**INSTITUTE OF RADIOELECTRONICS
AND MULTIMEDIA TECHNOLOGY**

WARSAW UNIVERSITY OF TECHNOLOGY

FACULTY OF ELECTRONICS AND INFORMATION TECHNOLOGY

ANNUAL REPORT

2022

Warsaw, January 2023

Institute of Radioelectronics and Multimedia Technology
Faculty of Electronics and Information Technology
Warsaw University of Technology
Nowowiejska 15/19
00-665 Warsaw
Poland

Head Office
room: 422
phone: +48 22 234 7233
fax: +48 22 825 3769

Internet information
http://www.ire.pw.edu.pl

From the Director

Dear Friends and Colleagues!

Another difficult year is already behind us. Although the COVID-19 pandemic seemed to slowly vanish, the full-scale Russian invasion on Ukraine broke out, having serious consequences especially for our country. Both events strongly influence daily Institute's operations. Besides expressing support for the nation of Ukraine, Warsaw University of Technology took specific measures to support its students and scientists. Our Institute also has a part in this process: we have the pleasure to host Peter Tokarsky, PhD, DSc, as he became the temporary member of our scientific staff. We have high hopes regarding cooperation with our Ukrainian colleagues and believe the grim war circumstances also create opportunity to strengthen international cooperation and will be fruitful in the long term.

The quickly changing political situation in the world is of course affecting our situation and daily routines, but we managed to return to the nominal state. Therefore the Institute of Radioelectronics and Multimedia Technology continued its activities in various fields, most of all including science, didactics and organizational efforts.

The publication achievements are usually a strong part of the Institute. This year we have over 60 journal publications, 50 of which were published in journals from the JCR list. Their only deficiency is the lack of papers in the highest evaluated journals (granted 200 points by the Polish Ministry of Education and Science) To deal with this problem, multiple measures have already been taken, we are expecting more impressive results next year. Although the conferences (due to COVID-19 pandemic) are still not in the full spread, our staff were able to publish 30 papers in the conference proceedings, both national and international.

We were also hosting conferences and workshops. The most notable were KKRRiT national conference (held in Warsaw in September), and 10th Microwave and Radar Week, held in Gdańsk. The third event was IMEKO TC10 workshop, also held in Warsaw in September. Feedback from participants has shown the effort put for organizing these events was not in vain.

One of the serious changes in the University's operation was merging previous five PhD schools into the single one. Its didactic path is now in its second year, and the main impact on the institute operations is the decreased number of PhD students. However, we are still struggling to keep the Phd student's number as high as possible as we treat them as the investment for the future.

An important aspect in the life of the Institute is the advancement of our staff. Firstly, new PhD degrees give hope for expanding the professional staff. This year has been fruitful in this matter, as we have greeted 3 new PhDs, one of which already became part of our scientific team.

Warm congratulations go to prof. Janusz Marzec, who received full professor degree from President of Republic of Poland. We are extremely happy for this well deserved nomination and strongly believe this is just the first of many in the incoming years.

Unfortunately, this year was also full of sad events. We have to bid farewell to the former employees of the Institute and our long-time friends. Dr Waldemar Scharf has been the exceptional (very popular among students) specialist in the field of biomedical accelerators. The second loss, Barbara Eichler, was responsible for managing operations of our secretariats, working as a chief of the secretary staff.

We hope the next year will be more fruitful, especially regarding publications in the top world journals and the world turmoil will finally come to an end.

Professor Józef Modelski

Warsaw, January 2023

Contents

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 neuroimag-

ing, data analysis in proteomics, software and hardware developments in Electrical Capacitance Tomography and Nanoparticle Magnetic Tomography.

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

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

1.2. Board of Directors

Director of the Institute

Józef Modelski, Prof. D.Sc., Full Professor
room: 535, phone: +48 22 2347723
e-mail: jozef.modelski@pw.edu.pl

Secretariat

Anna Smenda, Administrative Clerk
room: 422, phone: +48 22 2347233, +48 22 8253929
fax: +48 22 8253769
e-mail: anna.smenda@pw.edu.pl

Marta Rudnicka, Senior Administrative Clerk
room: 422, phone: +48 22 2347742, +48 22 8253929
fax: +48 22 8253769
e-mail: marta.rudnicka@pw.edu.pl

Deputy Director for Research

Piotr Bilski, D.Sc., Associate Professor
room: 127, phone: +48 22 234 5367, +48 22 2347644
e-mail: piotr.bilski@pw.edu.pl

Secretariat

Anna Noińska, Administrative Clerk for Research (0.8, till Aug. 2022)
room: 426, phone: +48 22 2345367
e-mail: anna.noinska@pw.edu.pl

Karolina Bąk, M.A., Administrative Clerk for Research (from Jun. 2022)
room: 426, phone: +48 22 2345367
e-mail: karolina.bak@pw.edu.pl

Deputy Director for Academic Affairs

Andrzej Buchowicz, Ph.D. Assistant Professor
room: 424, phone: +48 22 2347829, +48 22 8255248
e-mail: andrzej.buchowicz@pw.edu.pl

Secretariat

Izabela Dudek, Administrative Clerk for Teaching
room: 424, phone: +48 22 2347829, +48 22 8255248
fax: +48 22 8255248
e-mail: izabela.dudek@pw.edu.pl

Monika Feluś, M.A., Administrative Clerk for Teaching
room: 424, phone: +48 22 2347696, +48 22 8255248
fax: +48 22 8255248
e-mail: monika.felus@pw.edu.pl

Director's Representative for Economy & Administration

Piotr Brzeski, Ph.D., Didactic Assistant Professor (0.5 till Sept. 2022, 0,3 from Oct. 2022)
room: 422, phone: +48 22 2347742, +48 8253929
e-mail: piotr.brzeski@pw.edu.pl

1.3. Organisation of the Institute

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

- Electroacoustics Division;
- 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
room: 131, phone: +48 22 2347999
e-mail: jan.zera@pw.edu.pl

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
Krzysztof Mroczek, Ph.D., Assistant Professor

Junior academic staff

Maciej Jasiński, M.Sc., Assistant

Technical staff

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

Ph.D. Students

Krzysztof Dowalla, M.Sc., from Feb. 2017
Salomea Grodzicka, M.Sc., from Oct. 2019
Maciej Jasiński, M.Sc., from Feb. 2018
Jacek Majer, M.Sc., from Oct. 2018
Tomasz Markowski, M.Sc., from Feb. 2018
Bartosz Połok, M.Sc., from Oct. 2015
Karolina Pondel-Sycz, M.Sc., from Oct. 2021
Jakub Tkaczuk, M.Sc., from Oct. 2020
Katarzyna Wynimko, M.Sc., from Oct. 2018

Retired

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

The activities of the Division concern electroacoustics and digital audio techniques, including investigations, measurements and applications. They are focused on:
- fundamentals of acoustics;
- electroacoustics;
- psychoacoustics;
- digital audio;
- design and measurements of electroacoustic transducers;
- investigation and modeling of acoustic field distribution;
- noise control and active noise reduction;
- architectural and industrial acoustics;
- sound studio techniques;
- hearing protection.

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

The other field of interest concerns fundamental and ap-

plied 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

Janusz Marzec, Prof. D.Sc., Full Professor
room: 63, phone: +48 22 2347955, +48 22 2347643
e-mail: janusz.marzec@pw.edu.pl

Senior academic staff

Krzysztof Zaremba, Prof. D.Sc., Full Professor

Piotr Bogorodzki, D.Sc., Associate Professor

Waldemar Smolik, D.Sc., Associate Professor

Grzegorz Domański, Ph.D., Assistant Professor

Bogumił Konarzewski, Ph.D., Didactic Assistant Professor

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 (0.7)

Piotr Brzeski, Ph.D., Didactic Assistant Professor (0.5 till Sept. 2022, 0,3 from Oct. 2022)

Tomasz Olszewski, M.Sc., Didactic Assistant (0.5)

Junior academic staff

Kamil Lipiński, M. Sc., Assistant (0,5 from Oct. 2022)

Wojciech Obrębski, M.Sc., Assistant (0.5)

Damian Wanta, M.Sc., Assistant (0.5)

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

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 concentra-

ted 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

Wojciech Wojtasiak, D.Sc., Associate Professor
room: 549, phone: +48 22 2345886
e-mail: wojciech.wojtasiak@pw.edu.pl

Senior academic staff

Józef Modelski, Prof. D.Sc., Full Professor

Wojciech Wojtasiak, D.Sc., Associate Professor

Jacek Cichocki, Ph.D., Didactic Assistant Professor 0,5

Vitomir Djaja-Jośko,Ph.D., Assistant Professor (from Mar. 2022)

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

Karol Kuczyński, Ph.D., Assistant Professor (0,5 from Nov. 2022)

Krzysztof Kurek, Ph.D., Assistant Professor

Przemysław Miazga, Ph.D. Didactic Assistant Professor

Mirosław Mikołajewski, Ph.D., Assistant Professor

Dawid Rosołowski, Ph.D., Assistant Professor

Junior academic staff

Marcin Kołakowski, M.Sc., Assistant

Technical staff

Mirosław Lubiejewski, Foreman

Ph.D. students

Marcin Kołakowski, M.Sc., from Oct. 2016

Tomasz A. Miś, M.Sc., from Oct. 2017

Łukasz Nowicki, M.Sc., from Oct. 2021

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.,

Stanisław Rosłoniec, Prof. 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, modula-

tors, 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

Yevhen Yashchyshyn, Prof. D.Sc., Full Professor
  room: 33, phone: +48 22 2347727
  e-mail:yevhen.yashchyshyn @pw.edu.pl

Senior academic staff

Yevhen Yashchyshyn, Prof. D.Sc., Full Professor

Paweł Kopyt, D.Sc., Associate Professor

Bartłomiej Salski, D.Sc., Associate Professor

Peter Tokarsky, D.Sc., Associate Professor (0,75 from Jul. 2022)

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., Didactic Assist. Professor 0.5

Junior academic staff

Tomasz Karpisz, Ph.D., Assistant

Mateusz Krysicki, M.Sc., Research Assistant

Technical Staff

Adam Pacewicz, Ph.D., Senior R&D Engineer

Ph.D. students

Jerzy Cuper, M.Sc., from Oct. 2019

Piotr Czekała, M.Sc., from Oct. 2021

Jakub Sobolewski, M.Sc., from Feb. 2017, till Dec. 2022

Maciej Soszka, M.Sc., from Oct. 2018

Temporary Staff

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

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 Teraherz 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

Kajetana Snopek, D.Sc., Associate Professor
  room: 443, phone: +48 22 2347713
  e-mail:kajetana.snopek@pw.edu.pl

Senior academic staff

Roman Z. Morawski, Prof. D.Sc., Full Professor (0.75)
Władysław Skarbek, Prof. D.Sc, Full Professor (0.75)
Grzegorz Pastuszak, D.Sc., Associate Professor
Kajetana Snopek, D.Sc., Associate Professor
Andrzej Buchowicz, Ph.D., Assistant Professor
Xin Chang, Ph.D., Assistant Professor (from Oct. 2022)
Grzegorz Galiński, Ph.D., Assistant Professor
Krystian Ignasiak, Ph.D., Didactic Assistant Professor
Paweł Mazurek , Ph.D., Assistant Professor
Andrzej Miękina, Ph.D., Assistant Professor
Jakub Wagner, Ph.D., Assistant Professor

Junior academic staff

Xin Chang, M.Sc. (0.5 till Sept. 2022)
Grzegorz Gwardys, M.Sc. , Assistant (0.5)

Technical staff

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

Ph.D. students

Michał Daniluk, 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

Monika Feluś, M.A., Administrative Clerk for Teaching
  room: 424, phone: +48 22 2347696, +48 22 8255248
  fax: +48 22 8255248
  e-mail: monika.felus@pw.edu.pl

1.5. Other Institute's Units

1.5.1. Accounting Department

Head

Aleksandra Jefimowicz, M.A., Accounting Clerk
  room: 420, phone: +48 22 2347645
  e-mail: aleksandra.jefimowicz@pw.edu.pl

Staff

Zdzisława Fenikowska, M.A., Accounting Clerk
  room: 421, phone: +48 22 2347743
  e-mail: zdzislawa.fenikowska@.pw.edu.pl

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

Beata Rosłon, Accounting Clerk
  room: 421, phone: +48 22 2347743
  e-mail: beata.roslon@w.edu.pl

1.5.2 Supply Section

Staff

Andrzej Laskowski, Worker
  room: 419, phone: +48 22 2345018
  e-mail: andrzej.laskowski@pw.edu.pl

Andrzej Owczarek, M.Sc., Maintenance Engineer (0.5)
  room: 419, phone: +48 22 2345018
  e-mail: andrzej.owczarek@pw.edu.pl

1.5.3 Office of the Foundation for the Development of Radiocommunication and Multimedia Technology

Anna Czarnecka, M.Sc., (em.), Research Suport Eng.
  room: 535, phone: +48 22 2347910
  e-mail: anna.czarnecka@pw.edu.pl

2. STAFF

2.1. Senior academic staff

Paweł Bajurko
  room: 34, phone: +48 22 2347795
  e-mail: pawel.bajurko@pw.edu.pl
M.Sc. ('04), Ph.D. ('12); antennas and antenna arrays; reconfigurable systems, sub-THz techniques, wireless localization; **Assistant Professor**, Sub-Terahertz Technology Division.
[Edu129], [Pro2], [Pro25], [Pub9], [Pub11], [Pub27], [Pub60], [Pub64], [Pub69], [Pub94], [Pub98], [Pat3].

Piotr Bilski
  room: 127, phone: +48 22 2347644
  e-mail: piotr.bilski@pw.edu.pl
M.Sc. ('01), Ph.D. ('06), D.Sc. ('14); measurement systems, virtual instrumentation, digital signal processing, diagnostics of analog systems, artificial intelligence; **Associate Professor**, Electroacoustics Division.
Deputy Director for Research of the Institute of Radioelectronics and Multimedia Technology ('19-); Secretary of the Board of the Foundation for the Development of Radiocommunications and Multimedia Technology ('21-); Member of IEEE ('05), POLSPAR Board ('14-), and IMEKO TC10 Board ('12-). Member of the Control Committee of the iUSER Sector Program, National Centre for the Research and Development ('16-); Member of the Scientific Council for Automatic Control, Electronics, and Electrical Engineering, WUT ('19-).
[Edu26], [Edu90], [Pro9], [Pro20], [MSc12], [BSc13], [BSc43], [BSc46], [Pub15], [Pub16], [Pub17], [Pub36], [Pub73], [Pub74], [Pub79], [Pub80].

Piotr Bobiński
  room: 125, phone: +48 22 2347637
  e-mail:piotr.bobinski@pw.edu.pl
M.Sc. ('98), Ph.D. ('04); acoustics, electroacoustics and sound engineering, digital audio signal processing, multimedia and measurement systems, distributed systems and web technology; **Assistant Professor**, Electroacoustics Division;
[Edu1], [Edu14], [Edu73], [Edu79], [Edu92], [Edu129], [Edu131], [BSc22], [Pub79].

Grzegorz Bogdan
  room:35, phone: +48 22 2347796
  e-mail: grzegorz.bogdan@pw.edu.pl
M.Sc. ('13), Ph.D. ('19); telecommunications; **Assistant Professor**, Sub-Terahertz Technology Division.
[Edu34], [BSc3], [Pub11], [Pub70], [Pub95].

Piotr Bogorodzki
  room: 70, phone: +48 22 2347345
  e-mail: piotr.bogorodzki@pw.edu.pl
M.Sc. ('88), Ph.D. ('98), D.Sc. ('12); biomedical engineering; **Associate Professor**, Nuclear and Medical Electronics Division.
Member of the Review Board of *IEEE Trans. on Medical Imaging* ('06-); Member of the Associate Editors Board of *International Journal of Electronics and Telecommunications* ('14-); Member of the Programme Board of High Field Resonance Imaging ECOTECH--COMPLEX Center ('15-); Member of the Scientific Council for Biom. Engineering, WUT ('19-).
[Edu97], [Edu105], [Edu128], [Edu130], [Pro8], [Pro18], [MSc14], [Pub14], [Pub28].

Piotr A. Brzeski
  room: 60, phone: +48 22 2347577
  e-mail: piotr.brzeski@pw.edu.pl
M.Sc. ('70), Ph.D. ('82); biomedical engineering; **Didactic Assistant Professor**, Nuclear and Medical Electronics Division.
Head of the Dean's Financial Committee ('12-); Member of the Faculty Council Committee on Education ('05-); Director's Representative for Economy & Administration ('12-).
[Edu5], [Edu6], [Edu15], [Edu29], [Edu43], [Edu55], [Edu96], [Edu112], [Edu128], [Edu130].

Andrzej Buchowicz
  room: 451, phone: +48 22 2347840
  e-mail: andrzej.buchowicz@pw.edu.pl
M.Sc. ('88), Ph.D. ('97); television, digital signal and image processing, digital television systems; **Assistant Professor**, Multimedia Engineering Division.
Deputy Director for Academic Affairs of the Institute of Radioelectronics and Multimedia Technology ('20-). Member of the Faculty Council ('05-12, '20-); Member of the Faculty Council Committee on Education ('20-), Head of the Area of Wireless and Multimedia Technology, II^0 studies ('21-). Member of the Management Board of the Foundation for the Development of Radiocommunications and Multimedia Technology ('02-).
[Edu8], [Edu10], [Edu29], [Edu76], [Edu91], [Edu95], [Edu96], [Edu124], [Edu129], [Edu131], [Pro1], [Pro17], [BSc33].

Xin Chang
  room: 452, phone: +48 22 2347957
  e-mail: xin.chang@pw.edu.pl
M.Sc. ('18), Ph.D. ('22); information and communication technology, **Assistant Professor**, Multimedia Engineering Division.

Jacek Cichocki
  room: 27, phone: +48 22 2347635
  fax: +48 22 8253759
  e-mail: jacek.cichocki@pw.edu.pl
M.Sc. ('79), Ph.D. ('92); measurement and instrumentation, radiocommunications, cellular systems; **Didactic Assistant Professor**, Radiocommunications and Radiolocation Division.
Head of the Area of Radiocommunications and Multimedia Technology ('08-'21); Head of the Area of Wireless and Multimedia Technology, I^0 studies ('21-). Member of the Programme Committee of the National Conf. of Radiocom. and Broadcasting ('08-).
[Edu12], [Edu23], [Edu29], [Edu60], [Edu64], [Edu95], [Edu96], [Edu129], [Pro4], [Pro5].

Krzysztof Derzakowski
  room: 550, phone: +48 22 2347933
  e-mail: krzysztof.derzakowski@pw.edu.pl
M.Sc. ('84), Ph.D. ('91); radio-frequency engineering, microwave technique; **Assistant Professor**, Sub-Terahertz Technology Division.
[Edu7], [Edu42].

Vitomir Djaja-Jośko
  room: 29, phone: +48 22 2347620
  e-mail: vitomir.djaja-josko@pw.edu.pl
M.Sc. ('15), Ph.D. ('22); information and communica-

tion technology; **Assistant Professor**, Radiocommunications and Radiolocation Division.
[Pro4], [Pro5], [BSc1], [BSc30], [Pub54], [Pub72].

Grzegorz Domański
room: 61, phone: +48 22 2347626
e-mail: grzegorz.domanski@pw.edu.pl
M.Sc. ('94), Ph.D. ('01); nuclear and medical electronics; **Assistant Professor**, Nuclear and Medical Electronics Division.
Faculty Coordinator of Radiological Protection ('02-); Tutorial assistance of Biomedical and Nuclear Engineering Students Scientific Group ('13-). Head of Specialization: Biomedical Apparatus ('21-).
[Edu51], [Edu67], [Edu99], [Edu128], [Edu130], [Pro18], [MSc1], [MSc3], [MSc10], [MSc28], [MSc31], [Pub28], [Pub45].

Grzegorz Galiński
room: 451, phone: +48 22 2345016
e-mail: grzegorz.galinski@pw.edu.pl
M.Sc. (97'), Ph.D. ('03); image and video processing, multimedia systems, multimedia indexing; **Assistant Professor**, Multimedia Engineering Division.
[Edu4], [Edu41], [Edu91], [Edu129], [Pro1], [Pro11], [Pro17], [MSc6], [MSc13], [BSc7], [BSc34], [Pub55], [Pub61].

Konrad Godziszewski
room: 35, phone: +48 22 2347796
e-mail: konrad.godziszewski@pw.edu.pl
M.Sc. ('11), Ph.D. ('18); telecommunications, **Assistant Professor**, Sub-Terahertz Technology Division.
[Edu63], [Edu65], [Edu66], [Edu80], [Edu129], [Edu131], [Pro30], [BSc47], [Pub11], [Pub53].

Daniel Gryglewski
room: 549, phone: +48 22 2345886
e-mail: daniel.gryglewski@pw.edu.pl
M.Sc. ('96), Ph.D. ('01); microwave technique; **Assistant Professor**, Radiocommunications and Radiolocation Division.
Head of RF&Microwave Engineering Laboratory.
[Edu13], [Edu32], [Edu71], [Pro6], [Pro12], [Pro23], [Pro29], [Pro31], [Pub63], [Pub78], [Pat2].

Krystian Ignasiak
room: 451, phone: +48 22 2345016
e-mail: krystian.ignasiak@pw.edu.pl
M.Sc. ('94), Ph.D. ('99); informatics, multimedia systems, distributed systems, web technology;**, Didactic Assistant Professor**, Multimedia Engineering Division.
[Edu9], [Edu11], [Edu17], [Edu33], [Edu59], [Edu62], [Edu78], [Edu129], [Edu131], [BSc35].

Tomasz Karpisz
room: 547, phone: +48 22 2347622
e-mail: tomasz.karpisz@pw.edu.pl
M.Sc. ('15), Ph.D. ('20), microwave technique; **Assistant Professor**, Radiocommunications and Radiolocation Division.
[Pro15], [Pro16], [Pro21], [Pro22], [Pro24], [Pub20], [Pub39], [Pub87].

Wojciech Kazubski
room: 433, phone: +48 22 2347378
e-mail: wojciech.kazubski@pw.edu.pl
M.Sc. ('86), Ph.D. ('98); radio frequency engineering, radio receivers, RF measurement techniques, short-

-wave propagation; **Assistant Professor**, Radiocommunications and Radiolocation Division.
[Edu63], [Edu129].

Jerzy Kołakowski
room: 27, phone: +48 22 2347635
fax: +48 22 8253759
e-mail: jerzy.kolakowski@pw.edu.pl
M.Sc. ('88), Ph.D. ('00); ultrawideband systems, cellular systems, measurement and instrumentation; **Assistant Professor**, Radiocommunications and Radiolocation Division. Tutorial assistance of Radio Localization Student Research Group (LORAD), Member of the Management Board of the Foundation for the Develop. of Radiocom. and Multi. Technology ('02-).
[Edu23], [Edu40], [Edu45], [Edu77], [Edu109], [Pro4], [Pro5], [Pro32], [Pro33], [MSc9], [BSc48].

Bogumił Konarzewski
room: 64, phone: +48 22 2347916
e-mail: bogumil.konarzewski@pw.edu.pl
M.Sc. ('91), Ph.D. ('98); nuclear and medical electronics; **Didactic Assistant Professor**, Nuclear and Medical Electronics Division.
Director's Representative for Software and Computer Devices ('16-).
[Edu2], [Edu68], [Edu128], [Edu130].

Paweł Kopyt
room: 546, phone: +48 22 2345829
e-mail: pawel.kopyt@pw.edu.pl
M.Sc. ('01), Ph.D. ('06), D.Sc. ('16); microwave technique, modeling of multiphysics effects involving electromagnetic phenomena; **Associate Professor**, Sub-Terahertz Technology Division; Member of the Scientific Board of the Polish Security Printing Works ('19-); Member of the Scientific Council for Automtic Control, Electronics and Electrical Engineering, WUT ('19-).
[Edu37], [Edu38], [Edu71], [Edu98], [Pro6], [Pro7], [Pro10], [Pro14], [Pro16], [Pro21], [Pub20], [Pub21], [Pub23], [Pub24], [Pub35], [Pub38], [Pub39], [Pub71], [Pub77], [Pub90], [Pub92], [Pub97].

Przemysław Korpas
room: 548, phone: +48 22 2347624
e-mail: przemyslaw.korpas@pw.edu.pl
M.Sc. ('10), Ph.D. ('15); microwave technique, IoT & embedded systems, web & mobile applications; **Assistant Professor**, Radiocommunications and Radiolocation Division. Member of the Faculty Council ('20-). Tutorial assistance of 3Z5PW Experimental Amateur Radio Station ('16-); Co-author of the *www.RadioPolska.pl* website ('20-).
[Edu74], [Edu75], [Edu81], [Edu89], [Edu129], [Edu131], [Pro23], [MSc24], [Pub56], [Pub57], [Pub63], [Pub78], [Pat2].

Sebastian Kozłowski
room: 444, phone: +48 22 2346088
e-mail: sebastian.kozlowski@pw.edu.pl
M.Sc. ('04), Ph.D. ('11); MIMO systems, **Assistant Professor**, Radiocommunications and Radiolocation Division.
[Edu52], [Edu111], [Edu128], [Edu129], [Edu131], [Pro23], [Pro33], [MSc15], [BSc31], [Pub22], [Pat2].

Jacek Kryszyn
room: 59, phone: +48 22 2347577
e-mail: jacek.kryszyn@pw.edu.pl

M.Sc. ('12), Ph.D. ('18), computer engineering, biomedical engineering, computer tomography; **Assistant Professor**, Nuclear and Medical Electronics Division. Head of Specialization: Biomedical Information Technology (21-).
[Edu58], [Edu128], [Edu130], [Pro18], [Pro19], [Pro27], [BSc8], [BSc10], [BSc32], [BSc39], [Pub25], [Pub28], [Pub45], [Pub46], [Pub47], [Pub58].

Krzysztof Kurek
  room: 551, phone: +48 22 2345476
  e-mail: krzysztof.kurek@pw.edu.pl
M.Sc. ('96), Ph.D. ('02); radiocommunications, radio-frequency engineering, space technologies; **Assistant Professor**, Radiocommunications and Radiolocation Division.
Tutorial assistance of Space Engineering Student Scientific Group ('04-); Member of the Committee on Space Research of the Polish Academy of Sciences ('07-).
[Edu12], [Edu86], [Edu113], [Edu129], [Pro32], [Pro33], [Pub22], [Pub43].

Karol Kuczyński
  room: 442, phone: +48 22 2347341
  e-mail: karol.kuczynski@pw.edu.pl
M.Sc. ('04), Ph.D. ('22); automation, electronics and electrical engineering, robotics; **Assistant Professor**, Radiocommunications and Radiolocation Division.
[Pub80].

Robert Kurjata
  room: 61, phone: +48 22 2347626
  e-mail: robert.kurjata@pw.edu.pl
M.Sc. ('00), Ph.D. ('07); nuclear and medical electronics; **Assistant Professor**, Nuclear and Medical Electronics Division.
Member of the Faculty Council ('16-);
[Edu9], [Edu20], [Edu107], [Edu117], [Edu128], [Edu130], [Pro1], [Pro3], [Pro17], [BSc2], [BSc6], [Pub6], [Pub7], [Pub8], [Pub10], [Pub34], [Pub86], [Pub88].

Marcin Lewandowski
room: 125, phone: +48 22 2347637
  e-mail: marcin.lewandowski@pw.edu.pl
M.Sc. ('06), Ph.D. ('13); acoustics, electroacoustics and sound engineering, digital audio signal processing, digital sound synthesis; **Assistant Professor**, Electroacoustics Division.
[Edu11], [Edu72], [Edu83], [Edu94], [Edu115], [Edu129], [Pro20], [MSc16], [MSc25], [BSc12], [BSc20], [Pub26].

Robert Łukaszewski
  room: 441, phone: +48 22 2347340
  e-mail: robert.lukaszewski@pw.edu.pl
M.Sc. ('97), Ph.D. ('07); measurement and instrumentation; **Assistant Professor**, Electroacoustics Division.
[Edu46], [Edu79], [Edu129], [Edu131], [MSc20], [Pub15], [Pub16], [Pub17], [Pub73].

Grzegorz Makarewicz
  room: 130, phone: +48 22 2347748
  e-mail: grzegorz.makarewicz@pw.edu.pl
M.Sc. ('80), Ph.D. ('93); acoustics, mechanical vibrations, active noise and vibration control, tube audio devices, digital signal processing; **Assistant Professor**, Electroacoustics Division.

[Edu19], [Edu85], [Edu125], [Pro20], [Pro28], [MSc27], [Pat1].

Janusz Marzec
  room: 63, phone: +48 22 2347643
  e-mail: janusz.marzec@pw.edu.pl
M.Sc. ('75), Ph.D. ('83), D.Sc. ('03) Prof. Title ('22); nuclear and medical electronics, HEP detectors and front-end electronics; **Full Professor**, Nuclear and Medical Electronics Division, Head of Division ('17-); Member of the High Energy Physics Experiments Platform, WUT ('14-); Member of the Scientific Council of WUT Priority Research Program "High Energy Physics and Experimental Techniques" ('20-).
[Edu21], [Edu22], [Edu110], [Edu128], [Edu130], [Pro17], [BSc4], [Pub8].

Paweł Mazurek
  room: 11, phone: +48 22 2345772
  e-mail: pawel.mazurek@pw.edu.pl
M.Sc. ('14), Ph.D. ('18); biomedical engineering, **Assistant Professor**, Multimedia Engineering Division.
[Edu35], [Edu36], [Edu49], [Edu54], [Edu56], [Edu110], [Edu128], [MSc17], [Pub5], [Pub81].

Przemysław Miazga
  room: DS500, phone: +48 22 2347878
  e-mail: przemyslaw.miazga@pw.edu.pl
M.Sc. ('80), Ph.D. ('89); microwaves, computer engineering, measurements; **Didactic Assistant Professor**, Radiocommunications and Radiolocation Division.
Tutorial assistance of Innovative Information Technologies Student Scientific Group ('05-).
[Edu24], [Edu34].

Andrzej Miękina
  room: 439, phone: +48 22 2347346
  e-mail: andrzej.miekina@pw.edu.pl
M.Sc. ('85), Ph.D. ('98); measurement and instrumentation; **Assistant Professor**, Multimedia Engineering Division.
[Edu56], [Edu129].

Mirosław G. Mikołajewski
  room: 539, phone: +48 22 2347724
  e-mail: miroslaw.mikolajewski@pw.edu.pl
M.Sc. ('87), Ph.D. ('93); radio-frequency engineering, power electronics, radio transmitters, switch-mode power supplies; **Assistant Professor**, Radiocommunications and Radiolocation Division.
[Edu30], [Edu128].

Józef W. Modelski
  room: 535a, phone: +48 22 2347723
  e-mail: jozef.modelski@pw.edu.pl
M.Sc. ('73), Ph.D. ('78), D.Sc. ('87), Prof. Title ('94); radio-frequency engineering, microwave technologies; **Full Professor**, Director of the Institute of Radioelectronics and Multimedia Technologies;
Honoris Causa Doctorates from: Military University of Technology ('11) and Lodz University of Technology ('14); Honorary Life Member of IEEE Microwave Theory and Technology Society ('19-); Fellow Member of IEEE ('01-); Member of the Polish Academy of Sciences PAN ('07-); Golden Graduates' Book of WUT ('15); Chair of URSI Polish National Committee ('12-); Chair of Microwave and Radar Weeks ('04-); President of the Foundation for Development of Radiocommunications and Multimedia Technology ('99-);

Chair of the MIKON Foundation Council ('15-); Member of the Polish Space Agency Council ('20-); Chair of the Programme Council of PIKE International Conferences ('05-); Honorary Ambassador of Polish Congresses ('17-); Honorary Citizen of Golina city ('18-); TPC member of several international conferences ('90-); Member of Editorial Boards and reviewer of few IEEE journals ('95-); Member of Scientific Councils in PAN institutes: Space Research Center ('00-) and Nicolaus Copernicus Astronomical Center ('19-); Member of Scientific Council of Military Communication Institute ('10-); Member of the Senate Committee on University Organization ('05-).
[Edu129], [Edu131], [Pro33], [Pub29], [Pub30], [Pub31], [Pub32], [Pub66], [Pub67], [Pub76], [Pub86].

Roman Z. Morawski
room: 445, phone: +48 22 2347721
e-mail: roman.morawski@pw.edu.pl
M.Sc. ('72), Ph.D. ('79), D.Sc. ('90), Prof. Title ('01); measurement and instrumentation; **Full Professor**, Multimedia Engineering Division.
Member of the Editorial Board of the journal *Measurement* ('97-); Member of the Editorial Board of the journal *Technisches Messen* ('15-); Reviewer of several *IEEE* and *Elsevier* journals ('00-); Member of the Senate Committee on Professional Ethics ('12-); Honorary Senior Fellow of University of London ('10-); Member of the Faculty Council Committee on Academic Staff Development ('16); Member of the Jury of the WUT Medal for Young Scientist ('08-);
[Edu16], [Edu35], [Edu36], [Edu48], [Edu49], [Edu56], [Edu57], [Edu108], [Edu126], [Edu128], [Edu129], [Edu130], [Pub5], [Pub48], [Pub65], [Pub100].

Krzysztof Mroczek
room: 440, phone: +48 22 2347946
e-mail: krzysztof.mroczek@pw.edu.pl
M.Sc. ('95), Ph.D. ('02); measurement and instrumentation, digital technique; **Assistant Professor**, Electroacoustics Division.
[Edu25], [Edu27], [Edu28], [Edu39].

Grzegorz Pastuszak
room: 451; phone: +48 22 2347840
e-mail: grzegorz.pastuszak@pw.edu.pl
M.Sc. ('01), Ph.D. ('06), D.Sc. ('15); integrated circuits design, multimedia systems, video processing; **Associate Professor**, Multimedia Engineering Division.
Member of the Scientific Council for Information and Communications Technology WUT ('19-). Head of Specialization: Computer Science in Multimedia ('21-).
[Edu44], [Edu91], [Pro1], [Pro17], [BSc38], [BSc41], [Pub50].

Ewa Piątkowska-Janko
room: 69, phone: +48 22 2347918
e-mail: ewa.piatkowska.janko@pw.edu.pl
M.Sc. ('78), Ph.D. ('01); medical and nuclear engineering; **Assistant Professor**, Nuclear and Medical Electronics Division.
[Edu128], [Edu130], [Pro8], [BSc15], [BSc23], [Pub14], [Pub28].

Agnieszka P. Pietrzak
room: 131, phone: +48 22 2347999
e-mail: agnieszka.pietrzak@pw.edu.pl
M.Sc. ('14), Ph.D. ('21); acoustics, electroacoustics, psychoacoustics, noise control; **Assistant Professor**, Electroacoustics Division.

[Edu72], [Pro20], [MSc2], [Pub1], [Pub37], [Pub52], [Pub75].

Dariusz Radomski
room: 4 , phone: +48 22 2345017
e-mail:dariusz.radomski@pw.edu.pl
M.Sc. ('96), Ph.D. (automatics and robotics '01), Ph.D. (medical science '06); mathematical modeling of physiological and disease processes, biostatistical methods, experiments design methods; **Research Assistant Professor**, Nuclear and Medical Electronics Division. [Edu128], [Edu130], [Pub2].

Dawid Rosołowski
room: 548, phone: +48 22 2347624
e-mail: dawid.rosolowski@pw.edu.pl
M.Sc. ('05), Ph.D. ('12); microwave technique, RF signal processing, SDR technology; **Assistant Professor**, Radiocommunication and Radiolocation Division.Tutorial assistance of 3Z5PW Experimental Amateur Radio Station ('16-).
[Edu2], [Edu47], [Edu50], [Edu116], [Edu129], [Edu131], [Pub62], [Pub63], [Pub78].

Tymon Rubel
room: 74, phone: +48 22 2347739
e-mail: tymon.rubel@pw.edu.pl
M.Sc. ('03), Ph.D. ('10); medical and nuclear engineering; **Assistant Professor**, Nuclear and Medical Electronics Division.
[Edu17], [Edu100], [Edu102], [Edu104], [Edu128], [Edu130], [MSc4], [MSc11], [BSc11], [BSc25], [BSc36], [Pub4], [Pub34], [Pub86], [Pub88], [Pub89].

Andrzej Rychter
room: 64, phone: +48 22 2347916
e-mail: andrzej.rychter@pw.edu.pl
M.Sc. ('10), Ph.D. ('16); medical and nuclear engineering; **Assistant Professor**, Nuclear and Medical Electronics Division. Head of Specialization: Electronics and Computer Science in Medicine ('21-).
[Edu47], [Edu128], [Pro1], [Pro3], [Pro17], [MSc18], [MSc21], [BSc24], [Pub6], [Pub7], [Pub8], [Pub10].

Bartłomiej Salski
room: 546, phone: +48 22 2347622
e-mail: bartlomiej.salski@pw.edu.pl
M.Sc. ('06), Ph.D. ('10), D.Sc. ('15); microwave technique; **Associate Professor**, Sub-Terahertz Technology Division.
Member of CLEO ('14-), Reviewer of journals: *IEEE Trans. on Antennae and Propag.* ('10-), *Micro. Theory and Techniques* ('10-), *IEEE Micro. & Wireless Compon. Letters* ('12-); Member of Sect. of Microwes and Radiolocation of the Electronics and Telecommunication Comm. of the Polish Academy of Sciences ('15-); Founder and President of the Board Council of the Microwave and Radiolocation Foundation ('15-); Tutorial assistance of Electromagnetic Modelling Students Scientific Group ('16-); Member of the Scientific Council for Automatic Control, Electronics, and Electrical Engineering, WUT ('19-).
[Edu37], [Edu38], [Edu61], [Pro7], [Pro10], [Pro13], [Pro16], [Pro21], [Pro22], [Pro24], [Pub20], [Pub21], [Pub23], [Pub24], [Pub33], [Pub35], [Pub38], [Pub39], [Pub49], [Pub68], [Pub71], [Pub77], [Pub87], [Pub90], [Pub91], [Pub92], [Pub97].

Władysław Skarbek
room: 452, phone: +48 22 2345315

e-mail: wladyslaw.skarbek@pw.edu.pl

M.Sc. ('72), Ph.D. ('77), D.Sc. ('94); Prof. Title ('03); information technology, image processing, digital media; **Full Professor**.

Member of the Editorial Board of *Fundamenta Informaticae* ('03-), *International Journal of Electronics and Telecommunication* ('13-); Member of the Programme Committee of the National Conference of Radiocommunications and Broadcasting ('01).

[Edu82], [Edu93], [Edu106], [Edu121], [Edu129], [Edu131], [PhD1].

Waldemar Smolik
  room: 5, phone: +48 22 2345786
  e-mail: waldemar.smolik@pw.edu.pl

M.Sc. ('91), Ph.D. ('97), D.Sc. ('14); computer engineering, biomedical engineering, computer tomography; **Associate Professor**, Nuclear and Medical Electronics Division.

Head of the Laboratory of Information Acquisition and Processing Systems in the Nuclear and Medical Electronics Division ('15-); Member of the Faculty Council Committee on Education ('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; Member of the Education Committee of the Council of the Faculty of Electronics and Information Technology; Member of the Scientific Council of the Discipline of Biomedical Engineering; Head of the field of study "Biomedical Engineering" at the Faculty of Electronics and Information Technology; Member of the WUT Doctoral School Council.

[Edu87], [Edu103], [Edu128], [Edu130], [Pro9], [Pro18], [Pro19], [Pub25], [Pub28], [Pub45], [Pub46], [Pub47], [Pub58].

Kajetana M. Snopek
  room: 443, phone: +48 22 2347713
  e-mail: kajetana.snopek@pw.edu.pl

M.Sc. ('91), Ph.D. ('02), D.Sc. ('14); signal and system theory and applications; **Associate Professor**, Multimedia Engineering Division.

Head of the Multimedia Engineering Division ('20-); Head of the "WUT Eagle School" Project at the Faculty of Electronics and Information Technology (POWER Program ('19-); Head of the Scholarship Commission of the Foundation for the Development of Radiocommunications and Multimedia Technology ('21-); Member of the Scientific Council for Technical Informatics and Telecommunications, WUT ('21-); Member of the Steering Committee - *Intelligent Decision Support System based on the Algorithmic Image Analysis in the Operations of the Justice System* - BIO10 Programme ('20-22); Expert of the Telecommunications Section of KEiT PAS ('22-23); Editor in chief (with W.Wojtasiak and G. Pastuszak) of Special Issue Electronics (mdpi) – "Wireless Communication and Multimedia Technology – Theory and Applications" ('22); Coordinator of the 5th edition of the Engineer 4 Science 2022 engineering diploma thesis competition at FEIT, WUT (Biomedical Engineering) ('22); Session Chair - *23rd Foundation Scholarship Holders Seminar;*

[Edu18], [Edu44], [Edu70], [Edu128], [Edu130], [Pro9], [BSc18], [BSc27], [Pub13].

Maciej Sypniewski
  room: 541, phone: +48 22 2347347
  e-mail: maciej.sypniewski@pw.edu.pl

M.Sc. ('83), Ph.D. ('96); microwave technique; **Didactic Assistant Professor**, Sub-Terahertz Technology Division.

[Edu61], [BSc17], [BSc45], [BSc51].

Peter Tokarsky
  room 36, phone: +48 22 2347796
  e-mail: peter.tokarsky@pw.edu.pl

Ph.D. ('05), D.Sc. ('07); information and communication technology, **Assistant Professor**, Sub-Terahertz Technology Division.

[Pub93].

Jakub Wagner
  room: 11, phone: +48 22 2345772
  e-mail: jakub.wagner@pw.edu.pl

M.Sc. ('11), Ph.D. ('20); measurement and instrumentation, **Assistant Professor**, Multimedia Engineering Division.

[Edu35], [Edu57], [MSc29], [BSc16], [BSc26], [BSc44], [Pub5], [Pub48], [Pub96].

Wojciech Wojtasiak
  room: 549, phone: +48 22 2345886
  e-mail:wojciech.wojtasiak@pw.edu.pl

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-).

[Edu50], [Edu69], [Edu129], [Edu131], [Pro6], [Pro12], [Pro23], [Pro31], [Pub63], [Pub78], [Pat2].

Yevhen Yashchyshyn
  room: 33, phone: +48 22 2347727
  e-mail: yevhen yashchyshyn@pw.edu.pl

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 Electronics 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 ('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-).

[Edu3], [Edu84], [Edu131], [Pro2], [Pro30], [BSc19], [BSc21], [BSc40], [BSc50], [BSc52], [BSc53], [BSc54], [Pub9], [Pub11], [Pub12], [Pub40], [Pub41], [Pub44], [Pub51], [Pub53], [Pub69], [Pub70], [Pub98], [Pat3].

Krzyszof Zaremba
  room: 72, phone: +48 22 2347955, +48 22 2347497
  e-mail: krzysztof.zaremba@pw.edu.pl
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 Scientif. 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-).
[Edu54], [Edu110], [Edu128], [Edu130], [Pro3], [Pro17], [Pub6], [Pub34], [Pub86], [Pub88].

Marcin Ziembicki
  room: 62, phone: +48 22 2347643
  e-mail: marcin.ziembicki@pw.edu.pl
M.Sc. ('02), Ph.D. ('20); nuclear and medical electronics; **Assistant Professor**, Nuclear and Medical Electronics Division.
[Pro1], [Pro3], [Pro17], [Pub6], [Pub7], [Pub8], [Pub10].

Jan Żera
  room: 131, phone: +48 22 2347999
  e-mail: jan.zera@pw.edu.pl
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-).
[Edu53], [Edu101], [Edu129], [Edu131], [Pro26], [PhD2], [MSc26], [BSc5], [BSc29], [Pub1], [Pub18], [Pub19], [Pub52].

2.2. Junior academic staff

Grzegorz Gwardys, M.Sc., Assistant (0.5)
  room: 452, phone: +48 22 2347957
  e-mail: grzegorz.gwardys.@pw.edu.pl

Maciej Jasiński, M.Sc., Assistant
  room: 131, phone: +48 22 2347999
  e-mail: maciej.jasinski@pw.edu.pl

Marcin Kołakowski, M.Sc., Assistant
  room: 29, phone: +48 22 234 7620
  e-mail: marcin.kolakowski@pw.edu.pl

Mateusz Krysicki, M.Sc., Research Assistant
  room: 543, phone: +48 22 2347631
  e-mail: mateusz.krysicki@pw.edu.pl

Kamil Lipiński, M.Sc., Assistant (0.5)
  room: 69, phone: +48 22 2347918
  e-mail: kamil.lipinski@pw.edu.pl

Wojciech Obrębski, M.Sc., Assistant (0.5)
  room: 71, phone: +48 22 2346087
  e-mail: wojciech.obrebski@pw.edu.pl

Tomasz Olszewski, M. Sc., Didactic Assistant (0.5)
  room: 59, phone: +48 22 2347577
  e-mail: tomasz.olszewski@pw.edu.pl

Damian Wanta, M.Sc., Assistant (0.5)
  room: 59, phone: +48 22 2347577
  e-mail: damian.wanta@pw.edu.pl

Michał Wieteska, M.Sc., Assistant (0.5)
  room: 71, phone: +48 22 2346087
  e-mali: michal.wieteska@pw.edu.pl

Przemysław Wróblewski, M.Sc., Assistant
  room: 5, phone: +48 22 2345786
  e-mail: przemyslaw.wroblewski@pw.edu.pl

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

Ph.D. Student (tutor)

Ph.D. Student	(tutor)
Piotr Czekała, M.Sc.	(B.Salski)
Piotr Czarnecki, M.Sc. [*]	(P. Bilski)
Michał Daniluk, M.Sc. [*]	(W.Skarbek)
Krzysztof Dowalla, M.Sc.	(P. Bilski)
Monika Drabik, M.Sc.	(P. Bogorodzki)
Salomea Grodzicka, M.Sc.	(P. Bilski)
Maciej Jasiński, M.Sc.	(J. Żera)
Marcin Kołakowski, M.Sc.	(J. Modelski)
Szymon Kruszewski, M.Sc.	(R. Z. Morawski)
Kamil Lipiński, M.Sc.	(P. Bogorodzki)
Jacek Majer, M.Sc.	(J. Żera)
Tomasz Markowski, M. Sc. [*]	(P. Bilski)
Mateusz Midura, M.Sc.	(W. Smolik)
Tomasz A. Miś, M.Sc.	(J. Modelski)
Daniel Mostowski, M.Sc. [*]	(W.Skarbek)
Łukasz Nowicki, M.Sc.	(W. Wojtasiak)
Katarzyna Orzechowska, M.Sc.	(P.Bogorodzki)
Bartosz Połok, M.Sc.	(P. Bilski)
Rafał Protasiuk, M.Sc.	(W. Skarbek)
Jakub Sobolewski, M.Sc.	(Y. Yashchyshyn)
Maciej Soszka, M.Sc. [*]	(Y. Yashchyshyn)
Mateusz Stosio, M.Sc.	(W. Smolik)
Jakub Tkaczuk, M.Sc.	(P. Bilski)
Mikołaj Wieczorek, M.Sc. [*]	(G. Pastuszak)
Marcin Wiśniewski, M.Sc.	(W.Wojtasiak))
Przemysław Wróblewski, M.Sc.	(W. Smolik)
Katarzyna Wynimko, M.Sc.	(J. Żera)

[*] implementation doctorate

2.4. Technical and administrative staff

Karolina Bąk, M.A., Administrative Clerk for Research (from Jun. 2022)
  room: 426, phone: +48 22 2345367
  e-mail: karolina.bak@ire.pw.edu.pl

Izabela Dudek, Administrative Clerk for Teaching
  room: 424, phone: +48 22 2347829
  e-mail: izabela.dudek@pw.edu.pl

Monika Feluś, M.A., Administrative Clerk for Teaching
  room: 424, phone: +48 22 2347696
  e-mail: monika.felus@pw.edu.pl

Zdzisława Fenikowska, M.A., Accounting Clerk
  room: 421, phone: +48 22 2347743
  e-mail: zdzislawa.fenikowska@pw.edu.pl

Aleksandra Jefimowicz, M.A.,. Accounting Clerk
room: 421, phone: +48 22 2346089
e-mail: aleksandra.jefimowicz@pw.edu.pl

Marcin Karpisz, B.Sc., Research Support Eng. (0.5)
room: 546, phone: +48 22 2345829
e-mail: marcin.karpisz@pw.edu.pl

Dariusz Kołodziej, M.Sc., Research Support Eng.**
room: 540, phone: +48 22 2347833
e-mail: dariusz.kolodziej@pw.edu.pl

Tomasz Krzymień, M.Sc., Administrative Clerk for Health and Safety
room: 11a, phone: +48 503510402
e-mail: tomasz.krzymien@pw.edu.pl

Andrzej Laskowski, Worker
room: 419, phone: +48 22 2347987
e-mail: andrzej.laskowski@pw.edu.pl

Mirosław Lubiejewski, Foreman
room: 532, phone: +48 22 2347633
e-mail: miroslaw.lubiejewski@pw.edu.pl

Grzegorz Makarewicz, Ph.D., Res. Support Eng.(0.5)
room: 130, phone: +48 22 2347748
e-mail: grzegorz.makarewicz@pw.edu.pl

Anna Noińska, Admin. Clerk for Research (0.8, till Aug. 2022)
room: 426, phone: +48 22 2345367
e-mail: anna.noinska@pw.edu.pl

Tomasz Olszewski, R&D Engineer (0.5)
room: 58, phone: +48 22 234 7577
e-mail: tomasz.olszewski@pw.edu.pl

Andrzej Owczarek, M.Sc., Maintenance Eng. (0.5)
room: 552A, phone: +48 22 2347233
e-mail: andrzej.owczarek@pw.edu.pl

Adam Pacewicz, Ph.D., Senior R&D Eng.*)
room: 543, phone: +48 22 2347631
e-mail: adam.pacewicz@pw.edu.pl

Beata Rosłon, Accounting Clerk
room: 421, phone: +48 22 2347743
e-mail: beata.roslon@pw.edu.pl

Marta Rudnicka, Senior Administrative Clerk
room: 422, phone: +48 22 2347742,
fax: +48 22 8253769
e-mail: marta.rudnicka@pw.edu.pl

Anna Smenda, Administrative Clerk
room: 422, phone: +48 22 2347233,
fax: +48 22 8253769
e-mail: anna.smenda@pw.edu.pl

Andrzej Wasilewski, Worker
room: 73, phone: +48 22 2347919
e-mail: andrzej.wasilewski@pw.edu.pl

*) temporary research staff for the projects: OPUS 16, **) WidePOWER

3. TEACHING ACTIVITIES

(the summer semester of the academic year 2021/2022 and the winter semester of the academic year 2022/2023)

3.1. Regular studies – main fields of study:

Electronics
Specialization: Electronics and Computer Science in Medicine
Head
Andrzej Rychter, Ph.D., Assistant Professor
room: 64, phone: +48 22 2347916
e-mail: A.Rychter@ire.pw.edu.pl

Informatics
Specialization: Computer Science in Multi-media
Head
Grzegorz Pastuszak, D.Sc., Associate Professor
room: 451, phone: +48 22 2347840
e-mail: G.Pastuszak@ire.pw.edu.pl

Biomedical Engineering
Specialization: Biomedical Apparatus
Head
Grzegorz Domański, Ph.D., Assistant Professor
room: 61, phone: +48 22 2347626
e-mail: G.Domanski@ire.pw.edu.pl

Specialization: Biomedical Information Technology
Head
Jacek Kryszyn, Ph.D., Assistant Professor
room: 59, phone: +48 22 2347577
e-mail: J.Kryszyn@ire.pw.edu.pl

Telecomunications
Specialization:
- **Radiocomunications and Multimedia Techniques**
- **Wireless and Multimedia Technologies (I⁰ studies)**

Head
Jacek Cichocki, Ph.D., Didactic Assistant Prof.
room: 27, phone: +48 22 2347635
e-mail: J.Cichocki@ire.pw.edu.pl

Specialization:
- **Wireless and Multimedia Techniques (II⁰ studies)**

Andrzej Buchowicz, Ph.D., Assistant Prof.
room: 451, phone: +48 22 2347840
e-mail: A.Buchowicz@ire.pw.edu.pl

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.

[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: the 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 - DEPJO); 30 h/sem.; J. Marzec.

[Edu22] *Detection of Nuclear and Biomedical Signals* (Detekcja sygnałów biomedycznych

i jądrowych – DSBJ); 60 h/sem.; J. Marzec.

[Edu23] *Digital Cellular Systems* (Cyfrowe systemy komórkowe – CSK); 45 h/sem.; J. Cichocki, J. Kołakowski.

[Edu24] *Digital Circuits* – EDC1; 60 h/sem.; P. Miazga (English-medium studies).

[Edu25] *Digital Circuits* (Technika cyfrowa – TECY), 70 h/sem.; K. Mroczek (Faculty coordinator: the Instutue of Telecommunications).

[Edu26] *Digital Communications* – EDICO; 60 h/sem.; P. Bilski (English-medium studies).

[Edu27] *Digital Systems* (Systemy cyfrowe – SYCYF), 20 h/sem.; K. Mroczek (Faculty coordinator: the Institute of Telecommunications).

[Edu28] *Digital Systems* (Układy cyfrowe – UCYF), 12 h/sem.; K. Mroczek (Faculty coordinators: the Institute of Microelectronics and Optoelectronics and the Institute of Telecommunications).

[Edu29] *Diploma Seminar for Undergraduate Students* (Seminarium dyplomowe inżynierskie – SDI); 30 h/sem.; P. Brzeski, A. Buchowicz, J. Cichocki.

[Edu30] *DC/DC Power Converters Supply* (Zasilanie układów elektronicznych - ZUE); 45 h/sem.; M. Mikołajewski.

[Edu31] *Electronic Circuits* (Układy elektroniczne – UEL); 60 h/sem.; W. Obrębski.

[Edu32] *Electronic Circuits and Systems* (Elementy i układy elektroniczne – UKEL); 60 h/sem.; D. Gryglewski.

[Edu33] *Event-Driven Programming* (Programowanie zdarzeniowe – PROZE); 45 h/sem.; K. Ignasiak.

[Edu34] *Evolutionary Algorithms* (Algorytmy ewolucyjne – AE); 45 h/sem.; G. Bogdan, P. Miazga, A. Raniszewski.

[Edu35] *Ethical Aspects of Research and Engineering* – EEARE; 30 h/sem; R. Z. Morawski, P. Mazurek, J. Wagner (English-medium studies).

[Edu36] Ethical Aspects of Technoscientific Research – EEATR; 15 h/sem; R. Z. Morawski, P. Mazurek (Doctoral Schools of WUT).

[Edu37] *Fields and Waves* (Pola i fale – POFA); 60 h/sem.; P. Kopyt, M. Krysicki, B. Salski

[Edu38] *Fields and Waves* (Pola i fale – POFAT); 56 h/sem.; P. Kopyt, B. Salski.

[Edu39] *Fundamentals of Digital Circuits* (Podstawy techniki cyfrowej – PTCY), 120 h/sem., K. Mroczek (Faculty coordinators: the Institute of Control and Computation Engineering and the Institute of Computer Science).

[Edu40] *Fundamentals of Wireless Communication* (Podstawy transmisji bezprzewodowej – PTB); 57 h/sem.; J. Kołakowski.

[Edu41] *Image Techniques* (Technika obrazowa-

TO); 60 h/sem.; G. Galiński

[Edu42] *Influence of Electromagnetic Waves on Living Organisms* (Oddziaływanie fal elektromagnetycznych na organizmy żywe – OFE); 30 h/sem.; K. Derzakowski.

[Edu43] *Introduction to Medical Science* (Wprowadzenie do nauk medycznych – WNM); 45 h/sem.; P. Brzeski, R. Jóźwiak.

[Edu44] *Introduction to Multimedia* (Wstęp do multimediów – WMM); 24 h/sem.; G. Pastuszak, K. Snopek.

[Edu45] *IoT Radio Interfaces* (Interfejsy radiowe systemów internetu rzeczy – IRI); 45 h/sem.; J. Kołakowski.

[Edu46] *Measurement Systems* (Systemy pomiarowe – SPOM); 60 h/sem.; R. Łukaszewski.

[Edu47] *Medical Electronic Instrumentation* (Elektroniczna aparatura medyczna – EAME); 60 h/sem.; A. Rychter.

[Edu48] Methodological Aspects of Engineering Practice (Metodyczne aspekty działaności inżyniera) – MADI; 20 h/sem; R. Z. Morawski (Institute of Telecommunications).

[Edu49] Methodological Aspects of Technoscientific Research – EMATR; 20 h/sem; R. Z. Morawski, P. Mazurek (Doctoral School of WUT).

[Edu50] *Microwave Technique (*Technika mikrofalowa – TMO); 45 h/sem.; D. Rosołowski, W. Wojtasiak.

[Edu51] *Microprocessor Technique* (Technika mikroprocesorowa – TEMI); 45 h/sem.; G. Domański.

[Edu52] *Multi-service and Multimedia Networks* – EMSMN; 60 h/sem.; S. Kozłowski (English-medium studies).

[Edu53] *Musical Acoustics* (Akustyka muzyczna – AM); 30 h/sem.; J. Żera.

[Edu54] *Neural Networks in Biomedical Applications* (Sieci neuronowe w zastosowaniach biomedycznych – SNB), 45 h/sem.; P. Mazurek, K. Zaremba.

[Edu55] *Nuclear Medicine Techniques* (Techniki medycyny nuklearnej – TMENU); 30 h/sem.; P. Brzeski, T. Olszewski.

[Edu56] *Numerical Methods* (Metody numeryczne – MNUB); 45 h/sem.; A. Miękina, P. Mazurek, R. Z. Morawski.

[Edu57] *Numerical Methods* – ENUME; 60 h/sem.; R. Z. Morawski, J. Wagner (English-medium studies).

[Edu58] *Object-oriented Programming* (Programowanie obiektowe – PROBI); 60 h/sem.; J. Kryszyn.

[Edu59] *Object-oriented Programming of Multimedia Applications in Java (*Java – obiektowe programowanie aplikacji multimedialnych – OPA); 45 h/sem.; K. Ignasiak.

[Edu60] *Orientation* (Orientacja - ORIT); 8 h/sem.; J. Cichocki.

[Edu61] *Physics 2* – EPHY2; 60 h/sem.; B. Salski, M. Sypniewski (English-medium studies).

[Edu62] *Programming of Geoinformation Applications* (Programowanie aplikacji geoinformacyjnych – PAG); 30 /sem.; K. Ignasiak (for Faculty of Geodesy and Cartography).

[Edu63] *Radiocommunication Systems* (Systemy radiokomunikacyjne – SRKO); 45 h/sem.; K. Godziszewski, W. Kazubski, K. Radecki.

[Edu64] *Radioelectronics Measurements (*Miernictwo radioelektroniczne – MR); 45 h/sem.; J. Cichocki.

[Edu65] *Radio Networks and Systems* (Systemy i sieci radiowe- SISR); 45 h/sem.; K. Godziszewski.

[Edu66] *Radio Transmission* (Transmisja radiowa – TRRA); 57 h/sem.; K. Godziszewski.

[Edu67] *Radiological Apparatus in Medical Diagnostics* (Aparatura radiologiczna w diagnostyce medycznej – ARDM); 30 h/sem.; G. Domański.

[Edu68] *Radiology and Nucleonics* (Radiologia z nukleoniką – RN); 45 h/sem;. B. Konarzewski.

[Edu69] *RF & Microwave Engineering in Telecommunications* (Technika mikrofalowa w telekomunikacji – TMI); 45 h/sem.; W. Wojtasiak.

[Edu70] *Signals and Systems* (Sygnały i systemy – SYGSY); 60 h/sem.; K. Snopek.

[Edu71] *Simulations of Radioelectronics Circuits* (Symulacja układów radioelektronicznych – SUREL); 45 h/sem.; D. Gryglewski, P. Kopyt.

[Edu72] *Sound Recording Technique* (Dźwiękowa technika studyjna – DTS); 45 h/sem.; M. Lewandowski, A. Pietrzak.

[Edu73] *Sound Technique* (Technika dźwiękowa – TD); 45 h/sem.; P. Bobiński.

[Edu74] *Team Project 1* (Projekt grupowy 1 – PROJ1); 13 h/sem.; P. Korpas.

[Edu75] *Team Project 2* (Projekt grupowy 2 – PROJ1); 30 h/sem.; P. Korpas.

[Edu76] *Television Systems* (Systemy telewizyjne – SYTE); 45 h/sem.; A. Buchowicz.

[Edu77] *UMTS and LTE Systems (Systemy UMTS i LTE* – ULTE*);* 45 h/sem.; J. Kołakowski.

[Edu78] *User Interface Design* (Projektowanie interfejsu użytkownika – PIU); 15 h/sem.; K. Ignasiak.

[Edu79] *Web Applications* (Programowanie aplikacji internetowych – PAINT); 45 h/sem.; P. Bobiński, R. Łukaszewski.

[Edu80] *Wireless Transmission and Antennas* (Transmisja bezprzewodowa i anteny – TBAT); 60 h/sem.; K. Godziszewski.

[Edu81] *Wired and Wireless Communication* (Komunikacja przewodowa i bezprzewodowa – PBL3); 180h/sem.; P. Korpas.

3.1.2. Advanced courses

[Edu82] *Adaptive Image Recognition* – EADIR; 60 h/sem.; W. Skarbek (English-medium studies).

[Edu83] *Advanced Multimedia Signal Processing* (Zaawansowane przetwarzanie danych multimedialnych – ZPDM); 60 h/sem.; M. Lewandowski.

[Edu84] *Antennas* (Anteny – EANTE); 45 h/sem.; Y. Yashchyshyn (English-medium studies).

[Edu85] *Audio Equipment Investigation* (Badania urządzeń audio – BUA); 45 h/sem.; G. Makarewicz.

[Edu86] *Basics of Space Systems Design* (Podstawy projektowania systemów kosmicznych – PPSK); 60 h/sem.; K. Kurek

[Edu87] *Computed Tomography* (Tomografia komputerowa – TOM); 60 h/sem.; W. Smolik.

[Edu88] *Computer - Aided Medical Image Diagnostics* (Komputerowe wspomaganie obrazowej diagnostyki medycznej – KWOD); 45 h/sem.; A. Przelaskowski.

[Edu89] *Computional Electromagnetics for Telecommunications* – ECOET; 60 h/sem.; P. Korpas (English-medium studies).

[Edu90] *Contemporary Heuristic Techniques* (Współczesne techniki heurystyczne – WMH); 60 h/sem.; P. Bilski.

[Edu91] *Data Compression* (Kompresja danych – KODA); 45 h/sem.; G. Galiński, G. Pastuszak, A. Buchowicz.

[Edu92] *Design of Audio Devices and Systems* (Projektowanie urządzeń i systemów audio – PUSA); 60 h/sem.; P. Bobiński.

[Edu93] *Deep Neural Networks for Digital Media* (Głębokie sieci neuronowe w mediach cyfrowych – GSN); 45 h/sem.; W. Skarbek.

[Edu94] *Digital Audio Signal Processing* (Cyfrowe przetwarzanie sygnałów fonicznych – CPSF); 45 h/sem.; M. Lewandowski.

[Edu95] *Diploma Seminar for Graduate Students 1* (Seminarium dyplomowe magisterskie 1 – SDM1); 30 h/sem.; A. Buchowicz, J. Cichocki.

[Edu96] *Diploma Seminar for Graduate Students 2* (Seminarium dyplomowe magisterskie 2 – SDM2); 30 h/sem.; P. Brzeski, A. Buchowicz, J. Cichocki.

[Edu97] *Dynamic Medical Image Data Analysis* (Analiza medycznych obrazowych danych dynamicznych – AMDD); 45 h/sem.; P. Bogorodzki.

[Edu98] *Electromagnetic Compatibility* – EEMC; 45 h/sem.; P. Kopyt (English-medium studies).

[Edu99] *Embedded Programming for Medical Devices* (Programowanie wbudowane w urządzeniach medycznych – PWUM); 45 h/sem.; G. Domański.

[Edu100] *Genetic Engineering* (Inżynieria genetyczna – INGE); 15 h/sem.; T. Rubel.

[Edu101] *Hearing and Sound Perception* (Słyszenie i percepcja dźwięku – SPD); 45 h/sem.; J. Żera.

[Edu102] *High-Throughput Methods in Molecular Biology* (Wielkoskalowe metody pomiarowe w biologii molekularnej – MPB); 45 h/sem.; T. Rubel.

[Edu103] *Information Sytems in Medicine* (Systemy informatyczne w medycynie – SIM); 45 h/sem.; W. Smolik.

[Edu104] *Machine Learning in Bioinformatics* (Uczenie maszynowe w bioinformatyce – UMB); 60 h/sem.; T. Rubel.

[Edu105] *Magnetic Resonance Imaging* (Tomografia rezonansu magnetycznego – TRM); 45 h/sem.; P. Bogorodzki.

[Edu106] *Mathematics in Multimedia* (Matematyka w multimediach – MATMU); 60 h/sem.; W. Skarbek.

[Edu107] *Medical IT Systems* (Informatyczne systemy medyczne – ISMED); 45 h/sem.; R. Kurjata.

[Edu108] *Methodological and Ethical Aspects of Research* – EMAR); 45 h/sem.; R. Z. Morawski (English-medium studies).

[Edu109] *Microcontrollers in Wireless Transmission Systems* (Mikrokontrolery w systemach transmisji bezprzewodowej – MSTB); 45 h/sem.; J. Kołakowski.

[Edu110] *Noise and Electromagnetic Interference in Electronic Devices* (Szumy i zakłócenia w aparaturze elektronicznej – SZAE); 45 h/sem., J. Marzec.

[Edu111] *Modern Radio Transmission Techniques* (Nowe techniki transmisji radiowej – NTTR); 45h/sem.; S. Kozłowski.

[Edu112] *Nuclear Medicine Techniques* (Techniki medycyny nuklearnej – TMN); 60 h/sem.; P. Brzeski, T. Olszewski, R. Szabatin.

[Edu113] *Radiocommunication System Design* (Projektowanie systemów radiokomunikacyjnych – PSRK); 60 h/sem.; K. Kurek.

[Edu114] *Semantic Image Analysis* (Analiza semantyczna obrazu – ASO); 45 h/sem.; P. Garbat.

[Edu115] *Spatial Audio System* (Systemy dźwięku przestrzennego – SDP); 60 h/sem.; M. Lewandowski.

[Edu116] *SRD Technology in Applications* (Techniki radia programowalnego w zastosowaniach – TRPZ), 60 h/sem.; D. Rosołowski.

[Edu117] *Telemedical Systems* (Systemy telemedyczne - TELM); 45 h/sem.; R. Kurjata.

3.2. Special courses

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

[Edu118] *Compression and Immersion of Digital Objects* (Kompresja i zanurzanie obiektów cyfrowych – KZO); 12 h/sem.; R. Protasiuk.

[Edu119] *3D Modeling – Face and Body Image Analysis* (Modelowanie 3D – analiza obrazu twarzy i sylwetki osoby – M3D), 24 h/sem.; G. Gwardys.*Deep Networks in the Design of Computer Games - Content and Strategy Ascpects* (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.

[Edu125] *Testing Audio Devices* (Badania urządzeń audio – BUA); 45 h/sem.; G. Makarewicz.

3.3. International co-operation

[Edu126] Within the Advanced Technology Higher Education Network / Socrates (ATHENS), from March 14 to March 18, the course "Ethical Aspects of Research and Engineering" (WUT3) was given by **Roman Z. Morawsk**i to a group of 17 students from the following EU institutions of higher education:

    – École des Mines de Paris (Paris, France) – 3 persons;

    – Instituto Superior Técnico (Lisbon, Portugal) – 2 persons;

    – Katholieke Universiteit Leuven (Leuven, Belgium) – 6 persons;

    – Politecnico di Milano (Milan, Italy – 1 person);

    – Technische Universität München (Munich, Germany) – 2 persons;

    – Technische Universität Wien (Vienna, Austria) – 1 person;

    – Universidad Politécnica de Madrid (Madrid, Spain) – 2 person.

It should be noted that 10 persons registered for the course WUT3 did not arrive to Warsaw, most probably being afraid of the potential consequences of the Russian invasion of Ukraine. The course included 20 hours of lectures and 10 hours of class tutorials

[Edu127] **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., candidate from WUT who was registered as a doctoral student at the Doctoral School no. 3.

3.4. Educational projects

[Edu128] **Modification B.Sc. Studies: Biomedical Enginnering in the frame of Knowledge – Education – Development - Cooperation Project** (Modyfikacja studiów pierwszego stopnia na kierunku „Inżynieria Biomedyczna" w ramach projektu NERW – Nauka – Edukacja - Rozwój - Współpraca).
Waldemar Smolik, K. Zaremba, J. Marzec, R. Z. Morawski, 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 modificate 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.

[Edu129] **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. Godziszewski, K. Ignasiak, W. Kazubski, P. Korpas, S. Kozłowski, K. Kurek, M. Lewandowski, R. Łukaszewski, A. Miękina, J. Modelski, R. Z. Morawski, D. Rosołowski, W. Skarbek, W. Wojtasiak, J. Żera.
Feb. 01, 2018 – Dec. 01, 2022
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.

[Edu130] **Modification M.Sc. Studies: Biomedical Enginnering 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 Development 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.

[Edu131] **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. Godziszewski, 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. Yashchyshyn, 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.

4. RESEARCH ACTIVITIES

4.1. International projects

[Pro1] **Super-Kamiokande to Hyper-Kamio-kande (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 fulfil 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 nano-materiałów 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.

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

[Pro3] **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 Scien-ces, Faculty of Physics and Astronomy, Wroclaw 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.

[Pro4] **Integrated Care Platform Based on the Monitoring of Older Individual Intrinsic Capacity for Inclusive Health (CAREUP)** (Zintegrowana platforma inkluzywnej opieki nad osobami starszymi oparta na monitorowaniu zdolności wewnętrznych).
Jerzy Kołakowski, V. Djaja-Jośko J. Cichocki, M. Kołakowski
May, 1, 2022 – Nov. 30, 2024
Ambient Assisted Living (AAL)
Funded by the National Centre for Research and Development

The CAREUP project objective is to design and implement an ICT platform to preserve older adults' intrinsic capacity and functional ability through continuous monitoring and application of preventive measures. To do so, CAREUP will compensate for their decline (due to aging) through the development of a customized and personalized care plan with multi-component interventions whose implementation focuses on the fulfillment of the person-centered goals, uses principles of self-management support, community engagement, caregiver support and shared decision making with support caregivers.

[Pro5] **Personalized ICT solution to reduce rehospitalization rates in heart failure elderly patients suffering from comorbidities** (Zmniejszanie ryzyka hospitalizacji osób w starszym wieku z niewydolnością serca i chorobami współistniejącymi z wykorzystaniem technologii informacyjno-komunikacyjnych (ICT)).

Jerzy Kołakowski, V. Djaja-Jośko
J. Cichocki, M. Kołakowski;
Sept. 01, 2020 – Aug. 30, 2023
ERA PerMed
Funded by the National Centre for Research and Development

The PerHeart project employs Information and Communication Technology to reduce re-hospitalization rates in heart failure patients. The PerHeart ICT platform integrates modular design functionalities dedicated to patients and their professional caregivers. The underlying artificial intelligence software will adapt to the patient's needs. Data collected with sensors and medical devices will help elucidate specific risk factors for readmission while taking gender and socio-economic aspects into account and help interpret and predict complex multifactorial diseases.

4.2.2. Research grants

[Pro6] **High-precision technique of millimeter and sub-THz band characterization of materials for microelectronics** (Wysokoprecyzyjne techniki charakteryzacji materiałów w zakresie fal milimetrowych oraz subterahercowych do zastosowań mikroelektronicznych).
Jerzy Krupka (the Institute of Microelectronics and Optoelectronics, WUT).
Paweł Kopyt (head on behalf of the Institute of radioelectronics and Multimedia Technology), D. Gryglewski, W. Wojtasiak;
Nov. 01, 2016 Jun. 30, 2022
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 resonat 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.

[Pro7] **Correlations between electromagnetic and magnetoelastic properties of ferromagnetic thin films** (Korelacje pomiędzy właściwościami elektromagnetycznymi i magnetosprężystymi cienkich warstw ferromagnetycznych).
Jerzy Krupka (the Institute of Microelectronics and Optoelectronics), **P. Kopyt** (head on behalf of the Institute of Radioelectronics and Multimedia Technology, WUT), A. Pacewicz, B. Salski;
Jun. 18, 2019 - Jun. 17, 2023
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.

[Pro8] **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 Institut 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.

[Pro9] **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.

[Pro10] **Research and simulations of effects of HPM impulses** (Badania i symulacje skutków oddziaływania impulsów HPM).
Bartłomiej Salski, M. Krysicki, P. Kopyt;
Feb. 13, 2019 - Dec. 28, 2023
Strategic research and development program.
Funded by the National Centre for Research and Development

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

[Pro11] **Development and implementation of an artificial intelligence system for virtual characters allowingsimulation 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 system 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 (IRTM), 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 consortiumleader'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.

[Pro12] **Project implemented for the defence and security of the state of code name GRANIT**
Wojciech Wojtasiak, D. Gryglewski;
May, 19, 2021 – Dec. 22, 2022
Funded by the National Centre for Research and Development

Detail of this project cannot be published due to non-discloure agreement with the contractor. Leader of this project – PIT – Radwar.

[Pro13] **Standardize the measurement of dielectric properties of materials for 5G** (Standaryzacja pomiaru własności dielektrycznych materiałów na potrzeby technologii 5G)
Bartłomiej Salski;

Jul. 12, 2022 - Jul. 11, 2024
PolishMetrology

The main goal of this project is to elaborate an error budget of the complex permittivity measurement with a Fabry-Perot open resonator in the 20-110 GHz range. In addition , a new type of a dielectric resonator applicable to the characterization of ceramic pills above 20 GHz will be developed.

4.2.3. Grants for young researchers

[Pro14] **Accurate methods of materials spectroscopy in mm-wave and sub-THz frequencies** (Dokładne metody spektroskopii materiałów w paśmie milimetrowym I sub-terahercowym).
Jerzy Cuper, P. Kopyt;
Jul. 30, 2019 – Feb. 29, 2024
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 meth-ods, especially on Fabry-Perot open resonator struc-ture. Firstly, a dedicated setup for both low-loss materi-als 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.

[Pro15] **Novel autonomous measurement system for characterization of dielectric materials at microwave and milimeter-wave frequencies** (Nowy autonomiczny system pomiarowy do charakteryzacji materiałów dielektrycznych w zakresie mikrofal i fal milimetrowych).
Tomasz Karpisz;
Jan. 01, 2022 – Dec. 31, 2024
LIDER XII
Funded by the National Centre for Research and Development

The proposed project is devoted to research on the creation of new systems for measuring the electromagnetic properties of materials in the field of mycophagus and millimeter waves. There are solutions on the market that allow you to determine these values, but each of the methods has its limitations discussed in more detail in the project description.

4.3 Projects granted by the University

4.3.1 Priority Research Area Grants

[Pro16] **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

The main goal of this project was to elaborate and optimize two alternative methods of coupling of electromagnetic wave with Fabry-Perot open resonator's cavity. The effort would 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 would be taken in sub-THz and THz frequency band.

[Pro17] **Modern electronics, digital signal processing and data compresson 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. Obrębski, 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 was the integration and growth of a research team involved in several physical experiments within the process of the implementation of the planned research program. It covered 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.

[Pro18] **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, P. Wróblewski;
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.

[Pro19] **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.

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 contex 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.

[Pro20] **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. Makarewicz, 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.

[Pro21] **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. Czekała;
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

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

matching method that will be applied to solve the micro-resonator.

[Pro22] **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.

[Pro23] **Chemical reactor vessel using intelligent microwave source** (Reaktor chemiczny z wykorzystaniem inteligentnego źródła mocy mikrofalowej).
Przemysław Korpas, K. Jankowski, W. Wojtasiak, 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: synthesisi of nanofertilizer and separation of nanohybrid. The first selected process consists in a 2-step synthesis of a nanofertillizer 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.

[Pro24] **Methods for Increasing the sensitivity of measuring the ownership 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;
Jun. 27, 2021-Dec. 31, 2022
Project granted by the Scientific Council for Automatics, Electronics and Electrical Engineering, WUT.

The result of the research grant ia an up to 10-fold increase of the Q-factor of a double – concave Fabry-Perot rezonator In the 75 – 130 GHz frequency range.

This was achieved via the use of miniaturized (0,6 mm) coaxial coupling lines. Other methods of increasing the Q-factor were also experimentally studied, but turned out to be not as effective. The rezonator with the highest Q-factor was applied to the accurate characterization of thin films of dielectrics of high importance In electronics (e.g. Mylar, Kapton, TPX).

4.3.2. Internal grants

[Pro25] **Development and examination of improved antenna circuits for field-effect transistor-based subterahertz detectors** (Opracowanie i badanie udoskonalonych obwodów antenowych do detektorów subterahercowych na bazie tranzystorów polowych).
Paweł Bajurko, J. Sobolewski;
May 18, 2022 – Dec. 31, 2023
Project granted by the Scientific Council for Automatics, Electronics and Electrical Engineering, WUT.

The subject of the project is the design of THz detectors with improved efficiency by using new types of antennas and improved circuits for coupling the antenna to the semiconductor structure.

[Pro26] **Application of modern techniques in sound recording with the use of ambisonic microphones in determining the interaural cross correlation (IACC)**. (Zastosowanie nowoczesnych technik rejestracji dźwięku mikrofonami ambisonicznymi do wyznaczania międzyusznej korelacji skośnej sygnału IACC).
Jan Żera, M. Jasiński;
May 06, 2022 – Dec. 31, 2023
Project granted by the Scientific Council for Automatics, Electronics and Electrical Engineering, WUT.

The aim of the project is to explore application of the binaural room impulse response (BRIR) in determining quantities describing acoustic conditions in room, with the focus on the interaural cross correlation (IACC) characterizing the spatial features of sound field. Method considers spatial impulse response recorded with an ambisonic microphone combined with the head-related impulse response (HRIR) related to the presence of the listener in the acoustic field. The accuracy of this novel method is assessed in reference to standard measurements carried out using an acoustic manikin.

[Pro27] **Performance comparison of HL7, FHIR and openEHR standards** (Porównanie wydajności standardów HL7 FHIR oraz openEHR).
Jacek Kryszyn;
Apr. 26, 2022 – Dec. 31, 2023
Project granted by the Scientific Council for Biomedical Engineering, WUT.

The aim of the project is to perform load tests of several selected open-source solutions compliant with the openEHR and HL7 FHIR standards. The collected data will be analyzed in terms of the speed of operation and the ability to handle large network traffic of each solution. This will make it possible to determine whether one of the standards has an advantage over

the other in terms of the tested parameters. Based on the technical details of the solutions, an assessment of what has a key impact on performance in this type of system will be made.

4.4. Other projects

[Pro28] **Performing R&D tasks and creating a prototype of an innovative handset equipped with predictive active noise reduction (pANC) technology, which automatically adjusts to the working environment** (Przeprowadzenie prac B+R i 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.

[Pro29] **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 is 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.

[Pro30] **BST/polymer composites tunability studies in the frequency range up to 500 GHz** (Badania przestrajalności 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.

[Pro31] **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;
Mar. 11, 2022 – May 15, 2022
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

[Pro32] **Training in the Basics of Satellite Communication Systems** (Szkolenie z Podstaw Systemów Łączności Satelitarnej).
Krzysztof Kurek
Jun. 20-24,2022
Funded by Polish Space Agency

The aim of the training was to present the basics of theoperationof satellite communication systems with the use of satellites in GEO and LEO orbits. The following topics were discussed during the training: system architecture, organization of transmission in the satellite link, types of services and the basics of the satellite radio link budget.

[Pro33] **Analysis of the possibilities of the use of Polish orbital resources** (Analiza możliwości wykorzystania polskich zasobów orbitalnych)
Krzysztof Kurek, Sebastian Kozłowski, Józef Modelski;
Sep. 15 - Dec. 14,2022
Funded by Polish Space Agency

The aim of the project was to analyse the possibility of using Polish geostationary orbital resources in a satel-

lite communication system. The final report of the project presents a description of the architecture of satellite communication systems and the possibility of using such systems for the needs of the Polish government and public administration users for applications related to crisis management and critical infrastructure monitoring. Particular attention was paid to the possibility of creating a communication system with a satellite in a geostationary orbit using orbital resources at the disposal of Poland.

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 multiphse 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 Telecomunications, 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 Admi- nistration 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 Mazowian 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 Radiolectronics 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 sub systems in terms of PIC models and monolithic integration.
WG3: The goal is to identify the IMWP opportunities in terms of generation, SWaP, bandwidth, and integration to unlock the future 5G communications.

Polish Network of Neutrino Physics (Polska Sieć Neutrinowa)

In 2006, the Faculty of Electronics and Information Technology joined the Polish Network of Neutrino Physics. The network compreses several institutes

and laboratories working in the field of development of experimental neutrino physics. The Faculty is represented in the network by the Division of Nuclear and Medical Electronics, which has a long-term experience in collaboration with high energy physics (NMC, SMC, COMPASS) and neutrino physics (ICARUS, T2K) experiments.

Polish Network of Particle Astrophysics (Polska Sieć Astrofizyki Cząstek)

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

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

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

4.5.3. Student research groups

Space Engineering Student Research Group

Krzysztof Kurek – tutor.

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

Biomedical and Nuclear Engineering Student Research Group

Grzegorz Domański – tutor.

Biomedical and Nuclear Engineering Student Scientific Group (in Polish: Studenckie Koło Inżynierii Biomedycznej i Jądrowej "Biomedyczni") was formed in Dec. 2005 by a group of students from Biomedical Engineering. The group worked on software enabling determination of longitudinal relaxation time based of a series of images with different inversion time (TI).

The "Arduino for biomedical applications" project has been initiated to develop student interests in the design of new electronic systems, software, and use them in biomedicine. The main objective of the project group is to get acquainted with the electronic platform Arduino programming environment for creating low-cost, flexible and easy-to-use devices. The acquired knowledge and skills will be use at a later stage of the project to develop and implement a multi-functional system for biomedical use, based on the Arduino platform and additional electronic components.

Innovative Information Technologies Student Scientific Group

Przemysław Miazga – tutor.

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

Radio Localization Student Research Group

Jerzy Kołakowski – tutor.

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

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

In its projects LORAD cooperates with 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 inter-disciplinary 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 ucational 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

2016 – 2021

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] Xin Chang: *"Human emotion recognition from image and speech using deep neural networks"*, Prof. **W. Skarbek** (supervisor), Warsaw, May, 30, 2022.

[PhD2] Bartosz Żłobiński: *"Analiza generacji dźwięku w idiofonach dętych"* (Analysis of sound generation in sound idiophones), Prof. **J. Żera** (supervisor), Warsaw, Feb. 02, 2022.

5.2. M.Sc. Degrees

[MSc1] Barbara Bałaban: *"Filtracja adaptacyjna do poprawy jakości sygnału elektrokardiograficznego"* (Adaptive filtering for improving electrocardiographic signal quality), Assist. Prof. **G. Domański** (supervisor).

[MSc2] Wojciech Bartosik: *"Ocena jakości dźwięku przetworników cyfrowo-analogowych w układzie wykorzystującym metodę ABX"* (Evaluation of the sound quality of digital-to-analog converters in a system using the ABX method), Assist. Prof. **A. Pietrzak** (supervisor).

[MSc3] Piotr Chruślicki: *"Pomiar widma lampy rentgenowskiej metodą filtracyjną"* (Measurement of the X-RAY tube spectrum using filtering method), Assist. Prof. **G. Domański** (supervisor).

[MSc4] Gabriela Domaradzka: *"Techniki klasteryzacji w zastosowaniu do analizy danych pochodzących z badań transkryptomicznych"* (Clustering techniques applied to the analysis of transcriptomic data), Assist. Prof. **T. Rubel** (supervisor).

[MSc5] Ewelina Drelich: *„Antropomorficzna proteza dłoni – budowa i badanie funkcjonowania prototypu kciuka"* (Anthropomorphic hand prosthesis – design and functional testing of a thumb prototype), Assoc. Prof.**M. Kwacz** (supervisor), M.Sc. degree with honours.

[MSc6] Wojciech Jan Drzewiecki: *„Aplikacja do przygotowania i automatycznej obróbki galerii zdjęć 360"* (Application for preparation and automatic processing of 360 photo galleries), Assist. Prof. **G. Galiński** (supervisor)

[MSc7] Natalia Filipów: *„Analiza porównawcza dynamiki kręgosłupa w cyklu chodu"* (Comparative analysis of spinal dynamics in the gait cycle), Assist. Prof. **Z. Wawrzyniak** (supervisor).

[MSc8] Marta Grenadier: *„Eksploracja wiedzy z medycznych baz danych"* (Knowledge exploration from medical datebases), Assist. Prof. **Z. Wawrzyniak** (supervisor).

[MSc9] Grzegorz Maciej Gugała: *"Opracowanie uniwersalnego modułu transmisji danych w komórkowych sieciach IoT"* (Development of a universal data module for mobile IoT networks), Assist. Prof. **J. Kołakowski** (supervisor).

[MSc10] Karolina Jacek: *„Modelowanie systemów tomografii komputerowej"* (Modeling of computed tomography systems), Assist. Prof. **G. Domański** (supervisor).

[MSc11] Anna Kędziora: *„Predykcja czasu retencji peptydów w chromatografii cieczowej"* (Prediction of retention times of peptides in liquid chromatography), Assist. Prof. **T. Rubel** (supervisor).

[MSc12] Kinga Kimnes: *"System automatycznej klasyfikacji rekordów pacjentów na potrzeby analiz weterynaryjnych"* (A system for automatic classification of veterinary medical records for clinical research), Assoc. Prof. **P. Bilski** (supervisor).

[MSc13] Filip Knap: *„Rozpoznawanie marek i modeli samochodów z wykorzystaniem splotowych sieci neuronowych"* (Car makes and models classification with convolutional neural networks), Assist. Prof. **G. Galiński** (supervisor).

[MSc14] Bartosz Kochański: *"Przetwarzanie i analiza statystyczna danych w w spektroskopii rezonansu magnetycznego na przykładzie badania stężeń metabolitów w mózgu"* (Processing and statistical analysis of data in magnetic resonance spectroscopy on the example of the study of metabolite concentrations in the brain), Assoc. Prof. **P. Bogorodzki** (supervisor).

[MSc15] Jakub Kocot: *"Analiza algorytmów przydziału zasobów radiowych w łączu w dół w systemach LTEi 5G"* (Analysis of downlink scheduling algorithms in LTE and 5G networks), Assist. Prof. **S. Kozłowski** (supervisor).

[MSc16] Filip Kraszewski: *"Macierze mikrofonowe w systemach dwukierunkowej transmisji dźwięku i obrazu"* (Microphone arrays in two-way audio and video transmission systems), Assist. Prof. **M. Lewandowski** (supervi-sor).

[MSc17] Szymon Kruszewski: *"Automatyczne rozpoznawanie czynności osoby starszej w systemie monitoringu opartym na impulsowych czujnikach radarowych"* (Automatic recognition of activities of elderly persons in monitoring system based on impulse-radar sensors), Assist. Prof. **P. Mazurek** (supervisor)

[MSc18] Jakub Karol Lewandowski: *"Model stabilizacji temperatury detektora SiPM z łączem Ethernet"* (SiPM detector temperature stabilisation module with Ethernet connection), Assist. Prof. **A. Rychter** (supervisor).

[MSc19] Sonia Litwin: *"Skoncentrowane na człowieku myślenie systemowe. Ludzie, Natura i Technologia w projektowaniu robota socjalnego"* (Human-centered Systems Thin-

king. Humanity, Nature and Technology in Social Robot Design), Prof. **M. Olszewski** (supervisor).

[MSc20] Łukasz Maksimowski: *"Zastosowanie sieci definiowanej programowo w rozproszonych systemach pomiarowo-sterujących"* (Application of a software-defined network in distributed measurement and control systems), Assist. Prof. **R. Łukaszewski** (supervisor).

[MSc21] Katarzyna Marczuk: *"Oprogramowanie do oceny jakości systemów obrazowania typu SPECT przy użyciu fantomu Jaszczaka"* (Software for quality control (QC) assessment of SPECT system using the Jaszczak phantom), Assist. Prof. **A. Rychter** (supervisor).

[MSc22] Diana Misiak: *"Badanie rozwoju pandemii Sars-CoV-2 poprzez modelowanie i prognozowanie metodami data-driven"* (Research on the development of the Sars-CoV-2 pandemic through data-driven modeling and forecasting), Assist. Prof. **Z. Wawrzyniak** (supervisor).

[MSc23] Filip Mularz: *"Ocena zależności pomiędzy parametrami kardiologicznymii oddechowymi a obciążeniem podczas próby wysiłkowej"* (Assessment of the relationships between cardiorespiratory parameters and load during a stress test), Assist. Prof. **M. Młyńczak** (supervisor).

[MSc24] Karol Cezary Piechal: *"Interfejs webowy obsługi mikrofalowego miernika dobroci"* (Web interface for operating a microwave Q-meter), Assist. Prof. **P. Korpas** (supervisor).

[MSc25] Maciej Rosłaniec: *"Macierze mikrofonowe w automatycznym rozpoznawaniu mowy"* (Microphone arrays in automatic speech recognition), Assist. Prof. **M. Lewandowski** (supervi-sor).

[MSc26] Andrzej Skwarecki: *"Kamera akustyczna jako narzędzie do badania źródeł dźwięku"* (Acoustic camera as a tool for investigating sound sources), Prof. **J. Żera** (supervisor).

[MSc27] Wojciech Starek: *"Analiza porównawcza błędów związanych z pomiarami parametrów słuchu za pomocą audiometru STM32 i audiometru dopuszczonego do badań audiometrycznych"* (Comparative analysis of errors appearing in audiometry measurements using STM32 based audiometer and certified measurer), Assist. Prof. **G. Makarewicz** (supervisor).

[MSc28] Katarzyna Szmulewicz: *"Symulacja scyntykamery z wykorzystaniem metody Monte Carlo"* (Scintillation camera simulation using the Monte Carlo method), Assist. Prof. **G. Domański** (supervisor).

[MSc29] Marcin Szymański: *"Metody przetwarzania danych z czujnika głębi w celu czasowo–przestrzennej analizy chodu człowieka"* (Methods for processing data from depth sensors, aimed at spatio-temporal analysis of human gait), Assist. Prof. **J. Wagner** (supervisor).

[MSc30] Joanna Walkiewicz: *"Badanie promieniowania rozproszonego wokół mobilnego akceleratora śródoperacyjnego elektronów"* (Study of scattered radiation around a mobile intra operative electron accelerator Assist. Prof. **Sz. Cygan** (supervisor).

[MSc31] Anna Wojtyra: *"Analiza metod wykrywania zaburzeń rytmu pracy serca na podstawie sygnału EKG"* (Analysis of the methods of detecting cardiac arrhythmias based on the ECG signal), Assist. Prof. **G. Domański** (supervisor).

[MSc32] Klaudia Woźniak: *"Eksperymentalna i teoretyczna weryfikacja sterowanych procesów mikrodozowania w inżynierii biomedycznej"* (Experimental and theoretical verification of controlled microdosing processes in biomedical engineering), Prof. **M. Olszewski** (supervisor).

5.3. B.Sc. Degrees

[BSc1] Marcin Adamczuk: *„Opracowanie oprogramowania układu generatora sygnałów zakłócających zgodnych ze standardem IEEE802.15.4a"* (Development of software for jammer compatible with IEEE802.15.4a standard), Assist. Prof. **V. Djaja-Jośko** (supervisor).

[BSc2] Zuzanna Adamiuk: *„Aplikacja mobilna dzienniczek seniora"* (Senior notebook - mobile application), Assist. Prof. **R. Kurjata** (supervisor).

[BSc3] Paweł Marek Berentowicz: *„Mobilny moduł nadawczy w paśmie nielicencjonowanym U-NII-2C"* (Mobile transmitter in unlicensed U-NII-2C band), Assist. Prof. **G. Bogdan** (supervisor).

[BSc4] Aneta Natalia Bień: *"Badanie metodą Monte Carlo wpływu wybranych parametrów wiązki pierwotnej na wiązkę terapeutyczną akceleratora elektronów do radioterapii śródoperacyjnej"* (Monte Carlo study of the influence of selected primary beam parameters on the therapeutic beam of an electron accelerator for intraoperative radiotherapy), Prof. **J. Marzec** (supervisor).

[BSc5] Piotr Biernat: *„Opracowanie stanowiska do badania chordofonów"* (Development of a stand for testing of chordophones), Prof. **J. Żera** (supervisor).

[BSc6] Agnieszka Błachowiak: *"Aplikacja mobilna – dzienniczek pacjenta"* (Mobile application – patient notebook), Assist. Prof. **R. Kurjata** (supervisor).

[BSc7] Ziemowit Byzdra: *"Aplikacja do stabilizacji obrazu w sekwencji wideo"* (Application for frame stabilization in video sequence), Assist. Prof. **G. Galiński** (supervisor).

[BSc8] Krzysztof Czempik: "Transmisja danych z użyciem kontrolera GPMC w elektrycznym tomografie pojemnościowym EVT4" (Data Transmission Using the GPMC Controller

in the EVT4 Electric Capacitive Tomograph), Assist. Prof. **J. Kryszyn** (supervisor).

[BSc9] Julia Dąbrowska: *"Urządzenie do pomiaru mocy wytwarzanej podczas przysiadu ze sztangą"* (Device measuring the power generated during the barbell squat), Assist. Prof. **Sz. Cygan** (supervisor).

[BSc10] Kinga Depko: *"Aplikacja internetowa do obsługi e-recepty"* (E-prescription web application), Assist. Prof. **J. Kryszyn** (supervisor).

[BSc11] Natalia Joanna Dominik: *"Serwis internetowy udostępniający wyniki badań proteomicznych"* (Web service providing access to results of proteomic analysis), Assist. Prof. **T. Rubel** (supervisor).

[BSc12] Tomasz Duda: *"Korekcja parametrów systemu dźwiękowego dostosowana do warunków atmosferycznych"* (Correction of Sound System Parameters Adapted to Weather Conditions), Assist. Prof. **M. Lewandowski** (supervisor)

[BSc13] Kamil Ewertowski: *"Projekt inteligentnej aplikacji przeglądarkowej do przewidywania wartości cen akcji spółek giełdowych z wykorzystaniem chmurowej platformy obliczeniowej"* (Stock price predictor web application using Azure Machine Learning), Assoc Prof. **P. Bilski** (supervisor).

[BSc14] Eliza Filip: *'"Odkrywanie wiedzy oraz tworzenie systemu doradczego dla choroby Covid-19"* (Knowledge discovery and development of an expert system for Covid-19 disease), Prof. **J. Mulawka** (supervisor).

[BSc15] Aleksandra Gniewek: *"Lokalizacja lezji w obrazach strukturalnych MRI w grupie pacjentów ze stwierdzonym stwardnieniem rozsianym"* (Localization of lesion in MRI structural images in a group of patients diagnosed with multiple sclerosis), Assist. Prof. **E. Piątkowska-Janko** (supervisor).

[BSc16] Rafał Marek Gorecki: *"Aplikacja wspomagająca naukę gry na instrumentach poprzez analizę i wizualizację sygnałów muzycznych"* (Application supporting learning to play the instruments by analysis and visualisation of musical signals), Assist. Prof. **J. Wagner** (supervisor).

[BSc17] Jan Mikołaj Góralski: *"Aplikacja mobilna do wizualizacji wyników symulacji EM FDTD dla symulatora QuickWave 3D"* (Mobile application for visualization of EM FDTD simulation results for QuickWave 3D simulator), Assist. Prof. **M. Sypniewski** (supervisor).

[BSc18] Sebastian Gruszczyński: *"Wybrane metryki w ocenie wyników detekcji krawędzi w obrazach monochromatycznych"* (Selected metrics in the evaluation of edge detection results in monochrome images), Assoc. Prof. **K. Snopek** (supervisor).

[BSc19] Minjie Hu: *"Design of rectangular microstrip patch antenna based on HFSS simulation"*, Prof. **Y. Yashchyshyn** (supervisor), studies in English.

[BSc20] Piotr Leszczyński: *"Aplikacja serwerowa do rozpoznawania gatunku muzycznego"* (Server application for music genre recognition), Assist. Prof. **M. Lewandowski** (supervisor).

[BSc21] Jiawei Li: *"Development of an antenna for the BeiDou3 satellite navigation system"* Prof. **Y. Yashchyshyn** (supervisor), studies in English.

[BSc22] Paweł Jankowski: *"Projekt i realizacja aplikacji mobilnej generatora sygnałów akustycznych"* (Design and implementation of a mobile application for the acoustic signals generator), Assist. Prof. **P. Bobiński** (supervisor).

[BSc23] Aleksander Karabon: „Program bazodanowy z możliwością wizualizacji pomiarów wolumetrycznych mózgu" (Database application for visualization of volumetric measurements of brain), Assist. Prof. **E. Piątkowska-Janko** (supervisor).

[BSc24] Piotr Kielak: „Aplikacja mobilna do opieki nad bliskim: seniorem, dzieckiem" (A mobile application for lookong after a loved one: senior, child), Assist. Prof. **A. Rychter** (supervisor).

[BSc25] Aleksandra Sabina Krakowiak: *"Oprogramowanie do wizualizacji danych z tandemowej spektrometrii mas na potrzeby badań proteomicznych"* (Software for visualisation of tandem mass spectrometry data for proteomic research), Assist. Prof. **T. Rubel** (supervisor).

[BSc26] Magdalena Kryczka: „Aplikacja do czasowo-przestrzennej analizy chodu za pomocą czujnika głębi" (Application for spatiotemporal analysis of human gait by means of a depth sensor), Assist. Prof. **J. Wagner** (supervisor).

[BSc27] Stanisław Tomasz Krześniak: „Segmentacja obrazów dwuwymiarowych z wykorzystaniem algorytmów grafowych" (Graph-based 2D image segmentation), Assoc. Prof. **K. Snopek** (supervisor).

[BSc28] Anna Kulesza: „Metoda testowania żywotności oka wykorzystująca mimowolne ruchy źrenicy" (Eye liveness detection using involuntary pupil movements), Assist. Prof. **M. Trokielewicz** (supervisor).

[BSc29] Anna Kurczak: „Badanie wpływu korzystania z odtwarzaczy przenośnych na postrzeganie dźwiękowych sygnałów ostrzegawczych" (Study of impact of using personal audio players on perception of warning signals), Prof. **J. Żera** (supervisor).

[BSc30] Mateusz Maciej Kurek: *"Opracowanie modułu do do komunikacji w standardzie IEEE802.15.4a"* (Development of the system for communication using IEEE

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802.15.4a standard), Assist. Prof. **V. Djaja-Jośko** (supervisor).

[BSc31] Jintong Li: *„Aplikacja do generacji i wizualizacji geometrycznego modelu systemu MIMO"* (Application for generation and visualisation of a geometric MIMO channel model), Assist. Prof. **S. Kozłowski** (supervisor).

[BSc32] Oliwia Makowiecka: *"Numeryczne modelowanie płuc w tomografii elektrycznej"* (Numerical lungs modelling in electrical tomography), Assist. Prof. **J. Kryszyn** (supervisor).

[BSc33] Mateusz Marciniak: *„Wykrywanie i rozpoznawanie tekstu w obrazie z wykorzystaniem silnika optycznego rozpoznawania znaków Tesseract"* (Detection and text recognition using optical character recognition engine Tesseract), Assist. Prof. **A Buchowicz** (supervisor).

[BSc34] Michał Walenty Mianowski: *"Wieloplatformowa przeglądarka obrazów w formacie BPD"* (Cross-platform viewer of images in the BPG format), Assist. Prof. **G. Galiński** (supervisor).

[BSc35] Wojciech Gabriel Moczydłowski: *"Aplikacja webowa umożliwiająca wieloosobową rozrywkę w Ktulu"* (Web application that allows playing a multiplayer game in Ktulu), Assist. Prof. **K. Ignasiak** (supervisor).

[BSc36] Anna Maria Plęs: *"Zastosowanie sztucznej sieci neuronowej do identyfikacji białek w badaniach proteomicznych"* (ANN-based method for the identification of proteins in proteomic experiments), Assist Prof. **T. Rubel** (supervisor).

[BSc37] Jakub Płudowski: *"Automatyczna detekcja patologii płuc na zdjęciach radiografii cyfrowej klatki piersiowej"* (Automatic detection of lung pathologieson chest X-ray radiographs), Prof. **J. Mulawka** (supervisor).

[BSc38] Jakub Prochorec (Institute of Computer Science, WUT): *„Biblioteka modułów programowych kodeka VVC - transformacje, kwantyzacja i dekwantyzacja"* (VVC codec program modules library - transformations, quantization and dequantization), Assoc. Prof. **G. Pastuszak** (supervisor).

[BSc39] Joanna Krystyna Rancew: *„Oprogramowanie do analizy obrazów scyntygrafii dynamicznej nerek"* (Software for dynamic renal scintigraphy), Assist. Prof. **J. Kryszyn** (supervisor), B.Sc. degree with honours.

[BSc40] Shungin Rao: *"Design of microstrip antenna for a meteorological rocket"* Prof. **Y. Yashchyshyn** (supervisor), studies in English.

[BSc41] Piotr Sawicki (Institute of Computer Science, WUT): *„Biblioteka modułów programowych kodeka VVC – kodowanie i dekodowanie entropijne"* (VVC codec software module library – entropy encoding and decoding), Assoc Prof. **G. Pastuszak** (supervisor).

[BSc42] Ada Sawilska: *„Identyfikacja tożsamości za pomocą obszaru okołoocznego na urządzeniu mobilnym"* (Identity recognition with the periocular regionon the mobile device), Assist. Prof. **M. Trokielewicz** (supervisor).

[BSc43] Michał Smerdzyński: *„Aplikacja mobilna do strojenia gitary"* (Mobile application for tuning guitar), Assoc. Prof. **P. Bilski** (supervisor).

[BSc44] Anna Stachurka: *„Aplikacja wspomagająca kształcenie poczucia rytmu"* (Application for supporting the development of the sense of rhythm), Assist. Prof. **J. Wagner** (supervisor).

[BSc45] Kamil Stańkowski: *„Program weryfikacji dyskretyzacji obwodu dla celów symulacji elektromagnetycznej"* (Circuit discretization verification program for electromagnetic simulation purposes), Assist. Prof. **M. Sypniewski** (supervisor).

[BSc46] Michał Stolarski: *„Projekt inteligentnej aplikacji mobilnej zarządzającej procesem zakupowym z wykorzystaniem rzeczywistości rozszerzonej"* (Design of an intelligent mobile application that manages the shopping process using augmented reality), Assoc. Prof. **P. Bilski** (supervisor).

[BSc47] Piotr Strząska: *„Oprogramowanie do symulacji kanału radiowego w systemach radiokomunikacji ruchomej"* (Software for simulating radio channel in mobile radiocommunication systems), Assist. Prof. **K. Godziszewski** (supervisor).

[BSc48] Mateusz Szechiński: *"Opracowanie oprogramowania do analizy pracy modemu w sieci komórkowej IoT"* (Development of software for analyzing the operation of a modem in the IoT cellular network), Assist. Prof. **J. Kołakowski** (supervisor).

[BSc49] Joanna Walkiewicz: *„Badanie promieniowania rozproszonego wokół mobilnego akceleratora śródoperacyjnego elektronów"* (Radiation survey around a mobile electron linear accelerator, Assist. Prof. **Sz. Cygan** (supervisor).

[BSc50] Konrad Marek Wcisło: *"Projekt anteny paskowej na pasmo W"* (Design of W – band Microstrip Antenna), Prof. **Y. Yashchyshyn** (supervisor).

[BSc51] Karol Wojciechowski: *"Optymalizacja dyskretyzacji obiektu dla celów symulacji FDTD przy użyciu metod uczenia maszynowego"* (Optimizing of discretizating mesh for use in FDTD simulations with use of machine learning techniques), Assist. Prof. **M. Sypniewski** (supervisor).

[BSc52] Shuo Yan: *"Opracowanie prostokątnej anteny mikrostopowej dla pasma ISM"* (Development of rectangular microstrip an-

tenna for the ISM band), Prof. **Y. Yash-chyshyn** (supervisor).

[BSc53] Minyu Zhang: *"Dual-band antenna design based on PIFA structure"*, Prof **Y. Yash-chyshyn** (supervisor), stud-ies in English.

[BSc54] Chongwen Zhu: *"Konstrukcja prostokątnej anteny mikropaskowej 2x2 Array"*, (Design of 2x2 Array Rectangular Microstrip Patch Antenna) Prof **Y. Yashchyshyn** (supervisor), studies in English.

6. PUBLICATIONS

6.1. Scientific and technical books, chapters in books

[Pub1] A. P. Pietrzak, J. Żera: „The risk of musicians' high sound exposure during performances of classical music", in. *New techniques and methods for noise and vibration measuring, assessing and reducing. Digital Monograph, 2022, Centralny Instytut Ochrony Pracy - Państwowy Instytut Badawczy*, ISBN 9788373733800, pp. 52-56.

[Pub2] D. Radomski: „Do Contractions of Abdominal Muscles Bias Parameters Describing Contracile Activities of a Uterus? A Preliminary Study", in: *Information Technology in Biomedicine,* E. Piętaka, P. Badura, J. Kawa, W. Wieclawek (eds)*, part of book series: *Advance in Intelligent Systems and Computing, Springer* 2022, ISBN: 978-3-031-09134-6, e-book ISBN 978-3-031-09135-3, pp. 474-483.

[Pub3] S. Rosłoniec: "Wybrane zagadnienia techniki antenowej z przykładami projektowania" (Selected Problems of Antenna Technology with Design Examples), *Wydawnictwo Wojskowej Akademii Technicznej*, 2022, ISBN: 978-83-7938-329-0, 430 pp.

[Pub4] T. Rubel, K. Orzechowska: "Wydajny algorytm bazodanowej identyfikacji białek na podstawie danych ze spektrometrii mas" (Efficient algorithm for database protein identification based on mass spectrometry data), in: *Postępy w naukach przyrodniczych: stan obecny i perspektywy*, A. Danielewskiej i M Maciąg (eds), *Wydawnictwo Naukowe TYGIEL*, 2022, ISBN 978-83-67104-46-3, pp. 168-179.

[Pub5] J. Wagner, P. Mazurek, R. Z. Morawski: „Non-invasive Monitoring of Elderly Persons", *Springer*, Nature, Cham (Switzerland) 2022, ISBN: 978-3-030-96008-7, e-book ISBN: 987-3-030 -96009-4, 301 pp.

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 Education and Science 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.

[Pub6] K. Abe (…), K. Dygnarowicz, R. Kurjata, R. Rychter, K. Zaremba, M. Ziembicki: "Scintillator ageing of the T2K near detectors from 2010 to 2021", *Journal of Instrumentation*, vol. 17, no. 10, doi: 10.1088/1748-0221/17/10/p10028, pp. 1-36.

[Pub7] G. D. Alexeev (….), R. Kurjata, A. Rychter, M. Ziembicki (198 external authors): *"*Exotic Meson π_1 (1600) with J^{pc} =1^{-+}and its Decay into ρ(770)π", *Physical Review D*, vol. 105, 2022, doi: 10.1103/PhysRevD.105.012005, pp. 012005-1-012005-30.

[Pub8] G. D. Alexeev (….), R. Kurjata, J. Marzec, A. Rychter, M. Ziembicki (207 external authors): "Probing Transversity by Measuring Λ Polarisation in SIDIS", *Physics Letters B*, vol. 824, 2022, doi: 10.1016/j.physletb.2021.136834, pp. 1-10.

[Pub9] N. Andrushchak, D. Vynnyk, M. Melnyk, P. Bajurko, J. Sobolewski, Y. Yashchyshyn: "Impact of Optical Illumination on Transmission of Subterahertz Electromagnetic Waves by $Bi_{12}GeO_{20}$ Crystals", *Acta Physica Polonica A*, 2022, no. 4, vol. 141, doi: 10.12693/APhysPolA.141.415, pp. 415-419.

[Pub10] D. Attie (…), R. Kurjata, A. Rychter, M. Ziembicki (61 external authors): "Characterization of Resistive Micromegas Detectors for the Upgrade of the T2K Near Detector Time Projection Chambers", *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, vol. 1025, 2022, doi: 10.1016/j.nima.2021.166109, pp. 1-32.

[Pub11] P. Bajurko, J. Sobolewski, G. Bogdan, K. Godziszewski, J. Marczewski, J. Kulawik, M. Widlok, Y. Yashchyshyn: "Millimeter-Wave Transmitter with LTCC Antenna and Silicon Lens" *Jet - International Journal of Electronics and Telecommunications*, vol. 68, no. 2, 2022, doi: 10.24425/ijet.2022.139877, pp. 267-273.

[Pub12] Z. Barani, K. Stelmaszczyk, F. Kargar, Y. Yashchyshyn, G. Cywiński, S. Rumyantsev, A. A. Balandin: "Efficient Terahertz Radiation Absorption by Dilute Graphene Composites", *Applied Physics Letters,* vol. 120, doi: 10.1063/5.0079891, 2022, pp. 063104-1-063104-7.

[Pub13] Ł. Błaszczyk, K. M. Snopek: „On the Octonion Cross Wigner Distribution of 3-D Signals", *Applied Sciences*, vol. 12, no. 11, 2022, doi: 10.3390/app12115358, pp. 1-22.

[Pub14] I. Domitrz, E. Piątkowska-Janko, J. J. Rożniecki, N. Hryniewicz, P. Bogorodzki: „Parpoxysnal Hemicrania or Short-Lasting Unilateral Neuralgiform Headache Attacks with Trigeminal Neuralgia- Functional Neuroimaging Findings", *Neurologia i Neurochirurgia Polska*, 2022, doi: 10.5603/*PJNNS.*-a2022.0025, pp. 1-3, early access.

[Pub15] K. Dowalla, P. Bilski, R. Łukaszewski, A. Wójcik, R. Kowalik: „Application of the Time-Domain Signal Analysis for Electrical Appliances Identification in the Non-Intrusive Load Monitoring", *Energies*,

vol. 15, no. 9, 2022, article no. 3325, doi: 10.3390/en15093325, pp. 1-20.

[Pub16] K. Dowalla, P. Bilski, R. Łukaszewski, A. Wójcik, R. Kowalik: "A Novel Method for Detection and Location of Series Arc Fault for Non-Intrusive Load Monitoring", *Energies*, vol. 16, no. 1, doi: 10.3390/en16010171, pp. 1-23.

[Pub17] K. Dowalla, P. Bilski, R. Łukaszewski, A. Wójcik, R. Kowalik: "Wpływ częstotliwości próbkowania na skuteczność systemu NILM z analizą sygnałów w dziedzinie czasu" (Impact of sampling rate on the performance of NILM system with signal analysis in time domain), Przegląd Elektrotechniczny, vol. 98, no. 11, doi: 10.15199/48.2022.11.35, pp. 173-176.

[Pub18] M. Jasiński, J. Żera: „Estimation of Asymmetry in Head Related Transfer Functions", International Journal of Electronics and Telecommunications, vol. 68, no. 2, doi: 10.24425/ijet.2022.139867, pp. 193-200.

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[Pub96] J. Wagner: "Spatiotemporal analysis of human gait, based on feet trajectories estimated by means of depth sensors", Proc. Joint IMEKO TC1-TC7-TC13-TC18 Symposium 2022 (Porto, Portugal, Aug. 31 – Sep. 2, 2022).

[Pub97] M. Warecka, S. Dziedziewicz, R. Lach, P. Kowalczyk, P. T. Czekała, B. Salski, P. Kopyt: "Efficient Fabry-Perot Open Resonator Analysis by the use of a Scattering Matrix Method", Proc. 24th International Microwave and Radar Conference: MIKON 2022 (Gdansk, Poland, Sept. 12-14, 2022), pp. 1-4.

[Pub98] Y. Yashchyshyn, P. Bajurko, J. Sobolewski, P. Sai, S. Rumyantsev, G. Cywiński: "AlGaN/GaN Schottky Barrier Single-Pole Single-Throw RF Switch", Proc. 24th International Microwave and Radar Conference: MIKON 2022 (Gdansk, Poland, Sept. 12-14, 2022), pp. 1-3.

[Pub99] R. Zawiła, K. Bresler, M. Ciarka, G. Jas, K. Kidała, T. A. Miś, G. Mystkowska, R. Mystkowski, A. Shmyk, K. Wiater: "TOTORO Project: Student mission showing feasibility of studying Earth's magnetosphere on board a stratospheric balloon", Proc. 73rd International Astronautical Congress 2022 (Paris, France, Sept. 18-22, 2022), pp. 1-2.

6.4. Abstracts, Posters and presentations

[Pub100] R. Z. Morawski: "Application-oriented Model of Measurement Uncertainty", Conference Measurement at the Cross-roads (Milano, Italy, Jun. 29 – Jul. 01, 2022), presentation composed of 25 slides.

[Pub101] A. M. Olszewska, D. Droździel, M. Gaca, A. Kulesza, W. Obrębski, J. Kowalewski, A. Widlarz, A. Marchewka, A. Herman: "Unlocking the musical brain: an ecological approach to playing the piano in an MRI scanner", Conference: Neurohackademy 2022 (Jul, 2022), 1 pp.

7. RESEARCH REPORTS

[Rep1] P. J. Durka, P. Bogorodzki, E. Piątkowska-Janko, K. Lipiński: *"Śpiączka i zaburzenia świadomości – nowe wskaźniki prognostyczne i diagnostyczne oparte o EEG i MRI"* (Coma and consciousness disorders – new prognostic and diagnostic indicators based on EEG and MRI), Final report for the National Science Center, Warsaw, Jul. 2022.

[Rep2] J. Krupka, P. Kopyt, D. Gryglewski, W. Wojtasiak: *„Wysokoprecyzyjne techniki charakteryzacji materiałów w zakresie fal milimetrowych oraz subterahercowych do zastosowań mikroelektronicznych"* (High-precision technique of millimeter and sub-THz band characterization of materials for microelectronics), Final report for EU Framework Programme "Intelligent Development 2014-2020", and Foundation for the Polish Science, Warsaw, Jun. 2022.

[Rep3] K Zaremba, R. Kurjata, M. Ziembicki, A. Rychter: *„Eksperyment T2K* (T2K experiment", Final report for the Ministry of Education and Science, Warsaw, Sept. 2022.

8. PATENTS AND PATENT APPLICATIONS

[Pat1]   L. Morzyński, G. Makarewicz, P. Kowalski; *„Sposób pomiaru drgań mechanicznych oraz miernik drgań mechanicznych oddziałujących na człowieka"* (Method of measuring mechanical vibrations and a meter of mechanical vibrations affecting a person), Mar. 22, 2022.

[Pat2]   W. Gwarek, K. Jankowski, W. Wojtasiak, M. Borowska, P. Korpas, S. Kozłowski, D. Gryglewski, D. Kołodziej; *„Aplikator mikrofalowy do przeprowadzania reakcji chemicznych"* (Microwave applicator for chemical reactions a person), patent application no. P.442072, Aug. 23, 2022.

[Pat3]   G. Cywiński, S. Rumiantcev, P. Bajurko, Y. Yashchyshyn; *„A high frequency switch with field effect transistor",* patent application no. EP22204597.3, Oct. 29, 2022.

9. SCIENTIFIC EVENTS

9.1. Scientific events co-organized by the Institute

[Con1] *Multiconference 2022: KKRRiT 2022, KSTiT 2022* (Warsaw, Sept. 7-9, 2022), K. Snopek (chair of KKRRiT 2022), J. Cichocki, J. Modelski, G. Pastuszak, W. Wojtasiak, Y. Yashchyshyn (members of the Programme Committee).

[Con2] *10th Microwave & Radar Week: MRW 2022* with parallel conferences: *24th International Microwave and Radar Conference: MIKON 2022*, and *2022 International Radar Symposium* (Gdańsk, Poland, Sept. 12-14, 2022), J. Modelski (chair of *MRW 2022*), M. Krysicki, B. Salski (members of the Organizing Committee), W. Gwarek, B. Salski, W. Wojtasiak, Y. Yashchyshyn (members of the Technical Programme Committee – *MIKON 2022*).

[Con3] *18th IMEKO TC10 Conference 2022 Measurement for Diagnostics, Optimisation and Control to Support Sustainability and Resilience* (Warsaw, Poland, Sep. 26-27, 2022), P. Bilski *(*Technical Program Chairs and Local Organizing Committee), P. Mazurek, J. Wagner (Local Organizing Committee).

9.2. International scientific events

[Con4] *International Interdisciplinary PhD Workshop 2022* (Lublin, Poland, Mar. 15-17, 2022), T. Rubel (speaker).

[Con5] *14th Interdisciplinary Scientific Conference TYGIEL 2022*), (Lublin, Poland, Mar. 24-27, 2022), T. Rubel (speaker).

[Con6] *European Microwave Week 2021* (London, UK, Apr. 2-7, 2022), J. Modelski (MTT-S observer), P. Kopyt, B. Salski, M. Krysicki, J. Cuper, A. Pacewicz (participants).

[Con7] *OHBM 2022 Annual Meeting* (Glasgow, Scotland, Jun. 19-23, 2022), K. Lipiński (participant).

[Con8] *56th Annual Microwave Power Symposium: IMPI 2022 (Savannah, Georgia, USA, Jun. 14-16, 2022),* B. Salski (speaker).

[Con9] *International Microwave Symposium: IMS 2022* (Denver, USA, Jun. 19-24, 2022), J. Modelski (member of IEEE Microwave Theory and TechnologybSociety), B. Salski, P. Kopyt, M. Krysicki, J. Cuper (participants).

[Con10] *XIX Międzynarodowa Konferencja Zwalczania Hałasu* (XIXth International Conference on Noise Control) (Lidzbark Warmiński, Poland, Jun. 26-29, 2022), J. Żera (member of the Scientific Committee).

[Con11] *Measurement at the Crossroads 2022 – Measuring and Modeling* (Milano, Italy, Jun. 29 – Jul. 1, 2022), R. Z. Morawski (member of the Program Committee, speaker).

[Con12] *2022 IEEE MTT-S International Conference on Electromagnetic and Multiphysics Modeling and Optymization (NEMO2022) (July 6-8, 2022, Limoges, France), B. Salski (participant).*

[Con13] *Teraherz Technologies & Applications Summer School: TTASS 2022* (Warsaw, Jul. 11-15, 2022), Y. Yashchyshyn (speaker).

[Con14] 45th International Conference on Telecommunications and Signal Processing, (virtual conference, Jul. 13-15, 2022), K. Snopek (Member of the Programme Committee).

[Con15] *Joint IMEKO TC1-TC7-TC13-TC18 Symposium 2022* (Porto, Portugal, Aug. 31 – Sep. 2, 2022), P. Mazurek, J. Wagner (speaker).

[Con16] *73rd International Astronautical Congress 2022 (IAC), 2022, (Paris, France, Sept. 18-22, 2022), T. A. Miś (speaker).*

[Con17] *49 Międzynarodowa Konferencja I Wystawa PIKE 2022 (*49th International Conference and Exhibition PIKE) (Toruń, Poland Oct. 3-5, 2022), J. Modelski (chair of the Programe Council).

[Con18] *53° Congreso Español de Acústica – Tecniacustica'22- y XII Congreso Ibérico de Acústica (Elche, Spain, Nov. 2-4, 2022), A. P. Pietrzak (participant).*

[Con19] *Autumn School Series in Acoustics: ASSA 2022* (Eindhoven, the Netherlands, Nov. 7-11, 2022), A. P. Pietrzak (participant).

[Con20] 2022 IEEE 2nd Ukrainian Microwave Week (UkrMW) (Kharkov, Ukraine, Nov. 14-18, 2022), P. Tokarsky (speaker).

[Con21] 30th Telecommunications Forum (TELFOR), 2022 (Belgrade, Serbia, Nov. 15-16, 2022), V. Djaja-Jośko (speaker).

9.3 National scientific events

[Con22] *XIV Konferencja Naukowa Naukowa: Systemy Pomiarowe w Badanich Naukowych I w Przemyśle (*XIVth Scientific in Research and Industry) (Łagów, Poland, Jun. 12-15, 2022), P. Bilski (member of the Scientific Committee).

[Con23] Seminar of the Division of Philosophy and Ethics in Administration (Warsaw, Poland, Oct. 18, 2022), R. Z. Morawski: "Application-oriented meta-model of measurement uncertainty" (speaker).

10. AWARDS AND DISTINCTIONS

State Medals

Bartłomiej Wacław Salski, D.Sc.
Brązowy Krzyż Zasługi (Bronze Cross of Merit).

Kajetana Marta Snopek, D.Sc.
Medal Złoty za Długoletnią Służbę (Golden Medal for the Long-lasting Service).

Piotr Bogorodzki, D.Sc.,
Grzegorz Domański, Ph.D.
Medal Komisji Edukacji Narodowej (Medal of the National Education Committee).

Awards granted by international bodies

Piotr Bilski, D. Sc.
Distinction in the competition – "State Security Leader 2022" - 30th International Defence Industry Exhibition (MSPO).

Awards of the Rector

Agnieszka Pietrzak, Ph.D.
Individual IIIº award for the scientific achievements.

Vitomir Djaja-Jośko, Ph.D.
Individual IIIº award for the scientific achievements.

Jan Szmidt, Prof. D.Sc., (IMiO)
Arkadiusz Kaszewski, D.Sc., (ISEP)
Norbert Kwietniewski, M.Sc., (IMiO)
Wojciech Wojtasiak, D.Sc.,
Daniel Gryglewski, Ph.D.,
Michał Gierczyński, Ph.D., (ISEP)
Krzysztof Jackiewicz, M.Sc., (ISEP)
Andrzej Straś, M.Sc., (ISEP)
Lech Grzesiak, Prof. D.Sc., (ISEP)
Tomasz Bałkowiec, M.Sc., (ISEP)
Maciej Kamiński, M.Sc., (IMiO)
Bartłomiej Stonio, M.Sc., (IMiO)
Agnieszka Martychowiec, M.Sc. (IMiO)
Team Iº award for the scientific achievements.

Roman Z. Morawski, Prof. D.Sc.,
Andrzej Miękina, Ph.D.
Team Iº award for the teaching achievements.

Andrzej Bęben, D.Sc., (IT)
Andrzej Buchowicz, Ph.D.,
Jacek Cichocki, Ph.D.,
Konrad Godziszewski, Ph.D.,
Krystian Ignasiak, Ph.D.,
Sławomir Kula, Ph.D., (IT)
Danuta Ojrzeńska-Wójter, M.Sc., (IT)
Jerzy Siuzdak, Prof. D.Sc. (IT)
Team IIº award for the organizational achievements.

Jarosław Arabas, D.Sc., (II)
Mariusz Kaleta, D.Sc., (IAiIS)
Rajmund Kożuszek, M.Sc., (II)
Mieczysław Muraszkiewicz, Prof. D.Sc., (II)
Robert Marek Nowak, D.Sc., (II)
Piotr Pałka, Ph.D., (IAiIS)
Grzegorz Pastuszak, D.Sc.
Team IIº award for the organizational achievements.

Waldemar Smolik, D.Sc.,
Janusz Marzec, Prof. D.Sc.,
Piotr Brzeski, Ph.D.,
Robert Kurjata, Ph.D.,

Krzysztof Kałużyński, Prof. D.Sc., (IMiIB)
Jakub Żmigrodzki, D.Sc., (IMiIB)
Szymon Cygan, Ph.D. (IMiIB)
Team IIº award for the organizational achievements.

Best Paper Programme, third edition

Yevhen Yashchyshyn, Prof. D.Sc.
Konrad Godziszewski, Ph.D.
Authors of awarded paper *"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* 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.

Adam Pacewicz, Ph.D.
Ist award for the Ph.D. dissertation titled: *"Resonance methods for microwave characterization of ferromagnetic spheres",* supervisor: **Bartłomiej Salski, D.Sc.**

Vitomir Diaja-Jośko, Ph.D.
Degree with honours for the dissertation titled: *"Novel methods for the wireless synchronization in ultrawideband localization systems"* (Nowe metody bezprzewodowej synchronizacji w ultraszerokopasmowych systemach lokalizacyjnych), supervisor: **Józef Modelski, Prof. D.Sc.**

Scholarships of the Foundation for the Development of Radiocommunications and Multimedia Technologies granted in 2022.

Maciej Jasiński
Marcin Kołakowski
Bartosz Żłobiński
For preparing Ph.D. thesis.

Piotr Bartosik
Jakub Kocot
Aleksandra Krawczyk
Agnieszka Piwowar
Mateusz Wrzesiński

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

SPECIFICATION	2019	2020	2021	2022
academic staff [posts]				
total	54,5	56	54,5	58,75
professors	4	5,5	5,5	6,5
University professors	9	8	8	7
associate professors	2	1	0	0
assistant professors	26,5	30,5	31,5	38,25
readers	1	1	0	0
senior lecturers	5	2,5	0	0
assistants	7	7,5	9,5	7
Ph.D. students [persons]				
total	38	39	26	24
technical and administrative staff [posts]				
total	16,65	13,3	14,7	12,5
senior R&D associates	1,5	1	2	0
R&D associates	4,75	3,5	3,5	2
administrative associates	8,4	6,8	5,2	8
service workers	2	2	2	2
temporary staff [persons]	5	4	2	0,5
teaching activities				
basic courses	50	57	75	81
advanced courses	28	27	40	36
other courses	23	15	13	8
international projects, courses and lectures	4	1	2	6
research projects				
total	52	51	42	33
International granted by EU	4	4	3	2
granted by the Ministry	20	22	14	13
granted by the University	16	7	13	12
other	12	18	12	6
titles and degrees awarded				
Prof. titles	0	0	0	0
D.Sc. degrees	1	0	0	0
Ph.D. degrees	2	6	5	2
M.Sc. degree (regular studies + evening studies)	39+2	43+1	26	32
M.Sc. degree (studies in English)	0	0	0	0
B.Sc. degrees (regular studies + evening studies)	69+5	63+5	71	51+1
B.Sc. degrees (studies in English)	0	0	0	2
publications				
total	123	131	71	101
sci.-tech. books and chapters in books	2	2	1	5
sci.-tech. papers in journals - total	37	62	42	62
JCR-ICI list (IF>0)	31	52	37	59
in other journals	14	10	5	3
sci.-tech. papers in conference proceedings	55	59	17	32
other publications	12	8	11	2
patents and patent applications	2+1	2	3	1+2
international	0	0	3	1
national	3	2	0	2
research reports	33	24	19	3
scientific events attended by the staff	45	20	19	23

EXPLANATORY NOTE ON POLISH ACADEMIC AND PROFESIONAL 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 addendmends)