HRTF), Prof. **J. Żera** (supervisor).

- [MSc16] Natalia Kozak: „*Optymalizacja metody obrazowania przy pomocy fotonów rozproszonych wstecznie w celu wykrywania materiałów niebezpiecznych*” (Optimization of the imaging method with backscattered photons for the detection of hazardous materials), Assoc. Prof. **S. Wronka** (supervisor).
- [MSc17] Karol Kwietniak: „*Wielokanałowe urządzenie do rejestracji sygnału EKG*” (Multichannel ECG recording device), Assist. Prof. **G. Domański** (supervisor).
- [MSc18] Michał Maciola: „*Nagrzewnica indukcyjna z wysokosprawnym wzmacniaczem klasy E*” (Induction heater with class E tuned power amplifier), Assist. Prof. **M. Mikolajewski** (supervisor).
- [MSc19] Piotr Machowski: „*Modelowanie propagacji sygnału radiowego z wykorzystaniem numerycznego modelu terenu*” (Radio signal propagation modeling using a digital terrain model), Assist. Prof. **P. Korpas** (supervisor).
- [MSc20] Adrianna Maczuga: „*Moduł do pomiaru przekroju wiązki świetlnej przeznaczony dla stanowiska do charakteryzacji fotopowielaczy*” (Module for the measurement of the cross-section of the light beam intended for the photomultiplier characterization station), Assist. Prof. **R. Kurjata** (supervisor).
- [MSc21] Dagmara Katarzyna Mazur: „*Projekt spektrometru magnetycznego oraz pomiary energii liniowego akceleratora elektronów*” (Magnetic spectrometer design and energy measurements of a linear electron accelerator), Assoc. Prof. **S. Wronka** (supervisor).
- [MSc22] Michał Miotke: „*Model rozproszonego systemu do automatycznego przetwarzania oraz analizy danych z badań EKG w czasie rzeczywistym*” (Model of a distributed real-time system for automated processing and analysis of ECG data), Assist. Prof. **R. Kurjata** (supervisor).
- [MSc23] Katarzyna Muter: „*Techniki selekcji cech na potrzeby klasyfikacji danych z mikromacierzy DNA*” (Feature selection methods for microarray data classification), Assist. Prof. **T. Rubel** (supervisor).
- [MSc24] Piotr Steczeń: „*Komputerowe wspomaganie diagnostyki wirusowego zapalenia płuc, w tym COVID-19, za pomocą wybranych deskryptorów wizualnych*” (Computer-aided diagnosis of viral pneumonia, including COVID-19, using selected visual descriptors), Prof. **A. Przelaskowski** (supervisor).
- [MSc25] Julia Szyszko: „*Syntetyczny model mechaniczny lewej komory serca na potrzeby badań metod pomiaru deformacji tkanek z użyciem ultradźwiękowych technik diagnostycznych*” (Synthetic mechanical model of the left ventricle for research into the methods of measuring tissue deformation using ultrasound diagnostic techniques), Assoc. Prof. **J. Żmigrodzki** (supervisor).
- [MSc26] Marcin Wiktorowicz: „*Projekt układu magnetycznego prowadzenia wiązki e- w mikrotronie 30/45 MeV*” (The project of magnetic guidance system of an e-beam in microtron 30/45 MeV), Assoc. Prof. **S. Wronka** (supervisor).

5.3. B.Sc. Degrees

- [BSc1] Jakub Andrzejewski-Popow: „*Rejestracja fal dźwiękowych przy użyciu bezzałogowych statków powietrznych*” (Recording of sound waves using unmanned aerial vehicles), Assist. Prof. **M. Lewandowski** (supervisor).
- [BSc2] Hubert Bolczak: „*Stacja pogodowa z interfejsem BLE*” (Weather station with BLE), Assist. Prof. **K. Godziszewski** (supervisor).
- [BSc3] Wojciech Borowski: „*Aplikacja do optymalizacji projektów anten*” (Application for optimizing antenna designs), Assist. Prof. **G. Bogdan** (supervisor).
- [BSc4] Karolina Bralewska: „*Analiza cepstralna w analizie mowy zdrowej i patologicznej*” (Cepstral analysis in the analysis of healthy and pathological speech), Assoc. Prof. **K. Snopek** (supervisor).
- [BSc5] Krzysztof Brzóska: „*Przewodnik lokalny - aplikacja internetowa*” (Local guide - web application), Assist. Prof. **K. Ignasiak** (supervisor).
- [BSc6] Stanisław Bukowski: „*Aplikacja webowa do zautomatyzowanych testów słuchowych*” (Web application for automated sound quality tests), Assist. Prof. **P. Bobiński** (supervisor).
- [BSc7] Marcin Bykowski: „*Opracowanie oprogramowania do akwizycji i prezentacji wyników z modułu IoT*” (Development of software for the acquisition and presentation of results from the IoT module), Assist. Prof. **J. Kołakowski** (supervisor).
- [BSc8] Michał Daniłuk: „*Stanowisko komputerowe do badania informacyjnego maskowania dźwięku*” (Computer stand for measurements of informational sound masking), Assist. Prof. **A. Pietrzak** (supervisor).
- [BSc9] Adam Dobrowolski: „*Przedwzmocniacz lampowy z wielopasmową korekcją charakterystyki częstotliwościowej*” (Vacuum tube preamplifier with multiband frequency response correction), Assist. Prof. **G. Makarewicz** (supervisor), B.Sc. degree with honours.
- [BSc10] Wojciech Jan Drzewiecki: „*Układ do bezprzewodowej transmisji energii*” (A wireless power transfer system with a Class E amplifier), Assist. Prof. **M. Mikolajewski** (supervisor).

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- [BSc11] Aleksandra Julia Dudek: „Opracowanie stanowiska demonstracyjnego do badań idiofonów” (Development of a demonstration station for the study of idiophones), Prof. **J. Żera** (supervisor).
- [BSc12] Paulina Goluch: „Analiza ekspozycji muzyków orkiestry w pasmach 1/3 - oktawowych z uwzględnieniem okresu powstania wykonywanej muzyki” (An analysis of orchestra musicians' exposure to sound in 1/3-octave bands with consideration to musical periods), Prof. **J. Żera** (supervisor).
- [BSc13] Adam Grabicz: „Detekcja replik obrazów z wykorzystaniem splotowych sieci neuronowych” (Detection of image replicas using convolutional neural networks), Assist. Prof. **G. Galiński** (supervisor).
- [BSc14] Marta Grenadier: „Odszumianie sygnału EKG z wykorzystaniem metody progowania współczynników falkowych” (ECG signal denoising by wavelet transform thresholding), Assoc. Prof. **K. Snopek** (supervisor).
- [BSc15] Adam Gromadzki: „Opracowanie anteny miniaturowej dla systemów nawigacyjnych” (Development of electrically small antenna for navigation systems), Prof. **Y. Yashchyshyn** (supervisor).
- [BSc16] Jan Grzegorek: „Aplikacja do wyświetlania obrazów DICOM w przeglądarce internetowej” (Application for displaying DICOM images in a web browser), Assist. Prof. **R. Kurjata** (supervisor).
- [BSc17] Przemysław Hepner: „Układ efektu gitara-wego wykorzystującego lampy elektronowe” (Vacuum tube based guitar effect), Assist. Prof. **G. Makarewicz** (supervisor).
- [BSc18] Tomasz Jankowski: „Implementacja stacji radioamatorskiej na platformie USRP” (USRP-based SDR implementation of an amateur radio transceiver), Assist. Prof. **D. Rosołowski** (supervisor).
- [BSc19] Antoni Kalinkowski: „System do badania i porównywania algorytmów kompresji obrazu” (System comparing image compression algorithms), Assist. Prof. **G. Galiński** (supervisor).
- [BSc20] Marcin Klepacki: „Synteza wysokopoziomowa estymacji ruchu kodra wideo” (High-level synthesis of motion estimation in video encoder), Assoc. Prof. **G. Pastuszak** (supervisor).
- [BSc21] Filip Knap: „Poprawa rozdzielczości obrazów z wykorzystaniem splotowych sieci neuronowych” (Super resolution convolutional neural networks for image restoration), Assist. Prof. **G. Galiński** (supervisor).
- [BSc22] Klaś Kotkowska: „Opracowanie i implementacja metody przewidywania toksyczności związków małocząsteczkowych z wykorzystaniem uczenia maszynowego” (Development and implementation of the method of predicting small molecule com-
- pounds' toxicity with application of machine learning), Assist. Prof. **P. Tomaszewicz** (supervisor), B.Sc. degree with honours.
- [BSc23] Aleksandra Krawczyk: „Analiza materiałów obciążenia słuchu muzyków uzyskanych w pomiarach dozymetrycznych” (Analysis of musicians' sound exposure data obtained in dosimetric measurements), Prof. **J. Żera** (supervisor).
- [BSc24] Szymon Kruszewski: „Algorytmy estymacji parametrów sygnału użytecznego pochodzącego z impulsowych czujników radarowych ultra-małej mocy w systemie monitoringu osób starszych” (Algorithms for estimating parameters of useful signal from ultra-low power impulse radar sensors in the monitoring system of elderly people), Assist. Prof. **P. Mazurek** (supervisor).
- [BSc25] Adam Marcin Kubiński: „Wyznaczanie map głębi na podstawie pary obrazów stereoskopowych” (Creating depth map using pair of stereo images), Assist. Prof. **A. Buchowicz** (supervisor).
- [BSc26] Małgorzata Lus: „Program do analizy mammogramów w celu wykrywania zwień” (A program for analysing mammograms to detect calcification), Assist. Prof. **G. Domański** (supervisor).
- [BSc27] Damian Majcher: „Synchroniczna przetwornica podwyższająca” (Synchronous boost converter), Assist. Prof. **M. Mikołajewski** (supervisor).
- [BSc28] Bartosz Marchlewicz: „Mini moduł lokalizacyjny APRS” (APRS mini location module), Assist. Prof. **D. Rosołowski** (supervisor).
- [BSc29] Grzegorz Maros-Turek: „Moduł oprogramowania elektrycznego tomografu pojemościowego EVT4 do konfiguracji kanałów pomiarowych” (Software module for electrical capacitance tomograph EVT4 for measurement channels' configuration), Assoc. Prof. **W. Smolik** (supervisor).
- [BSc30] Karolina Marrodán-Wojtczak: „Analiza badań strukturalnych i dyfuzyjnych MRI kory mózgowej w diagnostyce choroby Parkinsona” (Analysis of cerebral structural and diffusion MRI in the diagnosis of Parkinson's disease), Assist. Prof. **E. Piątkowska-Janko** (supervisor).
- [BSc31] Martyna Mazur: „Analiza wartości progowych gęstości energii w efekcie fotobiochemicznym z wykorzystaniem cyfrowej mikroskopii holograficznej” (Analysis of energy density threshold values in photobiochemical effect using digital holographic microscopy), Assist. Prof. **W. Krauze** (supervisor), B.Sc. degree with honours.
- [BSc32] Krzysztof Bogumił Mazurek: „Badanie wpływu parametrów lampy rentgenowskiej w mammografie cyfrowym na rozkład energetyczny wiązki fotonów” (Study of the influence of X-ray tube parameters in digital mammography on the energy distribution of

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- the photon beam), Assoc. Prof. **S. Wronka** (supervisor).
- [BSc33] Marta Mejer: "Automatyczne rozpoznawanie typu badania na podstawie treści opisu radiologicznego" (Automatic recognition of the examination type based on the radiological report), Prof. **J. Mulawka** (supervisor).
- [BSc34] Karolina Sylwia Michalska: "Implementacja testów asocjacyjnych dla danych sekwencyjnego następnej generacji" (The implementation of association tests for next-generation sequencing data), Assoc. Prof. **T. Gambin** (supervisor).
- [BSc35] Diana Misiak: "Analiza przebiegu pandemii COVID-19 za pomocą metod statystycznych" (Analysis of the COVID-19 pandemic using statistical methods), Assist. Prof. **Z. Wawrzyniak** (supervisor).
- [BSc36] Kuba Tomasz Nicpoń: "Czujnik jakości powietrza z komunikacją GSM – IoT" (Air quality sensor with GSM - IoT communication), Assist. Prof. **A. Rychter** (supervisor).
- [BSc37] Artur Nowacki: „Stanowisko do pomiarów przepustowości sieci bezprzewodowych Wi-Fi” (Setup for throughput measurement of Wi-Fi wireless network), Assist. Prof. **P. Korpas** (supervisor).
- [BSc38] Marlena Petruccuk: "Wpływ powierzchni czujników światłowodowych na możliwości badania cieczy pochodzenia biologicznego" (The impact of surface properties of fiber optic sensors on the possibility of long-term analysis of liquids of biological origin), Prof. **M. Śmietańska** (supervisor).
- [BSc39] Jakub Pęksyk: "Czujnik IoT do rejestracji parametrów ruchu osób" (IoT sensor for elderly people's movements monitoring), Assist. V. **Djaja-Jośko** (supervisor).
- [BSc40] Bartosz Piotrowski: "Cyfrowy sterownik do szerokopasmowego tłumika sygnału na potrzeby stanowiska pomiarowego szumów przedwzmacniacza laboratorium DSBJ" (Digital controller for wideband signal attenuator for DSBJ laboratory preamplifier noise measurement station), Assist. Prof. **A. Rychter** (supervisor).
- [BSc41] Agnieszka Piwowar: "Pomiary porównawcze różnych anten GNSS" (Comparative measurements of various GNSS antennas), Assist. Prof. **P. Bajurko** (supervisor).
- [BSc42] Mariia Poleshvaiko: "Sterownik systemu antenowego" (Controller for the antenna system), Assist. Prof. **D. Rosołowski** (supervisor).
- [BSc43] Michał Pyrka: "Rozproszony system monitoringu wizyjnego w sieci lokalnej" (Distributed video monitoring system in local network), Assist. Prof. **G. Galiński** (supervisor).
- [BSc44] Mariusz Rogulski: "Realizacja systemu łączności poprzez satelitę Es'Hail2" (Implementation a communication system via Es'Hail2 satellite), Assist. Prof. **D. Rosołowski** (supervisor).
- [BSc45] Joanna Roman: „Opracowanie układu do bezprzewodowego ładowania czujnika IoT” (Development of a system for wireless charging of the Internet of Things sensor), Assist. Prof. **J. Kołkowski** (supervisor).
- [BSc46] Maciej Rosłaniec: „Wzmacniacz mocy na pasmo 462.6 - 467.5 MHz” (Power amplifier to band 462.6 - 467.5 MHz), Assoc. Prof. **W. Wojtasiak** (supervisor).
- [BSc47] Maciej Krzysztof Rytel: „Łączenia obrazów w obraz panoramiczny” (Image stitching to create a panorama), Assist. Prof. **A. Buchowicz** (supervisor).
- [BSc48] Patryk Sadowski: „Wymiana systemu telefonicznego w przedsiębiorstwie” (Replacement of an enterprise telephone system), Assist. Prof. **W. Kazubski** (supervisor), Engineer Degree Evening Studies on Radiocommunications and Multimedia Technology.
- [BSc49] Mykyta Shaltyko: „Modelowanie szumów fizjologicznych w danych fMRI” (Modeling physiological noise in fMRI data), Assoc. Prof. **P. Bogorodzki** (supervisor).
- [BSc50] Izabela Sobieska: „Wzmacniacz mocy klasy AB na pasmo 3.5-3.9 GHz dla technologii 5g/LTE” (Class AB power amplifier for the 3.5-3.9 GHz band for 5G / LTE technology), Assoc. Prof. **W. Wojtasiak** (supervisor).
- [BSc51] Maria Sulińska: „Segmentacja 3-wymiarowych obrazów ultrasonograficznych” (3D Ultrasound image segmentation), Assoc. Prof. **K. Snopk** (supervisor).
- [BSc52] Jędrzej Michał Synowiec: „Bramka LoRaWAN oparta na bezzałogowym statku powietrznym” (LoRaWAN gateway based on an unmanned aerial vehicle), Assist. M. **Golański** (supervisor).
- [BSc53] Witold Synowiec: „Termometr lekarski z interfejsem Bluetooth LE” (Medical thermometer with Bluetooth LE interface), Assist. Prof. **R. Kurjata** (supervisor).
- [BSc54] Maja Teodorczyk: „Porównanie fizycznych efektów gitaraowych z ich odpowiednikami w środowisku Digital Audio Workstation” (Electric guitar effects pedals compared to their simulation models in Digital Audio Workstation), Assist. Prof. **M. Lewandowski** (supervisor), studies in English
- [BSc55] Seweryn Tkacz: „Rozproszona aplikacja zarządzania zakładami sportowymi” (Distributed sports betting management application), Assist. Prof. **K. Ignasiak** (supervisor).
- [BSc56] Jan Tuchowski: „Czujnik IoT z interfejsem głosowym” (IoT sensor with speech synthesis interface), Assist. V. **Djaja-Jośko** (supervisor).
- [BSc57] Jakub Turliński: „Stanowisko pomiarowe do badań charakterystyk głośników” (Measu-

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| <p>rement station for measuring loudspeaker characteristics), Assist. Prof. P. Bobiński (supervisor).</p> <p>[BSc58] Anna Wargocka: „<i>Wpływ właściwości powierzchni czujników światłowodowych na możliwość długoterminowej analizy cieczy pochodzenia biologicznego</i>” (The impact of surface properties of fiber optic sensors on the possibility of long-term analysis of liquids of biological origin), Prof. M. Śmiertana (supervisor).</p> <p>[BSc59] Barbara Wąsowska: „<i>Oprogramowanie w języku JavaScript do diagnostyki funkcji nerek na podstawie scyntygrafii dynamicznej</i>” (JavaScript software for renal function diagnostics in dynamic scintigraphy study), Asocc. Prof. W. Smolik (supervisor).</p> <p>[BSc60] Antoni Winnicki: „<i>System do zarządzania przesyłkami kurierskimi</i>” (System for managing courier shipments), Assist. Prof. G. Galiński (supervisor).</p> <p>[BSc61] Kamil Wojtczyk: „<i>Internetowy system do gromadzenia i prezentacji danych z czujników medycznych</i>” (Internet system for collecting and presenting data from medical research), Assist. Prof. R. Kurjata (supervisor).</p> <p>[BSc62] Anna Wojtyra: „<i>Jednokanałowe urządzenie do pomiaru sygnału EMG</i>” (Development of a single-channel device for measuring the EMG signal), Assist. Prof. G. Domański (supervisor).</p> <p>[BSc63] Klaudia Woźniak (co-author: Sonia Litwin): „<i>Opracowanie i realizacja podstawowych założeń konstrukcyjnych robokota „Cthulhu* 2.0” we współpracy z Centrum Aplikacji Festo Polska</i>” (Development and implementation of fundamental design concepts for “Cthulhu* 2.0” robotic cat in collaboration with Festo Poland Application Centre), Prof. M. Olszewski (supervisor).</p> <p>[BSc64] Joanna Woźny: „<i>Optymalizacja kolimatora do obrazowania z użyciem wstecznego rozpraszania Comptona</i>” (Optimization of a collimator for imagining with the use of Compton backscattering), Assoc. Prof. S. Wronka (supervisor).</p> <p>[BSc65] Aleksandra Wrzesień: „<i>Stanowisko laboratoryjne do przeprowadzania testów psychoakustycznych</i>” (A laboratory workstation for psychoacoustic testing), Assist. Prof. A. Pietrzak (supervisor).</p> <p>[BSc66] Mateusz Wrzesiński: „<i>Eksperymentalne porównanie właściwości miniaturowych anten ceramicznych typu dipol magnetyczny i typu monopol elektryczny</i>” (Comparative experimental study of the performance of magnetic-dipole-type and electric-monopole-type miniature ceramic antennas), Assist. Prof. P. Bajurko (supervisor).</p> <p>[BSc67] Krzysztof Wyszyński: „<i>Przeglądarka obrazów medycyny nuklearnej</i>” (Nuclear medicine imaging browser), Assist. Prof. J. Kryszyn (supervisor).</p> | <p>[BSc68] Bartosz Marek Zabłotny: „<i>Realizacja sprzętowo-programowa algorytmu kryptograficznego z rodziny Argon2</i>” (Hardware-software implementation of the Argon2 cryptographic algorithm), Assoc. Prof. M. Rawski (supervisor).</p> <p>[BSc69] Łukasz Zielenkiewicz: „<i>Moduł do transmisji radiowo-światłowodowej ze wzmacniaczem</i>” (Radio-fiber optic transmission module with amplifier), Assist. Prof. K. Godziszewski (supervisor).</p> <p>[BSc70] Tomasz Wojciech Zielonka: „<i>Aplikacja serwera kamer video na bazie mikrokontrolera ARM</i>” (Implementation of video-camera server based on ARM microcontroller), Asocc. Prof. G. Pastuszak (supervisor).</p> <p>[BSc71] Mikołaj Żebrowski: „<i>Opracowanie szyku antenowego na pasmo milimetrowe</i>” (Development of antenna array for millimeter band), Prof. Y. Yashchyshyn (supervisor).</p> |
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6. PUBLICATIONS

6.1. Scientific and technical books, chapters in books

- [Pub1] K. M. Snoppek: "Complex and Hypercomplex Multidimensional Analytic Signals - The Theory and Chosen Properties", in: *Advances in Signal Processing: Reviews Book Series*, S. Y. Yurish (ed.), vol. 2, chapter 1, *International Frequency Sensor Association (IFSA) Publishing*, S. L., 2021, ISBN 978-84-09-28830-4, pp. 21-53.

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.

- [Pub2] K. Abe (...), R. Kurjata, A. Rychter, K. Zaremba, M. Ziembicki (348 external authors): „T2K Measurements of Muon Neutrino and Antineutrino Disappearance Using 3.13×10^{21} Protons on Target”, *Physical Review D*, vol. 103, 2021, pp. L011101-1-L011101-9.
- [Pub3] K. Abe (...), R. Kurjata, A. Rychter, K. Zaremba, M. Ziembicki (354 external authors): „Measurements of $\nu\mu$ and $\nu\mu + \nu\mu$ Charged-current Cross-sections without Detected Pions nor Protons on Water and Hydrocarbon at Mean Antineutrino Energy of 0.86 GeV”, *Progress in Theoretical and Experimental Physics*, vol. 2021, issue 4, 2021, doi: 10.1093/ptep/ptab014, pp. 043-C01-1-043C01-27.
- [Pub4] K. Abe (...), R. Kurjata, A. Rychter, K. Zaremba, M. Ziembicki (327 external authors): “Improved Constraints on Neutrino Mixing from the T2K Experiment with 3.13×10^{21} Protons on Target”, *Physical Review D*, vol. 103, 2021, no. 112008, pp. 112008-1-112008-59.
- [Pub5] K. Abe (...), R. Kurjata, A. Rychter, K. Zaremba, M. Ziembicki (324 external authors): “First T2K Measurement of Transverse Kinematic Imbalance in the Muon-Neutrino Charged-current Single- π^+ Production Channel Containing at Least One Proton”, *Physical Review D*, vol. 103, no. 112009, 2021, pp. 112009-1-112009-27.
- [Pub6] G. D. Alexeev (...), R. Kurjata, J. Marzec, A. Rychter, K. Zaremba, M. Ziembicki (210 external authors): „Spin Density Matrix Elements in Exclusive ω Meson Muoproduction”, *The European Physical Journal C*, vol. 81, 2021, article no. 126, pp. 1-69.
- [Pub7] G. D. Alexeev (...), R. Kurjata, J. Marzec, A. Rychter, K. Zaremba, M. Ziembicki (214 external authors): “Triangle Singularity as the Origin of the a_1 (1420)”, *Physical Review Letters*, vol. 127, 2021, pp. 082501-1-082501-8.
- [Pub8] A. Asaro, R. Sinha, M. Bakun, O. Kalnytska, A.-S. Carlo-Śpiewok, T. Rubel, A. Rozeboom, M. Dadlez, B. Kamińska, E. Aronica, A. R. Malik, T. E. Willnow: “ApoE4 Disrupts Interaction of Sortilin with Fatty Acid-Binding Protein 7 Essential to Promote Lipid Signaling”, *Journal of Cell Science*, 2021, doi: 10.1242/jcs.258894, 47 pp.
- [Pub9] Z. Barani, F. Kargar, Y. Ghafouri, S. Ghosh, K. Godziszewski, S. Baraghani, Y. Yashchyshyn, G. Cywiński, S. Rumyantsev, T. T. Salguero, A. A. Balandin: “Electrically Insulating Flexible Films with Quasi-1D van der Waals Fillers as Efficient Electromagnetic Shields in the GHz and Sub-THz Frequency Bands”, *Advanced Materials*, 2021, doi: 10.1002/adma.20200-7286, 9 pp.
- [Pub10] M. Bielewicz, A. Bancer, M. Barabanov, A. Chłopik, M. Czarnynoga (...), J. Marzec (53 external authors): “Conceptual Design Report of the MPD Cosmic Ray Detector (MCORD)”, *Journal of Instrumentation*, vol. 16, 2021, article no. P11035, pp. 1-4.
- [Pub11] A. Buchowicz, M. Dziewiecki, G. Galiński, R. Kurjata, J. Marzec, W. Obrebski, G. Pastuszak, A. Rychter, K. Zaremba, M. Ziembicki (401 external authors): “Supernova Model Discrimination with Hyper-Kamiokande”, *Astrophysical Journal*, vol. 916, 2021, pp. 1-17.
- [Pub12] X. Chang, W. Skarbek: “Multi-Modal Residual Perceptron Network for Audio-Video Emotion Recognition”, *Sensors*, vol. 21, no. 16, 2021, S. Berretti (academic editor), article no. 5452, doi: 10.3390/s-21165452, pp. 1-17.
- [Pub13] O. M. Chumak, A. Pacewicz, A. Lynnyk, B. Salski, T. Yamamoto, T. Seki, J. Z. Domagała, H. Głowiński, K. Takanashi, L. T. Baczewski, H. Szymczak, A. Nabialek: „Magnetoelastic Interactions and Magnetic Damping in $\text{Co}_2\text{Fe}_{0.4}\text{Mn}_{0.6}\text{Si}$ and $\text{Co}_2\text{FeGa}_{0.5}\text{Ge}_{0.5}$ Heusler Alloys Thin Films for Spintronic Applications”, *Scientific Reports*, 2021, doi: 10.1038/s41598-021-87205-y, 12 pp.
- [Pub14] K. Derzakowski: “Full Wave Analysis of Multilayered Cylindrical Resonator Containing Uniaxial Anisotropic Media”, *Progress in Electromagnetics Research - M*, vol. 101, 2021, pp. 101-115.
- [Pub15] K. Derzakowski: “Application of Radial Mode Matching Method to Determine the

- Resonant Frequency of a Cone Shaped Dielectric Resonator”, *IEEE Access*, vol. 9, 2021, doi: 10.1109/ACCESS.2021.3128-144, pp. 156239-156245.
- [Pub16] K. Fiedorowicz, W. Wargocka-Matuszewska, K. A. Ambrożkiewicz, A. Rugowska, Ł. Cheda, M. Fiedorowicz, A. Zimna, M. Drabik, Sz. Borkowski, M. Świątkiewicz, P. Bogorodzki, P. Grieb, P. Hamankiewicz, T. J. Kolanowski, N. Rozwadowska, U. Koźłowska, A. Klimczak, J. Kolasiński, Z. Rogulski, M. Karpisz: “Molecular Imaging of Human Skeletal Myoblasts (huSKM) in Mouse Post-Infarction Myocardium”, *International Journal of Molecular Sciences*, vol. 22, 2021, doi: 10.3390/ijms221910885, 20 pp.
- [Pub17] M. Fiedorowicz, M. Wieteska, K. Rylewicz, B. Kossowski, E. Piątkowska-Janko, A. M. Czarnecka, B. Toczyłowska, P. Bogorodzki: „Hyperpolarized¹³C Tracers: Technical Advancement and Perspectives for Clinical Applications”, *Biocybernetics and Biomedical Engineering*, 2021, doi: 10.1016/j.bbe.2021.03.010, 6 pp.
- [Pub18] M. Kołkowski: “Automated Calibration of RSS Fingerprinting Based Systems Using a Mobile Robot and Machine Learning”, *Sensors*, vol. 21, issue 18, 2021, article no. 6270, pp. 1-25.
- [Pub19] B. Konarzewski, J. Marzec, R. Kurjata, K. Zaremba, A. Rychter, M. Ziembicki, G. Domański: “An Analytical Model of Pre-amplifier Noise Identification in a Spectrometric System”, *Nuclear Instruments and Methods in Physics Research A*, vol. 1017, 2021, article no. 165805, pp. 1-9.
- [Pub20] P. Kopyt, B. Salski, J. Krupka: „Measurements of the Complex Anisotropic Permittivity of Laminates with TM₀₁₀ Cavity”, *IEEE Transactions on Microwave Theory and Techniques*, 2021, 11 pp, early access.
- [Pub21] A. Kozak, M. Wieteska, M. Ninghetto, K. Szulborski, T. Gałecki, J. Szaflik, K. Burnat: „Motion-based Acuity Task: Full Visual Field Measurement of Shape and Motion Perception”, *Translational Vision Science & Technology*, vol. 10, issue 1, 2021, doi: 10.1167/tvst.10.1.9, 9 pp.
- [Pub22] S. Kozłowski, K. Kurek: “Channel Occupancy Measurements in 868 MHz ISM Band in Residential Areas”, *Sensors*, vol. 21, no. 23, 2021, doi: 10.3390/-s21237805, article no. 7805, pp. 1-16.
- [Pub23] J. Krupka, A. Pacewicz, B. Salski, P. Kopyt, J. Bourhill: „Resonance in Large Ferrimagnetic YIG Samples - Electrodynamic Analysis”, *Journal of Magnetism and Magnetic Materials*, vol. 521, part 1, 2021, article no. 167536, 8 pp.
- [Pub24] M. Maliszewski, A. Zofka, D. Maliszewska, D. Sybilski, B. Salski, T. Karpisz, R. Rembelski: “Full-Scale Use of Microwave Heating in Construction of Longitudinal Joints and Crack Healing in Asphalt Pavements”, *Materials*, vol. 14, no. 18, 2021, article no. 5159, pp. 1-29.
- [Pub25] T. Markowski, P. Bilski: “Optimization of Autonomous Agent Routes in Logistics Warehouse”, *International Journal of Electronics and Telecommunications*, vol. 67, no. 4, 2021, doi: 10.24425/ijet.2021.-137846, pp. 559-564.
- [Pub26] T. A. Miś, J. Modelska: “Environmental Sensitivity of Large Stealth Longwave Antenna Systems”, *Remote Sensing*, vol. 13, no. 19, 2021, doi:10.3390/rs13193946, pp. 1-22.
- [Pub27] K. Mroczek: “SoPC-based DMA for PCI Express DAQ Cards”, *International Journal of Electronics and Telecommunications*, vol. 67, no. 4, 2021, doi: 10.24425/ijet.-2021.137847, pp. 565-570.
- [Pub28] A. Pacewicz, J. Cimek, B. Salski, M. Walczakowski, R. Buczyński: ‘Reconstruction and Modeling of the Complex Refractive Index of Nonlinear Glasses from Terahertz to Optical Frequencies”, *Optics Express*, vol. 29, no. 16, 2021, pp. 26191-26209.
- [Pub29] A. B. Piotrowska, E. Kamińska, W. Wojtasik: „Micro- and Nanotechnology of Wide-Bandgap Semiconductors”, *Electronics*, vol. 10, no. 507, 2021, doi: 10.3390/-electronics10040507, 3 pp.
- [Pub30] B. Połok, P. Bilski: “Intelligent Diagnostic System for the Ratchet Mechanism Faults Detection Using Acoustic Analysis”, *Measurement*, vol. 183, 2021, article no. 109637, 11 pp.
- [Pub31] B. Salski, P. CzeKała, J. Cuper, P. Kopyt, H. Jeon, W. Yang: „Electromagnetic Modeling of Radiowave Propagation and Scattering from Targets in the Atmosphere with a Ray-Tracing Technique”, *IEEE Transactions on Antennas and Propagation*, vol. 69, issue 3, 2021, doi: 10.1109/TAP.-2020.3016507, pp. 1588-1595.
- [Pub32] B. Salski, P. CzeKała, T. Karpisz, P. Kopyt: “Mode Coupling in a Fabry-Perot Open Resonator”, *IEEE Transactions on Microwave Theory and Techniques*, 2021, doi: 10.1109/TMTT.2021.3081725, pp. 299-306.
- [Pub33] B. Salski, P. CzeKała, J. Krupka, P. Kopyt: “A Microwave Sensor of Moisture Content and Salinity of Soil”, *IEEE Sensors Journal*, 2021, vol. 22, no. 3, doi: 10.1109/JSEN.-2021.3137370, pp. 2135-2141.
- [Pub34] B. Salski, J. Cuper, T. Karpisz, P. Kopyt, J. Krupka: “Complex Permittivity of Common Dielectrics in 20-110 GHz Frequency Range Measured with a Fabry-Perot Open Resonator”, *Applied Physics Letters*, vol. 119, issue 5, 2021, article no. 052902, 4 pp.
- [Pub35] D. Wanta, W. T. Smolik, J. Kryszyn, P. Wróblewski, M. Midura: “A Finite Volume

Method Using a Quadtree Non-Uniform Structured Mesh for Modeling in Electrical Capacitance Tomography”, *Proceedings of the National Academy of Science, India Section A: Physical Sciences*, 2021, doi: 10.1007/s40010-021-00748-7, pp. 1-10.

- [Pub36] A. Wójcik, P. Bilski, R. Łukaszewski, K. Dowalla, R. Kowalik: „Identification of the State of Electrical Appliances with the Use of a Pulse Signal Generator”, *Energies*, vol. 14, 2021, article no. 673, pp. 1-26.
- [Pub37] Y. Yashchyshyn, P. Bajurko, J. Sobolewski, P. Sai, A. Przewłoka, A. Krajewska, P. Prystarko, M. Dub, W. Knap, S. Rumyantsev, G. Cywiński: “Graphene/AlGaN/GaN RF Switch”, *Micromachines*, vol. 12, no. 11, 2021, article no. 1343, doi: 10.3390/mi12111343, pp. 1-11.
- [Pub38] Y. Yashchyshyn, K. Derzakowski, Ch. Wu, G. Cywiński: “W-Band Sensor for Complex Permittivity Measurements of Rod Shaped Samples”, *IEEE Access*, vol. 9, 2021, doi: 10.1109/ACCESS.2021.3103243 pp. 111125-111131.
- [Pub39] Y. Yashchyshyn, D. Vynnyk, V. Haiduchok, I. Solskii, Ch. Wu, G. Bogdan, J. Modelska: „A Tunable and Electrically Small Antenna for Compact GNSS Receivers”, *Remote Sensing*, vol. 13, 2021, article no. 485, doi: 10.3390/rs13030485, pp. 1-10.

6.2.2. Part B

This subsection contains papers in the journals not indicated on the list of the Ministry of Science and Higher Education

- [Pub40] M. Midura, P. Wróblewski, D. Wanta, G. Domański, M. Stosio, J. Kryszyn, W. T. Smolik: „The System for Complex Magnetic Susceptibility Measurement of Nanoparticles with 3D Printed Carcass for Integrated Receive Coils”, *Informatyka i Automatyka w Gospodarce i Ochronie Środowiska: IAPGOŚ*, 2021, vol. 11, no. 1, doi: 10.35784/iapgos.2456, pp. 4-9.

6.2.3. Other journals

- [Pub41] P. Mazurek: “Choosing Configuration of Impulse-Radar Sensors in System for Healthcare-Oriented Monitoring of Persons”, *Measurement: Sensors*, vol. 18, 2021, doi: 10.1016/j.measen.2021.100270, 7 pp.
- [Pub42] R. Z. Morawski: “Measurement as Abduction”, *Perspectives on Science*, vol. 29, no. 6, 2021, pp. 742-756.
- [Pub43] D. Radomski, E. Dmoch-Gajzerska: “Błędy poznawcze obciążające podejmowanie decyzji w położnictwie i ginekologii” (Cognitive Errors Biassing Clinical Decisions Making in Obstetrics and Gynecology), *Położna. Nauka i Praktyka*, vol. 53, no. 1, 2021, pp. 15-27.
- [Pub44] J. Wagner, R. Z. Morawski: “Gait-analysis-oriented Processing of One-Dimensional

Data with Total-variation Regularisation”, *Measurement: Sensors*, vol. 18, 2021, article no. 100287, *XXIII IMEKO World Congress “Measurement: sparking tomorrow’s smart revolution”* (Yokohama, Japan, Aug. 30 - Sept. 3, 2021), pp. 1-4.

6.2.4. Publications on general aspects of science, technology and education

- [Pub45] P. Bilski, L. Ciani: „Introductory Notes for the Acta IMEKO Special Issue on the 17th IMEKO Technical Committee 10 Conference ‘Global Trends in Testing, Diagnostics & Inspection for 2030’ (2nd Conference Jointly Organised by IMEKO and EUROLAB)”, *Acta IMEKO*, vol. 10, no 3, 2021, pp. 3-4.
- [Pub46] R. Z. Morawski: “Edukacyjne implikacje technonauki” (Educational Implications of Technoscience) in: *Ewolucja cywilizacyjnej roli i społecznego odbioru nauki*, J. Lubacz (ed.), *Instytut Problemów Współczesnej Cywilizacji im. Marka Dietricha*, 2021, Wydawnictwo SGGW, ISBN 978-83-89871-45-9, pp. 75-79.
- [Pub47] R. Z. Morawski: "Foreword", in: *Measurement across the Sciences: Developing a Shared Concept System for Measurement*, L. Mari, M. Wilson, A. Maul (eds.), *Springer International Publishing*, 2021, ISBN 978-3-030-65558-7, pp. v-viii.

6.3. Scientific and technical papers in conference proceedings

Conference proceedings published in online subscription-based scientific citation index: Web of Science are indicated by *)

- [Pub48] P. Bilski, A. Buchowicz, B. Hołyś, K. Jędrzejewski, M. Lewandowski, P. Mazurek, J. Olejnik: “Development of CCTV-camera-based System for Detection of Anomalous Behaviors in Penitentiary Institutions”, *Proc. 13th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications* (Cracow, Poland, Sept. 22-25, 2021), pp. 1114-1119.
- [Pub49] G. Bogdan, Y. Yashchyshyn: “Study of Bondwire Interconnect for Antenna Applications in W-Band”, *Proc. 2021 IEEE International Symposium on Antennas and propagation and USNC-URSI Radio Science Meeting (APS/URSI)* (Marina Bay Sands, Singapore, Dec. 04-10, 2021), pp. 1-2.
- [Pub50] J. Cuper, B. Salski, P. Kopyt: “Measurement of Dielectric Materials of High Anisotropy Ratio with TM₀₀ Cavity”, *Proc. 2021 IEEE MTT-S International Microwave Symposium: IMS 2021* (Atlanta, USA, Jun. 6-11, 2021), 4 pp.*
- [Pub51] P. Czeała (supervisor: B Salski): “Pomiary wilgotności i zasolenia ziemi metodami mikrofalowymi” (Measurements of Soil Moisture and Salinity via Microwave

- Methods), *Mat. 22 Seminarium: Radiokomunikacja i Techniki Multimedialne* (22nd Seminar: Radiocommunications and Multimedia Technologies) (Warsaw, Dec. 08, 2021), pp. 29-38.
- [Pub52] K. Dowalla, P. Bilski, R. Łukaszewski, A. Wójcik, R. Kowalik: "NILM Application for Real Time Monitoring of Appliances Energy Consumption", *Proc. IDAACS 2021* (Cracow, Poland, Sept. 22-25, 2021), pp. 1022-1025,
- [Pub53] J. Fąk (supervisor: K. Snoppek): "Synteza dźwięku na podstawie cyfrowego obrazu partytury" (Sound Synthesis based on Digital Score Image), *Mat. 22 Seminarium: Radiokomunikacja i Techniki Multimedialne* (22nd Seminar: Radiocommunications and Multimedia Technologies) (Warsaw, Dec. 08, 2021), pp. 47-50.
- [Pub54] B. L. Givot, A. P. Gregory, B. Salski, F. Zentis, N. Pettit, T. Karpisz, P. Kopyt: "A Comparison of Measurements of the Permittivity and Loss Angle of Polymers in the Frequency Range 10 GHz to 90 GHz", *Proc. 15th European Conference on Antennas and Propagation: EuCAP 2021* (Düsseldorf, Germany, Mar. 22-26, 2021), 5 pp.)
- [Pub55] P. Haraburda (supervisor: Ł. Dąbała): „System wspomagania diagnostyki chorób oczu” (Eye Diseases Diagnostics Support System), *Mat. 22 Seminarium: Radiokomunikacja i Techniki Multimedialne* (22nd Seminar: Radiocommunications and Multimedia Technologies) (Warsaw, Dec. 08, 2021), pp. 51-58.
- [Pub56] M. Kołkowski (supervisor: J. Modelska): "Wykorzystanie adaptacyjnych algorytmów do poprawy dokładności systemów lokalizacyjnych" (The Use of Adaptive Algorithms to Improve the Accuracy of Localization Systems), *Mat. 22 Seminarium: Radiokomunikacja i Techniki Multimedialne* (22nd Seminar: Radiocommunications and Multimedia Technologies) (Warsaw, Dec. 08, 2021), pp. 19-28.
- [Pub57] P. Korpas, D. Mieczkowska, M. Olszewska-Placha, J. Rudnicki, M. Celuch: "Quantitative Error Metrics and Test Patterns for Enhanced Dielectric Resonator Imaging of Microwave Materials", *Proc. 2021 IEEE MTT-S International Microwave Symposium: IMS 2021* (Atlanta, USA, Jun. 6-11, 2021), 4 pp.)
- [Pub58] J. Krupka, B. Salski, P. Kopyt, K. Derzakowski, P. Czekala, J. Mazierska: "Complex Permittivity of Sand Containing NaCl-water Solutions Measured at 2.5 GHz", *Proc. The 13th International Conference on Electromagnetic wave Interaction with Water and Moist Substances: ISEMA 2021* (Kiel, Germany, Jul. 26-30, 2021), 5 pp.)
- [Pub59] M. Kucharski, M. Widłok, P. Bajurko, R. Piesiewicz: "A W-band SiGe BiCMOS I/Q Receiver with Tunable Conversion Gain for Radar Applications", *Proc. 2021 28th International Conference on Mixed Design of Integrated Circuits and System: MIXDES* (Łódź, Poland, Jun. 24-26, 2021), doi: 10.23919/MIXDES52406.2021.9497628, pp. 81-84.
- [Pub60] M. Maciąła (supervisor: M. Mikołajewski): "Nagrzewnica indukcyjna z wysokosprawnym wzmacniaczem klasy E" (Induction Heater with Class E Tuned Power Amplifier), *Mat. 22 Seminarium: Radiokomunikacja i Techniki Multimedialne* (22nd Seminar: Radiocommunications and Multimedia Technologies) (Warsaw, Dec. 08, 2021), pp. 39-46.
- [Pub61] P. Mazurek: "Choosing Configuration of Impulse-radar Sensors in System for Healthcare-oriented Monitoring of Persons", *Proc. XXIII IMEKO World Congress "Measurement: sparking tomorrow's smart revolution"* (Yokohama, Japan, Aug. 30 - Sept. 3, 2021), pp. 1-4.
- [Pub62] J. Modelska: "Szanse i wyzwania współczesnej telewizji" (Opportunities and Challenges of Contemporary Television), *Mat. 48 Międzynarodowej Konferencji i Wystawy PIKE 2021* (Proc. 48th International Conference and Exhibition PIKE 2021) (Łódź, Poland, Oct. 4-5, 2021), pp. 15-19.
- [Pub63] M. Olszewska-Placha, D. Gryglewski, W. Wojtasik, M. Celuch: 'Demonstration of a Combined Active-Passive Methodology for the Design of Solid-State-Fed Microwave Ovens", *Proc. 18th International Conference on Microwave and High Frequency Applications: AMPERE 2021* (Gothenburg, Sweden, Sept. 13-16, 2021), pp. 69-76.
- [Pub64] J. Wagner, P. Mazurek: "Estimation of Movement Speed in Monitoring Systems based on Sensors of Multiple Types", *Proc. 14th International Joint Conference on Biomedical Engineering Systems and Technologies: BIOSTEC 2021, Biosignals*, vol. 4, 2021, doi: 10.5220/00102493-00690079, pp. 69-79.
- #### 6.4. Textbooks
- [Pub65] G. Bartkowiak, K. Baszczyński, A. Bogdan, A. Brochocka, A. Dąbrowska, R. Hrynyk, E. Irzmańska, D. Koradecka, E. Kozłowski, K. Majrzycka, K. Makowski, A. Marszałek, M. Mlynarczyk, R. Młyński, G. Owczarek, J. Żera: "Use of Personal Protective Equipment", *Handbook of Human and Ergonomics* (G. Salvendy, W. Karwowski (eds.), John Wiley & Sons. Inc., Vth edition, part IV: *Design for Health, Safety and Comfort*, chapter 25, 2021, ISBN 978-111-963-6113, pp. 668-684.
- [Pub66] R. Z. Morawski, A. Miękina: "Solved Problems in Numerical Methods for Students of Electronics and Information Technology", e-book, Oficyna Wydawnicza Politechniki Warszawskiej, 2021, ISBN: 978-838-156-1617, 208 pp.

6.5. Abstracts and Posters

- [Pub67] M. Drabik, A. Grzeczkowicz, P. Bacal, A. Kwiatkowska, M. Antosiak-Iwańska, B. Kazimierczak, E. Godlewska, L. Granička: "Composite Membrane Scaffolds with Incorporated Metallic Nanoparticles for Supporting Fibroblastic Cell Growth", *XXII Krajowa Konferencja Biocybernetyki i Inżynierii Biomedycznej* (XXIInd Polish Conference on Biocybernetics and Biomedical Engineering) (Warsaw, Poland, May 19-21, 2021), poster no. P.3.1.
- [Pub68] M. Midura, D. Wanta, P. Wróblewski, J. Kryszyn, W. Smolik: "Web Application with Semiautomatic Algorithm for Renal Blood Flow Estimation in Dynamic Scintigraphy", *XXII Krajowa Konferencja Biocybernetyki i Inżynierii Biomedycznej* (XXIInd Polish Conference on Biocybernetics and Biomedical Engineering) (Warsaw, Poland, May 19-21, 2021), poster no. P.1.10.
- [Pub69] T. A. Miś (supervisor; J. Modelska): "Terrestrial High-Power LF Signals as Contributing Factors to Natural AKR Environment", *Whole Heliosphere and Planetary Interactions Workshop* (San Francisco, USA, Sept. 13-17, 2021), 1 p.
- [Pub70] K. Orzechowska, T. Rubel: "An SVM-based Peptide Identification Algorithm Integrated into a Database Search Engine", *XXII Krajowa Konferencja Biocybernetyki i Inżynierii Biomedycznej* (XXIInd Polish Conference on Biocybernetics and Biomedical Engineering) (Warsaw, Poland, May 19-21, 2021), poster no. P. 1.22.
- [Pub71] A. Pacewicz, J. Cimek, B. Salski, M. Walczakowski, R. Buczyński: "Ultrawideband Reconstruction of the Refractive Index of Nonlinear Soft Glasses from Terahertz to Infrared Frequencies", *Photonics North 2021* (Toronto, Canada, May 31 - Jun. 02, 2021), 1 p.
- [Pub72] D. Wanta, M. Midura, P. Wróblewski, G. Domański, J. Kryszyn, W. T. Smolik: "Capacitively Coupled Electrical Tomography for Anatomical and Functional Imaging of Thorax", *XXII Krajowa Konferencja Biocybernetyki i Inżynierii Biomedycznej* (XXIInd Polish Conference on Biocybernetics and Biomedical Engineering) (Warsaw, Poland, May 19-21, 2021), poster no. P.1.

7. RESEARCH REPORTS

- [Rep1] P. Bajurko, J. Sobolewski: "Badanie szerokopasmowego mieszacza wzmacniacza niskoszumowego oraz odbiornika" (Examination of broadband mixer, low noise amplifier and receiver). Final report for SIRC sp.z.o.o., Warsaw, May 2021.
- [Rep2] P. Bajurko, J. Sobolewski: "Badania ostrzowe szerokopasmowych mieszaczy i wzmacniaczy niskoszumowych" (Contact-probe examination of broadband mixers and low noise amplifiers), Final report for SIRC sp.z.o.o., Warsaw, Jul. 2021.
- [Rep3] P. Bajurko, J. Sobolewski: "Badanie wzmacniacza typu Track & Hold" (Examination of Track & Hold amplifier), Final report for SIRC sp.z.o.o., Warsaw, Nov. 2021.
- [Rep4] P. Bajurko: "Badanie parametrów rozproszenia zestawu obwodów w zakresie częstotliwości 60-75 GHz" (Examination of scattering parameters of a set of circuits in the 60-75 GHz frequency range), Final report for THORIUM SPACE sp. z o.o., Warsaw, Dec. 2021.
- [Rep5] P. Bilski, P. Mazurek, M. Jasiński: „Wykład ze sztucznej inteligencji i nauczania maszynowego dla studentów studiów MBA Kaizen Industry 4.0” (Lecture on artificial intelligence and machine learning for MBA Kaizen Industry 4.0 students), Final report for the Instytut Industry 4.0 sp.z.o.o., Warsaw, Jul. 2021.
- [Rep6] D. Gromek (ISE), D. Rosołowski: „Radarowy system wspomagania nawigacji inferencyjnej w oparciu o pokładowe zobrazowanie powierzchni ziemi z wykorzystaniem technologii SAR” (Radar inertial navigation assistance system based on onboard surface imagery using SAR technology), Final report for the National Centre for Research and Development, Warsaw, Jul. 2021.
- [Rep7] J. Kołakowski, V. Djaja-Jośko, J. Cichocki, M. Kołakowski: „Zintegrowany system innowacyjnych rozwiązań dla opieki nad osobami starszym” (Integrated solution for innovative elderly care), Final report for the National Centre for Research and Development, Warsaw, Sept. 2021.
- [Rep8] P. Kopyt, B. Salski, J. Cuper, A. Pacewicz, T. Karpisz: „Opracowanie efektywnych metod dostarczania energii pola elektromagnetycznego do wnęki otwartego rezonatora Fabry-Perot pracującego w paśmie terahercowym” (Effective methods for electromagnetic coupling with Fabry-Perot Open resonator in THz frequency band), Final report for the Scientific Council for Automatic Control, Electronics and Electrical Engineering, WUT, Warsaw, Dec. 2021.
- [Rep9] J. Krupka, P. Kopyt, M. Piasecki: "Dokładne metody charakteryzacji materiałów dla mikroelektroniki w paśmie fal milimetrowych i subterahercowych" (High-precision technique of millimeter and sub-THz band characterization of materials for microelectronics). Final report for the TEAM-TECH, EU Framework Programme "Intelligent Development 2014-2020", and Foundation for the Polish Science, Warsaw, Oct. 2021.
- [Rep10] J. Kryszyn: "Szpitalny system informacyjny oparty na standardzie openEHR – analiza wydajności" (Hospital information system based on openEHR system – analysis of efficiency), Final report for the Scientific Council for Biomedical Engineering, WUT, Warsaw, Dec. 2021.
- [Rep11] R. Kurjata, A. Rychter, J. Marzec, K. Zaremba, W. Obrębski, G. Pastuszak, A. Buchowicz, G. Galiński, M. Ziembicki, A. Klekotko: „Nowoczesna elektronika oraz algorytmy przetwarzania sygnałów i kompresji danych dla fizyki wysokich energii” (Modern electronics, digital signal processing and data compression algorithms for high energy physics experiments, Final report for the Scientific Council for Biomedical Engineering, WUT, Warsaw, Dec. 2021).
- [Rep12] E. Piątkowska-Jankó: „Analiza danych strukturalnych z badań obrazowych z wykorzystaniem oprogramowania FreeSurfer” (Analysis of structural data from image studies using FreeSurfer software). Final report for SWPS University, Warsaw, Feb. 2021.
- [Rep13] D. Radomski: "Analiza wpływu wybranych czynników położniczych na sposób parametryzacji sygnału bioelektrycznej aktywności macicy" (Analysis of selected obstetric factors influence on the bioelectric uterine activity signal parameterization), Final report for the Scientific Council for Biomedical Engineering, WUT, Warsaw, Dec. 2021.
- [Rep14] D. Rosołowski: "Innowacyjny system alarmowy umożliwiający integrację z rozwiązaniami SmartHome oraz obsługę przez aplikacje mobilne" (An innovative alarm system with integrated SmartHome solutions and operation via mobile applications), Final report for the National Centre for Research and Development, Warsaw, Jul. 2021.
- [Rep15] A. Rychter, R. Kurjata, J. Kryszyn, M. Trokielewicz, E. Bartuzi, K. Dygnarowicz, M. Hałoń: "Opracowanie innowacyjnej usługi – platformy do bezpiecznej mobilnej komunikacji opartej na zaufanym potwierdzeniu tożsamości" (Development of an innovative service - platform for secure mobile communication based on trusted identity confirmation), Final report for NEONTRI sp.z.o.o., Warsaw, Dec. 2021.

- [Rep16] B. Salski, M. Krysicki: "Otwarty rezonator Fabry-Perot z siatką Bragga wykonaną metodą druku 3D" (A Fabry-Perot open resonator with a Bragg gratings made by 3D printing), Final report for the Scientific Council for Automatics, Electronics and Electrical Engineering, WUT, Warsaw, Dec. 2021.
- [Rep17] W. Smolik, A. Rychter, J. Kryszyn, D. Wanta: "Realizacja prac o charakterze badawczo-rozwojowych i eksperckich" (Realization of research and development expert works), Final report for Giełda papierów Wartościowych w Warszawie S.A. (Warsaw Stock Exchange), Warsaw, Nov. 2021.
- [Rep18] M. Wieteska, K. Lipiński: "Pomiar średnic hydrodynamicznych nanocząsteczek metodą jądrowego rezonansu magnetycznego (NMR)" Measurement the hydrodynamic diameter of nanoparticles by means of nuclear magnetic resonance (NMR), Final report for the Scientific Council for Biomedical Engineering, WUT, Warsaw, Dec. 2021.
- [Rep19] W. Wojtasiak, D. Gryglewski: „Analiza wpływu planowanej zabudowy w rejonie Wirażowa/Osińskiego/Bennetta na wskaźniki radarów będących w gestii Polskiej Agencji Żeglugi Powietrznej w rejonie lotniska Okęcie” (Analysis of the impact of buildings in the area Wirażowa/ Osińskiego/Bennetta to identify the radars of the Polish Air Navigation Services Agency in the Okęcie airport). Final report for JEMS ARCHITEKCI sp.z.o.o., Warsaw, Mar. 2021.
- [Rep20] P. Wróblewski, M. Midura: "Badanie nanocząsteczek magnetycznych w zastosowaniu do hipertermii metodą MPS" (Research on magnetic nanoparticles for hyperthermia by means of MPS method), Final report for the Scientific Council for Biomedical Engineering, WUT, Warsaw, Dec. 2021.

8. PATENTS AND PATENT APPLICATIONS

- [Pat1] K. Malej, W. Obrebski, M. Orzechowski, P. Rogowski, P. Soluch, K. Wrotkowski: “*System for giving feedback based on motion before or during medical imaging and corresponding method*”. European patent WO2021099191A1, May 27, 2021.
- [Pat2] W. Obrebski, M. Orzechowski, P. Rogowski, P. Soluch, K. Wrotkowski: “*System for communicating with a subject and/or for supervision of the subject during magnetic resonance imaging (MRI), camera module, control unit, receiving and sending unit and optical transmission system*”. European patent WO2020076171A2, Sept. 06, 2021.

9. SCIENTIFIC EVENTS

Due to the the coronavirus pandemic conference organizers has decided to cancel all in-person attendance and face-to-face activities. This chapter contains the list of conferences that have been held remotely.

9.1. Virtual international scientific events

- [Con1] *14th International Joint Conference on Bio-medical Engineering Systems and Technologies: BIOSTEC 2021* (Feb. 11-13, 2021), J. Wagner, P. Mazurek (participants).
- [Con2] *Workshop of the EU project ENHANCE "Launching the Future"* Mar. 12, 2021), R. Z. Morawski (session chairman).
- [Con3] *15th European Conference on Antennas and Propagation: EuCAP 2021* (Düsseldorf, Germany, Mar. 22-26, 2021), B. Salski, T. Karpisz, P. Kopyt (participants).
- [Con4] *Sensor and Measurement Science International Conference: SMSI 2021* (Nürnberg, Germany, May 3-6, 2021), R. Z. Morawski (member of SMSI 2021 Conference Committee 'Measurements Science', chairman of SMSI 2021 D3 Session 'Measurement Foundations').
- [Con5] *Photonics North 2021* (Toronto, Canada, May 31 - Jun. 2, 2021), B. Salski, A. Pacewicz.
- [Con6] *Research Seminar of International Center for Formal Ontology* (Jun. 1, 2021), R. Z. Morawski: "Measurement as abduction" (speaker).
- [Con7] *2021 28th International Conference on Mixed Design of Integrated Circuits and System: MIXDES* (Łódź, Poland, Jun. 24-26, 2021), P. Bajurko (participant).
- [Con8] *The 13th International Conference on Electromagnetic Wave Interaction with Water and Moist Substances* (Kiel, Germany, Jul. 26-30, 2021), P. Kopyt, B. Salski (participants).
- [Con9] *18th International Conference on Microwave and High Frequency Applications: AMPERE 2021* (Gothenburg, Sweden, Sept. 13-16, 2021), W. Wojtasik, D. Gryglewski (participants).
- [Con10] *The 25th International Conference on Signal Processing – Algorithms, Architectures, Arrangements and Applications: SPA 2021* (Poznań, Poland, Sept. 22-24, 2021), o.J. Modelska, W. Skarbek (members of the Scientific Committee).
- [Con11] *The 11th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems Technology and Applications: IDAACS 2021* (Cracow, Poland, Sept. 22-25, 2021), P. Bilski (International Programme Committee co-chairman), R. Z. Morawski (member of the International Programme Committee).

[Con12] *XXIII IMEKO World Congress "Measurement: sparking tomorrow's smart revolution"* (Yokohama, Japan, Aug. 30 - Sept. 3, 2021), R. Z. Morawski (participant), P. Mazurek, J. Wagner (speakers).

[Con13] *Whole Heliosphere and Planetary Interactions Workshop* (San Francisco, USA, Sept. 13-17, 2021), T. A. Miś (speaker).

[Con14] *10th International Conference on Computing, Communication and Sensor Networks: CCSN 2021* (Kolkata, Indie, Oct. 2-4, 2021), P. Bilski (keynote speaker).

[Con15] *48 Międzynarodowa Konferencja i Wystawa PIKE 2021* (48th International Conference and Exhibition PIKE) (Łódź, Poland Oct. 4-6, 2021), J. Modelska (chair of the Programe Council).

[Con16] *2021 IEEE International Symposium on Antennas and Propagation and USNC-USRI Radio Science Meeting* (Marina Bay Sands, Singapore, Dec. 4-10, 2021), Y. Yashchyshyn (chair of the session: Millimeter-Wave, Terahertz and Optical Antennas II), G. Bogdan (speaker).

9.2. Virtual national scientific events

[Con17] *XXII Krajowa Konferencja Biocybernetyki i Inżynierii Biomedycznej* (XXII Polish Conference on Biocybernetics and Biomedical Engineering) (Warsaw, Poland, May 19-21, 2021), W. Smolik, G. Domański, J. Kryszyn, D. Radomski, T. Rubel, M. Midura, D. Wanta, P. Wróblewski (participants).

[Con18] *Opiniowanie etyczne projektów naukowych* (Ethical Assessment of Research Projects), konferencja zorganizowana przez Komitet Etyki w Nauce PAN, Zakład Etyki Wydziału Filozofii UW i półrocznik *Etyka* (Warsaw, Nov. 26-27, 2021), R. Z. Morawski (invited speaker). Lecture titled: "Etyczne wyzwania technonauki" (Ethical Challenges of Technoscience).

[Con19] *22 Seminarium: Radiokomunikacja i Techniki Multimedialne* (22nd Seminar: Radio-communications and Multimedia Technologies) (Warsaw, Dec. 08, 2021), J. Kołakowski, K. Snopek, J. Modelska (session chairs), M. Kołakowski, P. CzeKała, J. Fąk, P. Harabuda, M. Maciąła.

10. AWARDS AND DISTINCTIONS

State Medals

Wojciech Wojtasiak, D.Sc.

Złoty Krzyż Zasługi (Golden Cross of Merit).

Daniel Gryglewski, Ph.D.

Brażowy Krzyż Zasługi (Bronze Cross of Merit).

Andrzej Buchowicz, Ph.D.

Golden Medal for the Long-lasting Service.

Krystian Ignasiak, Ph.D.,

Robert Łukaszewski, Ph.D.,

Tomasz Olszewski, M.Sc.

Silver Medal for the Long-lasting Service.

Krzysztof Kurek, Ph.D.

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

Awards granted by international bodies

Prof. Roman Z. Morawski has been listed in the World's TOP 2% Scientists 2020 ranking, prepared by Stanford University in cooperation with Elsevier Publishing House.

Awards in the Young Scientists Contest at international conferences

Awards granted by national bodies

Grzegorz Bogdan, Ph.D.

The START scholarship of the Foundation for Polish Science.

Piotr Czekała, M.Sc.

Diploma granted by the Minister Science and Education for the outstanding achievements in academic year 2020/2021.

Awards of the Rector

Piotr Bilski, D.Sc.

Individual I^o award for the scientific achievements.

Kajetana M. Snopka, D.Sc.

Individual III^o award for the didactic achievements.

Tomasz Karpisz, Ph.D.,

Jakub Wagner, Ph.D.,

Marcin Ziembicki, Ph.D.

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

Yevhen Yashchyshyn, Prof. D.Sc.,

Paweł Bajurko, Ph.D.,

Grzegorz Bogdan, Ph.D.,

Konrad Godziszewski, Ph.D.,

Jakub Sobolewski, M.Sc.

Team I^o award for the scientific achievements.

Jerzy Krupka, Prof. D.Sc., (IMiO)

Paweł Kopyt, D.Sc.,

Bartłomiej Salski, D.Sc.,

Tomasz Karpisz, Ph.D.,

Adam Pacewicz, Ph.D.,

Mateusz Krysiński, M.Sc.,

Jerzy Cuper, M.Sc.,

Piotr Czekała, M.Sc.

Team I^o award for the scientific achievements.

Andrzej Kraśniewski Prof. D.Sc., (IT)

Krzysztof Szczypiorski D.Sc., (IT)

Halina Tarasiuk, D.Sc., (IT)

Andrzej Bęben, D.Sc., (IT)

Piotr Firek, Ph.D., (II)

Mariusz Kaleta, Ph.D., (IAiS)

Jerzy Kołkowski, Ph.D.,

Przemysław Korpas, Ph.D.,

Konrad Markowski, Ph.D., (IT)

Michał Marzęcki, Ph.D., (IT)

Daniel Paczesny, Ph.D., (IT)

Piotr Wiśniewski, Ph.D., (IT)

Henryk Kowalski, M.Sc., (II)

Rajmund Kożuszek, M.Sc., (II)

Andrzej Manujło, M.Sc., (IAiS)

Danuta Ojrzeńska-Wójcier, M.Sc., (IT)

Maciej Sosnowski, M.Sc. (IT)

Team I^o award for the didactic achievements.

Józef Modelska, Prof. D.Sc.,

Adam Abramowicz, D.Sc., (ISE)

Grzegorz Bogdan, Ph.D.,

Anna Czarnecka, M.Sc.,

Mateusz Krysiński, M.Sc.

Team I^o award for the organizational achievements.

Best Paper Programme, second edition

Piotr Bilski, D.Sc.

Author of awarded paper "Analysis of the ensemble of regression algorithms for the analog circuit parametric identification", *Measurement* journal. Best Paper Programme is a competition for best scientific papers published in a given year by authors affiliated with the Warsaw University of Technology is announced as part of the "Excellence Initiative – Research University" project at the Warsaw University of Technology.

Awards of the Foundation for the Development of Radiocommunications and Multimedia Technologies for the Best Ph.D. Thesis.

Tomasz Karpisz, Ph.D.

IInd award for the Ph.D. dissertation titled: "Novel methods for characterization of dielectric materials at microwave and millimeter-wave frequencies" (Nowe metody charakteryzacji materiałów dielektrycznych w zakresie mikrofalowym oraz fal milimetrowych), supervisor: **Bartłomiej Salski, D.Sc.**

Marcin Góralczyk, Ph.D.

IIIrd award for the dissertation titled: "A s-band inverted 3-way Doherty amplifier with GaN HEMT transistors", supervisor: **Wojciech Wojtasiak, D.Sc.**

Scholarships of the Foundation for the Development of Radiocommunications and Multimedia Technologies granted in 2021.

Marcin Kołkowski

Bartosz Żłobiński

For preparing Ph.D. thesis.

Piotr Bartosik

Piotr Czekała

Jakub Fąk

Jakub Kocot

Michał Maciąga

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

SPECIFICATION	2018	2019	2020	2021
academic staff [posts]				
total	57,5	54,5	56	56,7
professors	4	4	5,5	5,5
University professors	9	9	8	8
associate professors	3	2	1	0
assistant professors	24,5	26,5	30,5	35,2
readers	1	1	1	0
senior lecturers	5,5	5	2,5	0
assistants	10,5	7	7,5	8
Ph.D. students [persons]				
total	37	38	39	29
technical and administrative staff [posts]				
total	14,25	16,65	13,3	14,7
senior R&D associates	1,5	1,5	1	2
R&D associates	2	4,75	3,5	3,5
administrative associates	8,75	8,4	6,8	5,2
service workers	2	2	2	2
temporary staff [persons]				
total	2	5	4	2
teaching activities				
basic courses	58	50	57	80
advanced courses	32	28	27	36
other courses	26	23	15	15
international projects, courses and lectures	3	4	1	2
research projects				
total	48	52	51	44
International granted by EU	4	4	4	3
granted by the Ministry	17	20	22	16
granted by the University	14	16	7	13
other	13	12	18	12
titles and degrees awarded				
Prof. titles	0	0	0	0
D.Sc. degrees	0	1	0	0
Ph.D. degrees	4	2	6	5
M.Sc. degree (regular studies + evening studies)	42+1	39+2	43+1	26
M.Sc. degree (studies in English)	3	0	0	0
B.Sc. degrees (regular studies + evening studies)	76+5	69+5	63+5	69+1
B.Sc. degrees (studies in English)	0	0	0	1
B.Sc. degrees e-learning	1	1	2	0
publications				
total	153	123	131	72
sci.-tech. books and chapters in books	2	2	2	1
sci.-tech. papers in journals - total	57	37	62	43
JCR-ICI list (IF>0)	33	31	52	38
in other journals	7	14	10	5
sci.-tech. papers in conference proceedings	89	55	59	17
other publications	5	12	8	11
patents and patent applications				
international	0	0	0	2
national	4+2	3	2	0
research reports				
25	33	24	20	
scientific events attended by the staff				
35	45	20	19	

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 (**professor 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 **wykładowca**, translated here as **Lecturer** – the professional title of *magister* or *magister inżynier*;
- for the post of **starszy wykładowca**, translated here as **Senior Lecturer** – the *doktor* or *magister inżynier* 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 **profesor uczelni**, translated here as **Associate Professor** – the *doktor habilitowany* degree;
- for the post of **profesor**, translated here as **Full Professor** – the professor title.

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

