



POZNAN UNIVERSITY OF TECHNOLOGY



Institute of Radiocommunications



Dear Readers,

It's my pleasure to welcome you to this year's bulletin from the Institute of Radiocommunications—a brief but insightful overview of our recent work in research, development, and education.

The Institute, part of the Faculty of Computing and Telecommunications at Poznan University of Technology, has been dedicated to advancing wireless communications since its establishment in 2020. Building on the legacy of the former Chair of Wireless Communication, we combine modern infrastructure, specialized laboratories, and a talented, experienced team. Our research is backed by collaborations with industry partners, national institutions, and the European Commission, and is regularly published in top-tier journals, books, and conferences. Much of this work leads to patents and licensing agreements, reflecting our focus on innovation and real-world impact.

Students and PhD candidates are central to our research mission, contributing to projects and developing their theses under the guidance of our faculty. We also take pride in our active international collaborations across Europe, Asia, Africa, and North America, as well as our involvement in leading organizations in the field of radiocommunications.

In this bulletin, you'll find highlights of our research areas, achievements, and educational initiatives. We hope it inspires future cooperation—whether through joint projects, academic exchanges, or shared ideas. We'd be delighted to explore opportunities with you and your institution.

Lastly, I warmly welcome all participants of the upcoming **European Conference on Networks and Communications (EuCNC) and the 6G Summit**, co-organized by our Institute. These events will take place at the Poznan Congress Center from June 3rd to 6th, 2025.

With best regards,

Professor Hanna Bogucka, PhD

Director of the Institute of Radiocommunications

Poznan, May 2025

On the practical application of RISes

What is the real impact of intelligent surfaces in everyday-life situations?

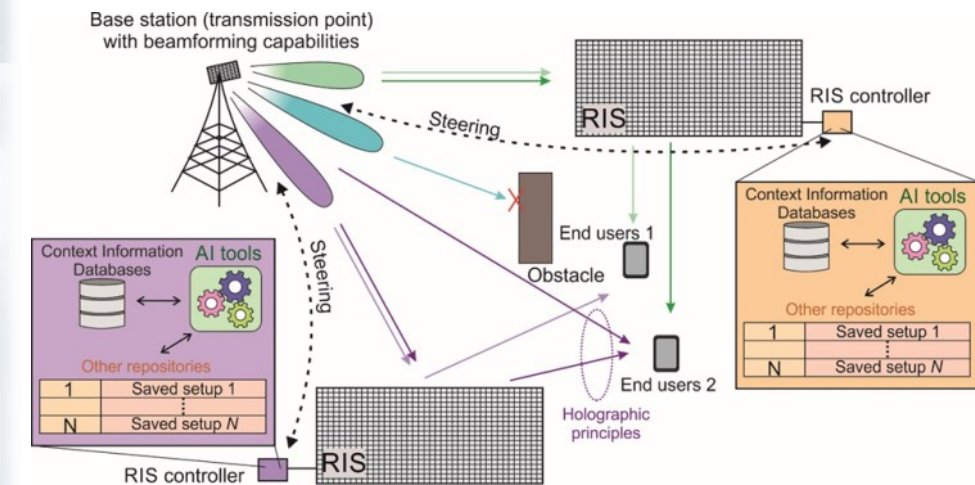
To answer this vibrant scientific question, an NCN OPUS project is being investigated at the Institute of Radiocommunications of PUT. The project title is called: *Context-information aware usage of intelligent antenna matrices and holography for wireless signal transmissions*, and is realized by a highly engaged research group, consisting of IR researchers and active students.

Conceptually, one of the vibrant concepts that appeared in the recent years in the scientific community of wireless communication system designers and enthusiasts is the application of the software-controlled, reconfigurable and intelligent surfaces. They are known under various names, such as reconfigurable intelligent surfaces (RIS), holographic MIMO, large intelligent surface antenna, or intelligent reconfigurable surfaces (IRS), to name the few. These large surfaces consist of many meta-material elements which – depending on the controlling signal and the meta-material type – may change to some extent the characteristics of the wireless environment. The ability of wireless environment modification through remote and software manipulations changes significantly the ways how the wireless systems can be interpreted and mathematically described. It may even influence the principal rules for wireless signal transmission, coding and signal processing, and, as such, it may have a significant impact on future design aspects of wireless communication systems.

RISes, fabricated from many meta-material elements, create great opportunities for improvement of traditional techniques applied in contemporary wireless systems. As meta-materials realize very specific electromagnetic properties, which are typically not found in nature, they, gathered together, create so-called metasurfaces which may realize various beam-steering and electromagnetic field transformations. Very initial experiments on prototypes of such boards focus on FPGA-controlled array of elements, typically containing some tens or hundreds of active modules. Such great possibilities of influencing the behavior of the radio environment have triggered numerous researches in the field of metasurface application in various areas of signal propagation and network performance improvement. RISes have been initially considered for channel capacity improvement through active interference management or advanced beam-steering. One may observe that the legitimate base station (LTE-A, New Radio or 6G, or in fact any other transmission point) is equipped with multiple antenna board allowing for MIMO transmission utilizing e.g. active beamforming to the selected served end-users. However, the presence of the software controlled RIS board creates new opportunities. First, the signal devoted to the given user may be enhanced (boosted) by advanced (passive) beamforming done by the RIS elements. At the same time, the other user's reception quality may be improved by applying interference nulling or cancellation. In consequence, both users' performance will be improved through increase in signal-to-interference-plus-noise ratio (SINR).



Prof. Adrian Kliks
Project leader



As the large surfaces with meta-material antennas will impact the environment in the location where they are deployed (mounted or located), we believe that the application of rich context information (CI) describing the radio environment will provide a significant support to flexible configuration and management of the environment. Such an approach will address one of the key challenges related to the real implementation of RISes for improvement of signal propagation, mainly, how to guarantee reliable and accurate access in real-time to the control information for the transmitter, the receiver and all involved RISes.

The processing delay may be too high to allow for smooth functioning of RIS-enabled system, thus an instantaneous access to the rich context information may be one of the possible enablers. Moreover, the complexity of the system becomes huge due to processing of large amount of data, thus the application of artificial intelligence (AI) tools seems to be necessary to benefit from the presence of RISes in real deployments.

Conceptually, the main idea behind the research planned of the project is this task is illustrated in the figure, where one can observe two RISes equipped with dedicated RIS controllers. These controllers need to communicate with the legitimate base station (and potentially between themselves) to exchange the crucial steering information. Each RIS controller consists of the advanced intelligence engine (denoted in the figure as AI tools), which processes the available context information (e.g., the knowledge about the radio-shadowed areas in the RIS vicinity, the time-table of the busses to predict the time when the RIS board has to be reconfigured for serving bus passengers, etc.) as well as other repositories. For example, the RIS controller should be able to use previously computed RIS board setup for the certain situation in the network. When there is one user in the radio-shadowed location, then the saved setup number 1 could be used, whereas when there are two users—setup number 2 would fit better. Moreover, when two boards cooperate mutually, they may both select setup number N to simultaneously serve selected areas (and users located there).

Moreover, when focusing on the dark violet communication link, such a scheme illustrates on one hand side an approach for SINR improvement, described in the previous section, however, it is also the basis for utilizing holographic principles. The end user covered by the violet link should be able to observe holographic maxima and minima, so this approach to information transfer may create new paths for wireless communications.

"RISes have been extensively evaluated and tested in various frequency band, yet their practical deployment still requires significant investments and verification. Within the OPUS project, we are addressing the limitations of practical RIS deployment in real environments", says Professor Adrian Kliks, the leader of the research team.

News and recent achievements

16.04.2025

During the ceremonial Gala of the Ambassadors of Polish Congresses 2025, which took place on April 16th, 2025 in the unique space of the Tadeusz Sygietyński "Mazowsze" Matecznik in Karolin, 21 new Ambassadors were distinguished - leaders of the world of science and business, who contributed to the organization of prestigious international events in Poland. Among the distinguished was **Prof. Adrian Kliks**. This is a great honor for our university and an expression of appreciation for Prof. Adrian Kliks' activity in the area of international cooperation and the development of the meetings industry. Congratulations and we wish you further success!



20.03.2025

An invited guest speaker, **Dr Can Ding**, gave a talk entitled "Multifunctional Advanced Antenna Systems for Base Stations, UAVs, and CubeSats" at the Radiocommunications Institute seminar. This talk focused on mitigating various interference among antenna arrays by developing electromagnetically uncoupled antenna elements.

Dr Can Ding received a Bachelor degree in integrated circuit and integrated systems from Xidian University, Xi'an, China, in 2009, and a joint Ph.D. Degree from Xidian University and Macquarie University, Australia, in electromagnetic fields and microwave technology in 2016. He is currently a senior lecturer with the Faculty of Engineering and IT (FEIT) at the University of Technology Sydney (UTS).



14.02.2025

Prof. Hanna Bogucka was included in the list of "100 Brilliant and Inspiring Women in 6G™" 2025 published by Women in 6G™.

The 6G revolution is being driven by researchers, engineers, and industry leaders working on groundbreaking innovations—from AI-powered networks to next-generation multiple access schemes. This year, continuing its mission, on February 14, 2025, Women in 6G™ unveiled the 2025 list of 100 Inspiring Women in 6G. It recognizes 100 exceptional women who are making an extraordinary impact in this field, pushing the boundaries of wireless communications, and paving the way for a more connected, intelligent, and sustainable world.



29.11.2024

The Institute of Management and Information Systems at the Faculty of Management Engineering of the Poznan University of Technology and the Entrepreneurial Women's Club organized the 2nd Forum of Women in Science and Business combined with the 5th edition of the Women's Entrepreneurial Day. **Prof. Hanna Bogucka** led the first panel entitled "Challenges of new technologies - opportunities and threats."



13.09.2024

Prof. Eduard A. Jorswieck delivered a lecture on "Next Generation Multiple Access from Basic Principles to Modern Architectures" at the seminar of the Institute of Radiocommunications and the meeting of the Polish Chapter of IEEE Communications Society.

Eduard A. Jorswieck, IEEE Fellow, is a Full Professor with Technische Universität Braunschweig, Brunswick, Germany, and the Head of the Chair for Communications Systems. He is a world-class expert in communications, applied information theory, and signal processing for networks with more than 180 journal articles, 17 book chapters, one book, four monographs, and some 300 conference papers published.



21.06.2024

Marcin Hoffmann, M.Sc., received a scholarship from the Minister of Science and Higher Education for outstanding young scientists in 2024. This was the 19th edition of the competition. The scholarship applications were assessed by the Advisory Team (for the evaluation of applications) using the point-based method within individual disciplines of science and art. According to the Team's guidelines, in a given scientific discipline, awarding no more than 5 scholarships to young scientists, including no more than 1 scholarship to a doctoral student is recommended. In computer engineering and telecommunications, this one scholarship for a doctoral student was awarded to Marcin Hoffmann, M.Sc. Congratulations!



20.06.2024

During the 151st Session of the General Assembly of the Polish Academy of Sciences, elections to the Academy of Young Scientists (AMU) were held, to which a record number of 116 candidates were submitted. AMU is an elite group of 35 members (10% of the statutory number of national members of the Polish Academy of Sciences) elected for a five-year term of office from researchers holding a doctoral degree and not older than 38 at the time of election. In 2024, 17 young scientists will end their mission at AMU, and 16 new members have been elected to replace them, including **Paweł Kryszkiewicz, professor of PUT** and an employee of the Institute of Radiocommunications.

10.06.2024

During the 104th Session of the General Assembly of the Polish Academy of Sciences in Poznań, the results of the 12th edition of the competition for the best research paper published in 2023 with the PhD student as a leading author, were announced. A distinction in the field of technical sciences was awarded to **Małgorzata Wasilewska, M.Sc.**, for the paper by M. Wasilewska, H. Bogucka, H. V. Poor, entitled "Secure Federated Learning for Cognitive Radio Sensing," published in IEEE Communications Magazine, Vol. 61, no. 3, March 2023, pp. 68 - 73.

At the same session the members of the corporation elected new authorities of the Branch: the President - **prof. Jerzy Kaczorowski**, and the Vice-President of the Branch - **prof. Hanna Bogucka**. The term of office of the newly elected authorities will begin on October 1, 2024, and will last until the end of 2026.

16.11.2023

During the Institute of Radiocommunication seminar and the meeting of the Polish Chapter of IEEE Communications Society, Professor George Alexandropoulos from the National and Kapodistrian University of Athens in Greece gave a lecture on "Integrated Sensing and Communications with Full Duplex MIMO and Reconfigurable Metasurfaces".

Professor George Alexandropoulos is an IEEE Communications Society Distinguished Lecturer and the world expert in MIMO technique and Intelligent Reflecting Surfaces.



26.10.2023

During the Institute of Radiocommunication seminar and the meeting of the Polish Chapter of IEEE Communications Society, Professor Lajos Hanzo from the University of Southampton in Great Britain gave a lecture on "The Evolution Of Quantum Key Distribution Networks: On The Road To The Qinternet".

Lajos Hanzo FREng, FIEEE, FIET, EURASIP Fellow, received his 5-year Master's degree in electronics from the Technical University of Budapest in 1976, his doctorate in 1983, and his Doctor of Sciences (DSc) degree in 2004. During his career in telecommunications, he has held various research and academic posts in Hungary, Germany, and the UK. Since 1986 he has been with the School of ECS, University of Southampton, UK, where he holds the Chair in Telecommunications. He published 2000+ research contributions at IEEE Xplore.



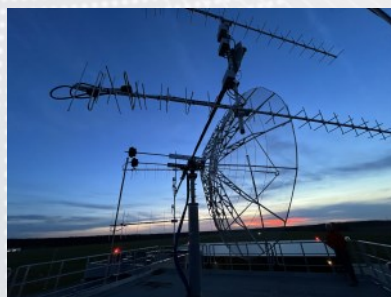
November 2023—April 2024



At the end of November, 2023, despite the unfavourable weather and with some delay, our first satellite antenna was finally installed in Kąkolewo campus. Engineers from ORBIT company, the antenna manufacturer, together with colleagues from TESPOL company, the system supplier, implemented this complicated operation smoothly and without any disturbances.

It took two days to assemble the radome and the antenna reflector on the ground, while on the third day the components were moved to the top of the tower using a crane and fastened safely. During day 4 the antenna system was calibrated and tested, and finally we were trained by the specialist from ORBIT in system maintenance.

The installation and testing of a secondary satellite antenna system took place in Kąkolewo campus at the beginning of April, 2024. Engineers from SpaceComm company, the main system supplier, installed the set of VHF/UHF YAGI antennas as well as C-band, 4.5m diameter parabolic antenna at the top of the tower. All antennas use a single rotator which enables tracking low earth orbit satellites fast and efficiently. The YAGI antennas may be remotely configured to operate in HOR/VERT/RHCP/LHCP modes, independently for transmission and reception of satellite signals. All RF and control cables were installed as well, together with transmitters and receivers (SDR based) and control equipment inside the technical container. The system was calibrated and some initial tests were performed successfully. In the next phase all systems will be integrated and connected to PUT network for remote operation from our control center, located in the Institute of Radiocommunications facilities.



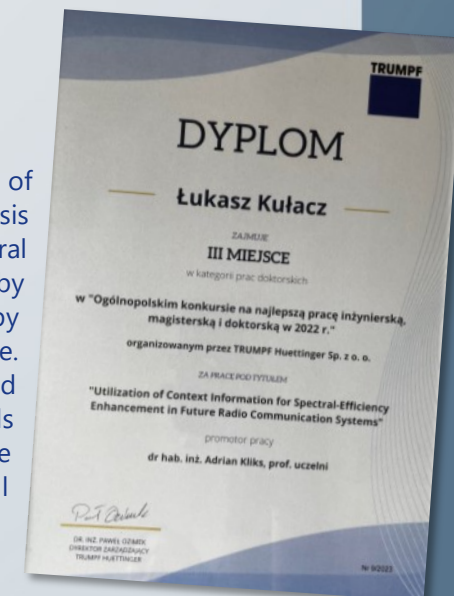
20.09.2023

The 21st edition of the national competition for the best doctoral thesis in the field of radiocommunication and multimedia techniques, organized by the Foundation for the Support of the Development of Radiocommunication and Multimedia Technologies, has ended. This year, the first prize went to **Dr. Bartosz Bossy** for the dissertation entitled "Energy-Efficient Resource Allocation in OFDM Systems with Computational Awareness." The supervisor of the thesis defended on June 27, 2022, was Prof. Hanna Bogucka. An honorable distinction in the competition also went to an employee of our Institute, **Dr. Łukasz Kułacz** for the dissertation entitled "Utilization of context information for spectral-efficiency enhancement in future radio communication systems". The supervisor of the thesis defended on December 13, 2022, was Prof. Adrian Kliks. The award ceremony took place on September 20, 2023, in Krakow, during the opening session of the Radiocommunications and Teleinformatics Conference, KRiT 2023.



20.09.2023

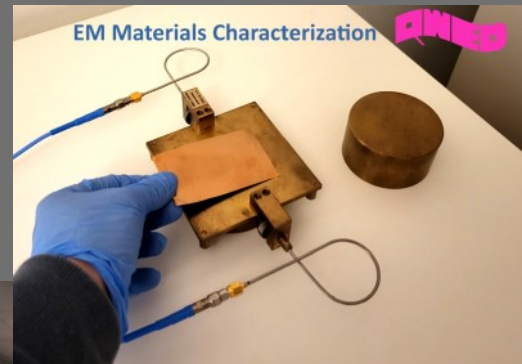
With great satisfaction, we noticed the announced results of the 1st edition of the "National competition for the best engineering, master's and doctoral thesis in 2022". Doctoral thesis entitled: "Utilization of Context Information for Spectral-Efficiency Enhancement in Future Radio Communication Systems", written by **Łukasz Kułacz** under the supervision of Prof. Adrian Kliks, was qualified by the Competition Jury to the group of the highest rated and took third place. 141 works were submitted to the competition, including 55 master's theses and 24 doctoral theses. By decision of the Competition Jury, three financial awards and two equivalent financial distinctions were awarded in each category of the competition. The awards ceremony took place on June 20, 2023 in the Small Hall of the Warsaw University of Technology.



SPEKTRUM — Students' Scientific Club

— news and achievements

On April 15, 2025, we represented our science club during the open house at the Poznań University of Technology. We had the opportunity to talk to many interested future students, whom we hope to see in our club's ranks soon..



On December 4, 2024, the Spectrum Student Research Group hosted specialists from QWED, Janusz Rudnicki and Łukasz Nowicki. QWED is a Polish company engaged in developing an electromagnetic simulator, conducting precise material measurements, and carrying out research and development in the field of computational electromagnetic modeling.

Students had the opportunity to learn about the Quick Wave electromagnetic simulator and a device for microwave measurement of materials' electromagnetic parameters. They were introduced to the process of designing microwave devices using the presented software. The team showcased microwave measurement devices for evaluating the electromagnetic properties of materials, including measurement resonators paired with dedicated software. Additionally, they highlighted the importance of discovering new materials that are lightweight, more durable, and possess suitable electromagnetic properties.



On October 2-3, 2024 members of the Spektrum Scientific Club traveled to the Karkonosze Mountains to visit a unique national broadcasting center. At an altitude of 1490 meters above sea level, overlooking the Śnieżne Kotły, lies the Radio and Television Broadcasting Center of the Emitel company. Once a mountain shelter, it is now a facility that utilizes the natural elevation of the terrain to provide residents of part of the Lower Silesian Voivodeship with access to radio and television. During the visit, the characteristics of the broadcasting equipment, the method of signal combining (including a star combiner), and antenna installations were presented. The microwave installations do not ice up because they are in a special room inside the building. Some microwave links transmit signals to seven fill-in stations.

Interesting facts were also revealed: This is the last Emitel broadcasting facility in Poland with a staffed operation; the rest are now unmanned. It is also the only facility powered by two countries: Poland and the Czech Republic. It takes two hours to reach the site in winter by snowmobile from Szklarska Poręba.



Spektrum Science Club had the pleasure of hosting representatives of the Wrocław branch of Nokia, Marcin Szczukiewicz and Piotr Wróbel.

At the open meeting, students had the opportunity to listen to a fascinating lecture about the project that Nokia is implementing together with NASA - namely, the construction of a 4G network on the moon. Participants of the lecture learned, among other things, what is the difference between designing a network that is to operate in space and one that is to operate in earthly conditions, as well as how many questions need to be asked and how many unexpected challenges designers face. After the lecture, the students had the opportunity to see the equipment that is to fly to the moon with their own eyes and ask about any issues they were interested in. The great punchline of this meeting was that dreams are there to be fulfilled, and the living proof of this was the story of our speaker Marcin Szczukiewicz, who has been interested in astronomy since childhood and now has the opportunity to participate in an international space project.





The project entitled "Analysis of the impact of electromagnetic waves on the human body: Design and research of phantoms for 5G and 6G technologies" has received funding from the Ministry of Science and Higher Education, as part of the Student Research Groups Create Innovations program!



The project goals are as follows:

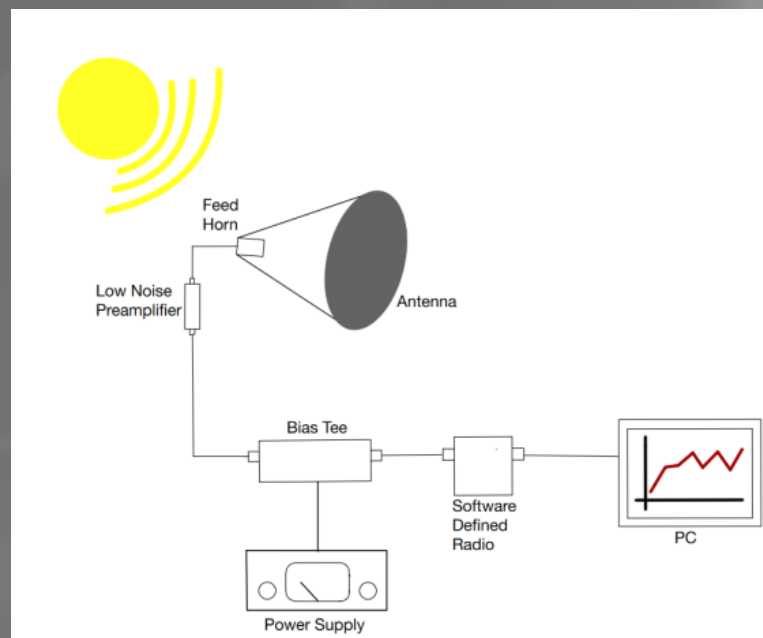
- develop phantoms reflecting electromagnetic parameters of the human body
- conduct electromagnetic simulations
- perform detailed measurements of the impact of electromagnetic waves on the heating of phantoms

The research results will allow for the verification of current standards regarding the radiation power density. In the future, they will also be the basis for the development of new standards for future 6G networks!



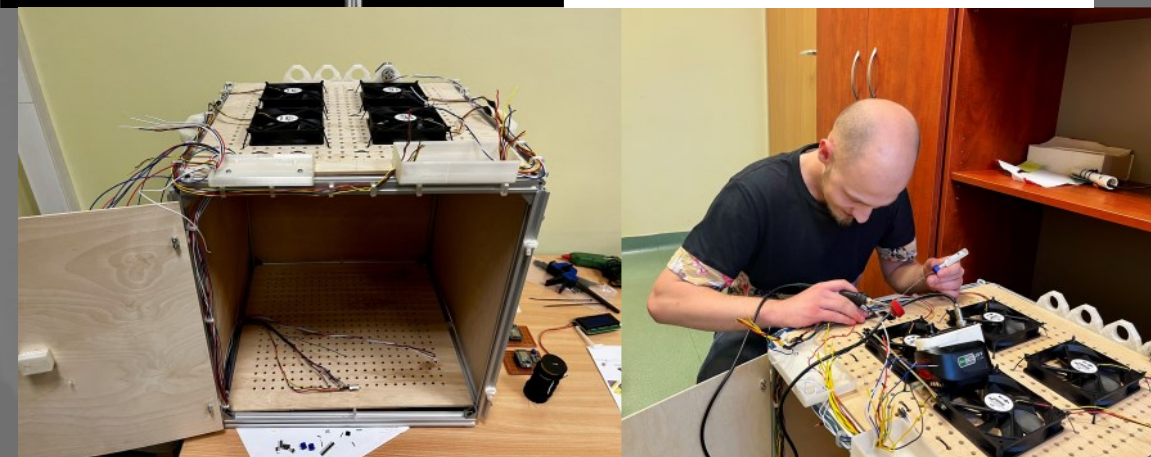
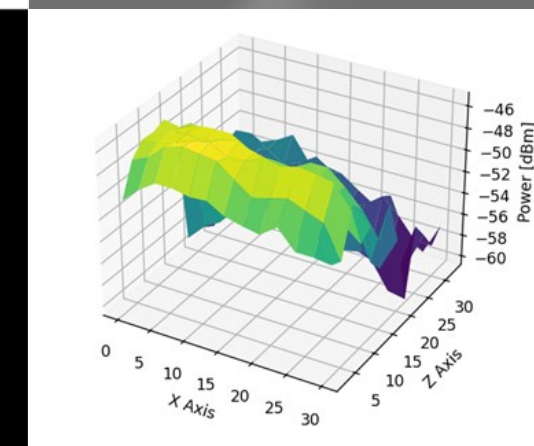
In March 2024, two projects proposed by Spektrum SSC, were accepted for further founding. The first one involves building a radio telescope and its necessary infrastructure, including a programmable component to acquire and analyze the received signal. It is aimed at observing the Sun by capturing electromagnetic waves to monitor solar activity. The signal acquired form antenna will be transmitted via a fiber optic cable to a software-defined radio receiver, offering flexible adjustments of radio frequency parameters. This system will utilize Python-developed software for signal analysis and data visualization. The project's potential expansions include increasing the observable spectrum, remote system control, and creating a neural network for detecting cosmic anomalies.

The second project "Spectrum Communications" is designed to enhance students' networking skills by setting up an autonomous system (AS) node for global internet traffic exchange within the Spektrum SSC. Students will access two independent traffic exchange nodes, facilitating advanced configuration testing and will gain practical experience in configuring real-world internet infrastructure components.



The Spektrum SSC is implementing the project entitled "Study of the influence of the electromagnetic field on plant development". The goal of the project is to build a set of stands enabling the subjecting of selected, small plants to the influence of a homogeneous electromagnetic field in the VHF and UHF frequency range.

Measurements in the TEM line have become a key element enabling the development of the project. The exemplary result of measurements for 150 MHz frequency is plotted in figure. This graphical representation makes it easier to understand the behavior of the TEM line during wave propagation, contributing to the greater utility and efficiency of further research.



Research thematic areas

Cellular networks

The Institute pursues research on contemporary and future radio access networks, in particular on the fourth-, fifth- and sixth-generation cellular systems (4G, 5G and 6G). It concerns new physical-, data-link control-, medium-access control-, and network-layer techniques for achieving key performance indicators (KPI) stated for 4G, 5G and 6G. New solutions, including non-orthogonal multiple access (NOMA) using diverse power allocation, and space-division multiple access (SDMA) using adaptive antennas, are investigated. Moreover, effective algorithms for radio-resource management in cells of various types, and for interference coordination in pico- and femto-cells are also the subjects of research.

An important direction of research is efficient duplex transmission in relay links, as well as flexible selection of relaying nodes for quality-of-service improvement in cellular networks. The investigated topic related to specific challenging applications is ultra-reliable low latency communication (URLLC), one of the main segments of 5G systems.



Satellite communications

The increasing popularity of nanosatellites, e.g. in Cubesat form factor, requires new types of radio links delivering high-throughput and high-reliability communications for downloading the data from satellite payload. Research in the area of satellite communications focuses on baseband/physical layer, as well as data-link-layer algorithms and protocols which can be used for the development of cheap communication modules implemented using the Software Defined Radio (SDR) technique. In particular, energy-efficient modulation types are investigated, having in mind the limited power available on-board the satellite. Due to the tight radio link budget, advanced synchronization and channel coding schemes are considered as well. Machine learning based algorithms for optimum transmission parameters selection is another field of interests. The selected solutions are implemented using the Software Defined Radio technique, based on off-the-shelf SDR platforms and general-purpose processors, as well as dedicated hardware including FPGA chips and integrated transceivers.



Cognitive radio systems

Research in the area of cognitive radio technologies includes theoretical studies and experimental trials on the acquisition of context information related to the radio environment, machine learning methods for the improvement of the quality of this information, as well as the principles of signal transmission in radio communication networks using it. In particular, the research focuses on autonomous and cooperative sensing and spectrum sharing policies based on either centralized or distributed coordination of dynamic spectrum access. Radio Environment Maps (REMs) are being investigated for their use in cognitive radio systems for the reduction of interference between systems utilizing a range of the radio frequency band. Moreover, physical-layer algorithms are being investigated that increase the spectral efficiency of systems with frequency-neighboring signal spectra.

V2X Communication Systems

Communication between vehicles and vehicles and infrastructure (V2X) which is one of the significant topics of 5G development, is a subject of investigations in the Institute. Part of the research was performed in the framework of cooperation with Nokia Solutions and Networks. The research team investigated traffic safety, meant as the minimization of vehicle collision probability, in the case of vehicle platoons (convoys) when a wireless communication system (e.g., IEEE 802.11p) is applied within a moving platoon. The team considered vehicle control algorithms ensuring reliability and string stability from the system theory point of view. The next research topic is lengthening the vehicle platoon by applying so-called virtual communication leaders. Subsequent research topics are related to radio resource management algorithms aiming at the minimization of packet collision probability by applying Mode 3 and 4 LTE system specialized in V2X communications. Recent investigations focus on databases and edge intelligence to support dynamic spectrum access for vehicle platooning.



Unmanned Aerial Vehicle Communications

Research related to communication with unmanned aerial vehicles (UAV) concentrate on air to ground radio channel modeling for both long-range (LOS/NLOS) and medium-range (LOS) UAV communication systems, physical layer solutions for control and telemetry radio links with high reliability and high-speed data links, as well as energy-efficient solutions for UAV communications. Original synchronization, modulation/demodulation and channel coding/decoding methods and algorithms are developed and investigated for the physical layer of UAV communication systems. The selected solutions are implemented using the Software Defined Radio (SDR) technique.



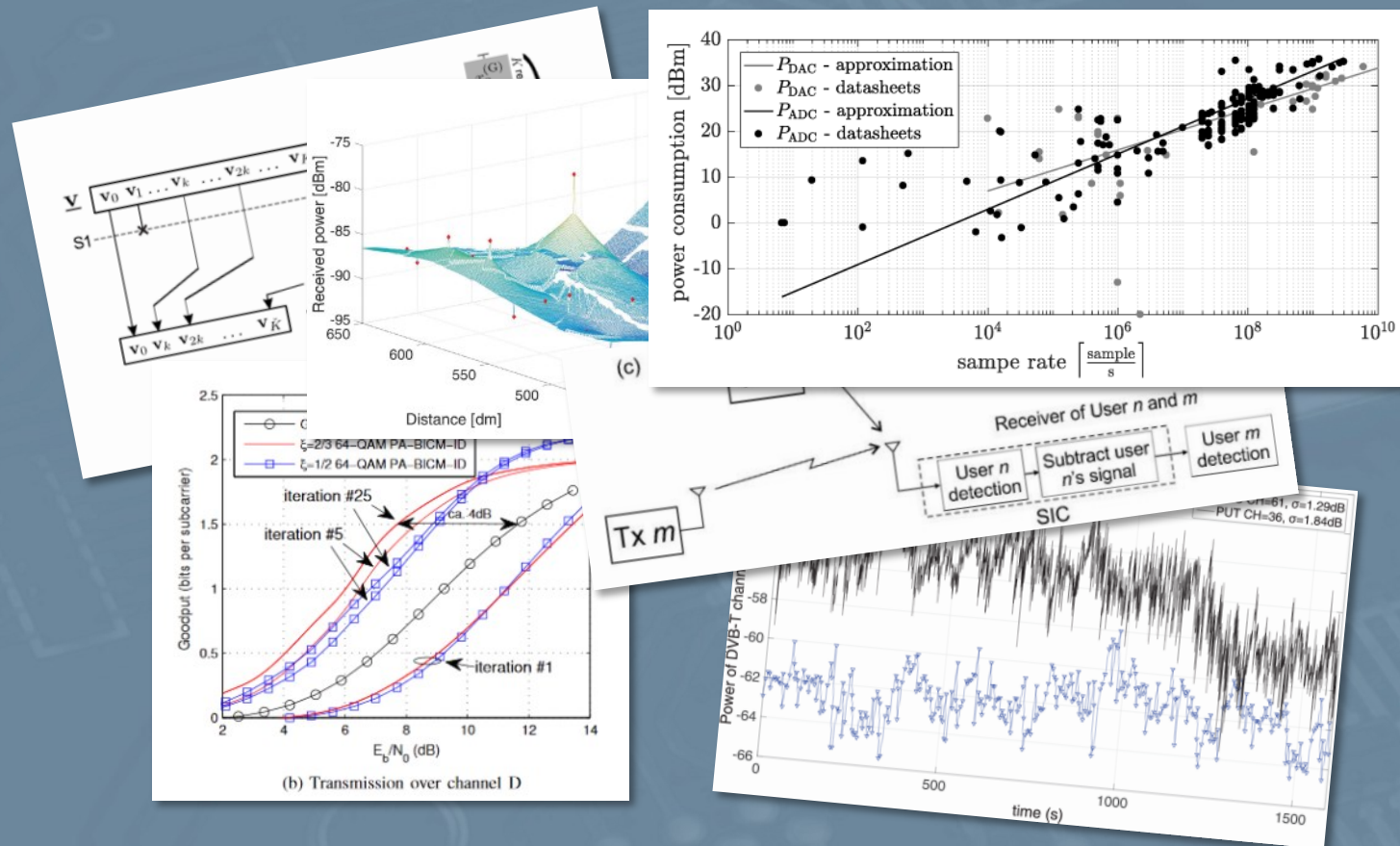
Green communications

An important area of research in the Institute are the so-called green communications, which encompass techniques aiming at high energy efficiency in the next-generation communication and computing networks. These techniques are designed to minimize the energy per successfully transmitted and processed information unit (bit), whereas all network segments are analyzed, *i.e.*, end-user equipment, wireless part (radio access network), wireline part (core network, Internet, long-distance optical links) and data centers implementing computational tasks. Optimization of these separate segments is considered, as well as joint optimization of the tasks transmission, offloading and computing in the network of various configurations based on edge-, cloud- and fog computing. Moreover, brain-inspired energy-efficient communication networking is a key topic of research in the Institute.



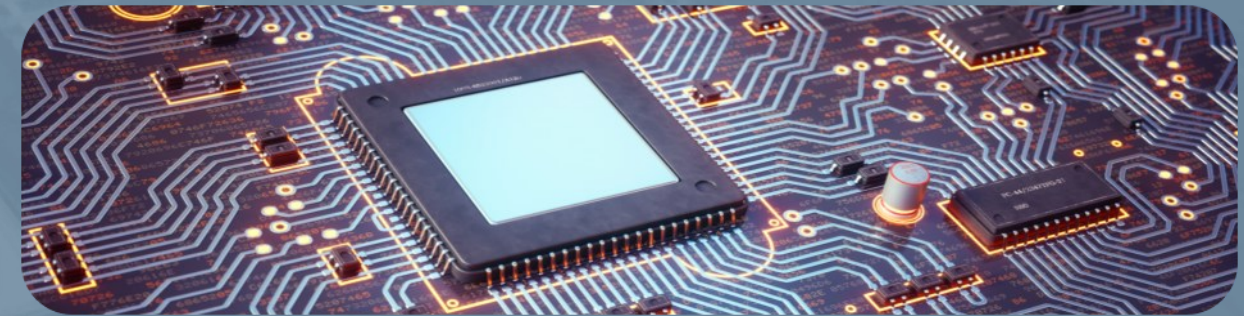
Physical-Layer Algorithms

The Institute pursues research on physical layer algorithms in modern mobile radiocommunication systems. They are connected with multitone modulation using orthogonal (OFDM) and non-orthogonal subcarriers (FBMC) and non-contiguous, fragmented spectrum bands. Research work is directed towards the minimization of the out-of-band emission, reduction of non-linear distortions, reliable reception of signals and synchronization algorithms. Another field of studies encompasses channel coding using various types of error correction codes, namely, convolutional codes, turbo codes, selected types of LDPC codes and polar codes with several decoding algorithms. Moreover, bit-interleaved coded modulation with iterative decoding is investigated. Applications and improvements of transmission and reception diversity techniques are also being explored, in particular Multiple-Input, Multiple-Output (MIMO) and massive MIMO (M-MIMO) technologies, and beamforming algorithms in antenna matrices.



VLSI Testing

Beginning with the introduction of commercial manufacturing of integrated circuits, electronic testing has a history of almost 60 years, and its importance cannot be overestimated. The unprecedented proliferation of digital devices in telematics, medicine, defense systems, or transportation, clearly underlines the extreme significance of their test quality. Failure to find defective circuits that constitute the heart of many life-critical or mission-critical mechanisms may lead to severe consequences. The goal of our group is to create new methods to allow the development of computer-aided tools supporting automated test generation, test data compression, built-in self-test, and design for testability. The corresponding research results are presented in prestigious publications and numerous US patents. Furthermore, several solutions have been commercialized, primarily by our industrial partner Mentor, A Siemens Business, with the introduction of award-winning VLSI test technologies, often the first solutions of this kind on the market.



Cybersecurity of radio networks

Research in cybersecurity focuses on methods of detection and mitigation of attacks launched via the radio interface and new methods of data encryption, authentication, and security monitoring. Algorithms for detecting anomalies in radiocommunication traffic are being developed using artificial intelligence (AI) methods, particularly machine learning (ML), and strategies for eliminating their effects. Methods are also being developed to detect and counteract attacks on the AI algorithms used in radio networks. The research also includes lightweight encryption and authentication algorithms characterized by low complexity and low energy consumption.



Laboratories and infrastructure

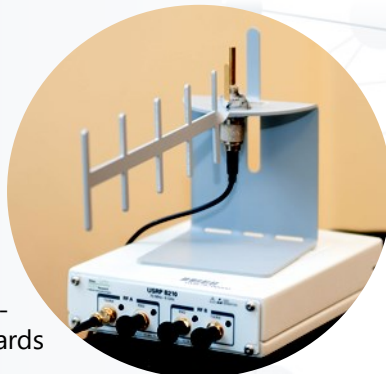
Advanced Wireless Communications Research Laboratory

In this laboratory, ambitious and exciting research projects in the field of wireless communications are realized. They include advanced MIMO technologies, communications with Unmanned Aerial Vehicles (UAVs) and practical implementation of software-defined platforms. There are evaluation boards PicoZed SDR (ADRV9361), Xilinx ZC702/706 modules with AD9361 transceivers, six MIMO transceivers supported by FPGA platforms. There are also six computationally powerful PCs, with specialist software tools, such as MATLAB/Simulink by Mathworks, FPGA Vivado by Xilinx, as well as software delivered by Mentor Graphics for the simulation and verification of FPGAs.



Mobile Radiocommunications and Cognitive Radio Laboratory

This laboratory is of mixed nature: both didactic and research. It involves practical exercises in various fields, such as: basic features of wireless signal propagation, cellular networks of all generations (2G-6G), radio measurements, software-defined and cognitive radio, as well as cellular network design. The laboratory is also equipped with highly advanced measurement devices, such as, signal generators (Rohde&Schwarz, Tektronix, Philips), spectrum and signal analyzers (Rohde&Schwarz, Agilent, Anritsu), radiocommunication testers (Rohde&Schwarz), digital oscilloscopes (Agilent, Tektronix). There are also software defined radio modules, mainly USRP N200, N210, USRP 1, and USRP B210, as well as evaluation boards with digital signal processors by Texas Instruments.



Wireless Local and Personal Area Network Laboratory

In this laboratory, ambitious and exciting research projects in the field of wireless communications are realized. They include advanced MIMO technologies, communications with Unmanned Aerial Vehicles (UAVs) and practical implementation of software-defined platforms. There are 12 work stations in the lab. Various WLAN devices are used, mainly, access points, access routers, bridges, controllers, and network adapters. Besides wireless devices, numerous elements of the structural networks are also used. Moreover, the lab is featured with a specialist spectrum analyzer, as well as advanced software tools designed for the analysis of traffic inside WLANs.



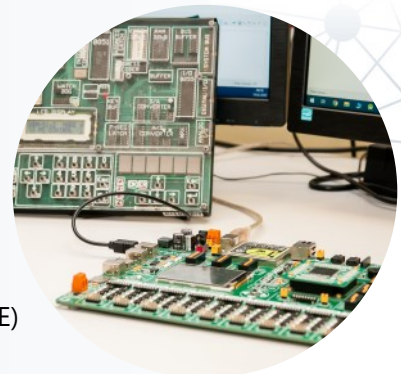
Mobile Terminal Programming Laboratory

Programming skills and well-established knowledge on testing of mobile applications (i.e., apps devoted for smartphones, smartwatches, tablets, etc.) are among the most desired abilities of prospective ICT workers. The lab on programming mobile terminals is prepared to instruct students on two most popular operating systems – Android and iOS. It is featured with 16 PCs with MS Windows 10, mostly with two screens, beamer with wireless connection, as well as 7 Apple MiniMacs with the newest operating system and XCode environment.



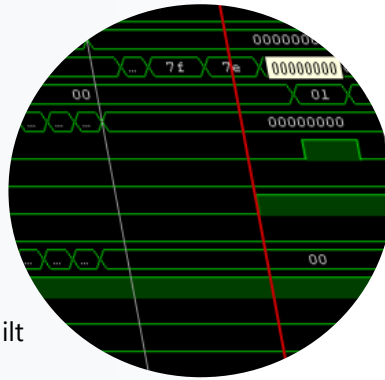
Microprocessor Programming Laboratory

A well-equipped laboratory introduces the fundamentals of creating and testing software for microcontrollers of different kinds. There are 16 separate workplaces featured with PCs operated by MS Windows 10 (in most cases, equipped with two screens), and two development kits: one devoted to the 8051 microprocessor, and one to the TI ARM Cortex M4. In particular, there are 16 boards called Didactic Microprocessor Kits DSM-51, and 16 boards „EasyMxPRO™v7 for STELLARIS® ARM®“ with the M4C123GH6PGE microcontroller. For programming, dedicated Integrated Development Environment (IDE) is used, called Code Composer Studio.



Digital Circuits & VLSI Testing Laboratories

The digital circuits laboratory is a computer-based lab, featured with software useful to design, analyse and simulate the performance of digital circuits, of either combinational or sequential type. The VLSI test laboratory was founded based on industrial grade design automation tools provided by Mentor, a Siemens Business. This software comprises several best-in-class EDA solutions, used to generate, simulate, and apply production test patterns for digital circuits and systems. During classes, students learn how to automate the process of test generation, fault simulation, test point insertion, and fault diagnosis. Furthermore, they are taught basics of modern HDL design for testability (using Verilog), test compression, and built-in self-test.



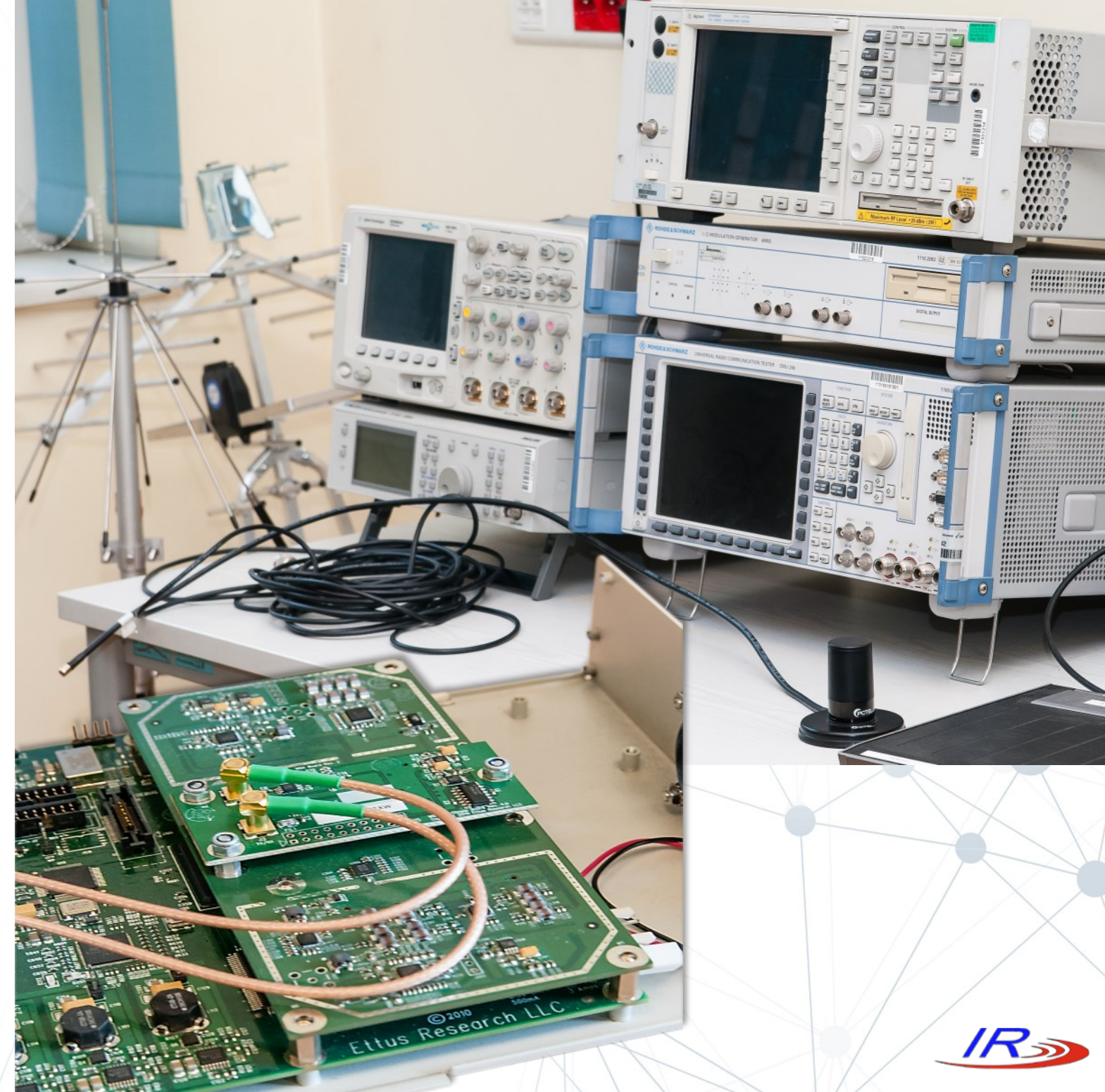
Software Engineering Laboratory

The software engineering laboratory is a comprehensive learning center, providing students with the opportunity to learn key skills in programming, algorithm design, and working with web technologies and ICT networks. It includes an air-conditioned room equipped with 18 PCs connected to the Internet, allowing hands-on learning in a comfortable environment. Each of the 18 PCs is installed with the MS Windows 10 and Linux Ubuntu operating systems, allowing students to choose the platform that suits their preferences or the requirements of the task at hand.



High-performance computer cluster

The computer cluster consists of 39 AMD processors with clock rate ranging from 3.0 to 4.0 GHz, total core number is equal to 316 and total RAM installed exceeds 400 GB. Such a configuration allows for independent usage of the each of available cores. The computing cluster itself is operated by Linux-based CentOS, whereas the management of cluster cores and processes is performed by means of Perceus and SLURM software, respectively. Sequential and parallel computations are allowed. Such flexibility allows for efficient cluster use in various research and teaching tasks in the field of wireless communications.





Teaching offer

The teaching offer of the Institute of Radiocommunications includes courses (lectures, classes, laboratory classes, projects and seminars) in wireless communications on three levels: elementary, advanced and expert. Theoretical knowledge on radio communication technologies and wireless networks is supplemented with practical experience obtained during laboratory and project tasks.

The B.Sc. and M.Sc. programs in Electronics and Telecommunications are offered both in Polish and English (specialization in Information and Communication Technologies), while programs in Teleinformatics, Cybersecurity, and in Microelectronics and Digital Communications (just the B.Sc. program) are currently offered only in Polish. Please, refer to our website for detailed programs and offered courses.

In the first-cycle (BSc Eng.) studies, our students have the opportunity to become familiar with the fundamentals of digital transmission systems, radiocommunications, cell networks (2G-5G), WLANs (in the IEEE 802.11 standard – WiFi) and WPANs (in the Bluetooth standard). Moreover, they obtain practical knowledge on high-level language programming and developing applications for mobile devices (e.g. smartphones, tablets) with Android and iOS. In second-cycle (MSc) studies, students learn about advanced mobile and satellite communication systems, sensor networks, solutions for the Internet-of-Things, programmable and cognitive radio technologies, advanced coding techniques, principles of cell network design, space communications and vehicle-to-vehicle communication systems (also between autonomous vehicles). Students have many opportunities to team up and participate in research and development projects dealing with modern mobile radio technologies.

Projects (2020–2025)

International projects

- **PASSIONATE** (<https://passionate.webs.tsc.uc3m.es>) – Physics-based wireless AI providing scalability and efficiency” – international project no. CHIST-ERA-22-WAI-04 within the CHIST-ERA program, funded by National Science Centre based on agreement no. 2023/05/Y/ST7/00002 (2023–2026)
- **COST CA20120** (<https://interactca20120.org>) – Intelligence-Enabling Radio Communications for Seamless Inclusive Interactions (INTERACT), EU Horizon 2020 Programme project (COST action) (2021–2025)
- **FAUST** – Fog Communication, Computing And Control for SUsustainable Future of ICT, project no. PL-TW/V/3/2018 for Polish-Taiwanese joint research funded by National Centre for Research and Development (2018–2021)
- **CERTAIN** – Cognitive Engine for Radio environmentT Awareness In Networks of the future, DAINA (DAINA 1) project no. 2017/27/L/ST7/03166 for Polish-Lithuanian research cooperation funded by National Science Centre (2018–2021)



National projects

- *Security of radio-physics-based federated learning in next-generation edge computing systems*, PRELUDIUM (PRELUDIUM 23) project no. 2024/53/N/ST7/02426, funded by National Science Centre (2025–2028)
- *Utilization of the Machine Learning and Radio Environment Maps for Management of User-Centric Massive MIMO Network*, PRELUDIUM (PRELUDIUM 21) project no. 2022/45/N/ST7/01930, funded by National Science Centre (2023–2026)
- *Context-information aware usage of intelligent antenna matrices and holography for wireless signal transmissions*, OPUS (OPUS 22) project no. 2021/43/B/ST7/01365 funded by National Science Centre (2022–2026)
- *Cross-layer design of ultra spectrally- and energy-efficient 6G system aware of radio front-end nonlinearity*, OPUS (OPUS 21) project no 2021/41/B/ST7/00136 funded by National Science Centre (2022–2025)
- *Fresh and Green Cellular IoT Edge Computing Networks* PRELUDIUM (PRELUDIUM 20) project no. 2021/41/N/ST7/03941, funded by National Science Centre (2022–2024)
- *Radio spectrum occupancy detection using federated machine learning*, PRELUDIUM (PRELUDIUM 20) project no. 2021/41/N/ST7/01298 funded by National Science Centre (2022–2023).
- *Advanced methods and techniques for identification and counteracting cyber attacks on 5G access network and applications* (5gSTAR), project no. CYBERSECIDENT/487845/IV/NCBR/2021 funded within the 4th CyberSecident programme - Cybersecurity and e-Identity by National Centre for Research and Development (2021–2024)
- *Universal nanosatellite platform for research, experimental and commercial type hosted payload missions*, POIR.01.01.01-00-1211/19 project funded by National Centre for Research and Development (2020–2023)
- *Utilization of rich context information for wireless communications in vehicle platooning*, OPUS (OPUS 15) project no. 2018/29/B/ST7/01241 funded by National Science Centre (2019–2022)
- *Brain-Inspired Massive Radio Communication Networks – BioNets*, OPUS (OPUS 12) project no. 2016/23/B/ST7/03937 funded by National Science Centre (2017–2020)

Industry-funded research

The Institute's researchers cooperate with national and international companies, implementing projects and research framework agreements with Siemens (formerly Mentor, A Siemens Business and Mentor Graphics Corporation) in Wilsonville, OR, USA, Nokia Wrocław R&D in Poland, Huawei Technologies Sweden AB, Fairspectrum in Helsinki, Finland, Military Aviation Plant no. 2 in Bydgoszcz, Poland, and others.

Dissertations (2022–2025)

Doctoral dissertations

Bartosz Kopras

Optimization of Energy Efficiency in Fog Computing with Latency Constraints (2025)

Promoter: Hanna Bogucka, auxiliary promoter: Filip Idzikowski

Karolina Lenarska

New Two-Way Relaying Transmission Schemes for 5G Wireless Communication Systems (2024)

Promoter: Krzysztof Wesołowski

Bartosz Włodarczak

On Secure Deterministic In-System Test Solutions (2024)

Promoters: Jerzy Tyszer, Janusz Rajski

Saif Sabeeh

Radio resource management for C-V2X communication systems (2023)

Promoter: Krzysztof Wesołowski, co-promoter: Paweł Sroka

Mohammed Jasim Obaid Khafaji

The Use of Evolutionary Algorithms in the Next-Generation Wireless Systems (2023)

Promoter: Maciej Krasicki

Łukasz Kułacz

Utilization of Context Information for Spectral-Efficiency Enhancement in Future Radio Communication systems (2022)

Promoter: Adrian Kliks

Bartosz Bossy

Energy-Efficient Resource Allocation in OFDM Systems With Computational Awareness (2022)

Promoter: Hanna Bogucka, co-promoter: Paweł Kryszkiewicz

Sylwester Milewski

Hypercompression of test data (2022)

Promoter: Jerzy Tyszer

Habilitation dissertation

Paweł Kryszkiewicz

New Methods of Increasing the Spectral and Energy Efficiency of Wireless Systems

Doctor Habilitus in Engineering and Technical Sciences,

Discipline: Technical Computer Science and Telecommunications (2022)



Conferences & events (2023–2025)

EuCNC & 6G Summit Poznan, June 3-6, 2025

The EuCNC & 6G Summit 2025 will be held at the Poznań International Fair. It is based on the merger of two successful conferences in the field of telecommunications: EuCNC (European Conference on Networks and Communications), supported by the European Commission, and 6G Summit, which was created as part of the 6G Flagship program in Finland, one of the first in this field. The conference is sponsored by the IEEE Communications Society (ComSoc), the European Association for Signal Processing (EURASIP) and the European Association on Antennas and Propagation (EurAAP) and focuses on all aspects of telecommunications, from the implementation of 5G and the mobile Internet of Things to the exploration of 6G and future communication systems and networks, including experiments and testbeds, and applications and services. It brings together cutting-edge research and world-renowned industries and companies, attracting in recent years over 1,000 delegates from over 40 countries worldwide to present and discuss the latest results, as well as an exhibition with over 50 exhibitors to demonstrate the technology developed in this area, namely within the framework of research projects from the EU R&I programmes.

We cordially invite you to Poznan!



The National Conference on Radio-communications and Teleinformatics Poznan, Sept. 11-13, 2024

The National Conference on Radiocommunications and Teleinformatics (KRiT 2024), the main Polish conference in the above-mentioned fields, was held on September 11-13, 2024 at the Poznan University of Technology. The organizers of the conference were the Institute of Radiocommunications and the Institute of Teleinformatic Networks of the Poznan University of Technology and the Association of Telecommunications Engineers (SIT).



The conference is the successor to two well-known annual events having a long tradition: the National Symposium on Telecommunications and Teleinformatics (KSTiT) and the National Conference on Radiocommunication, Radio Broadcasting and Television (KKRRiT). The Radiocommunication and Teleinformatics Conference, following the example of its predecessors, as well as KRiT 2023, which took place in Krakow in September 2023, creates excellent conditions for establishing new contacts between representatives of the world of science and business, because its participants are industry entrepreneurs, research workers of universities and research institutes, as well as PhD students and students.

COST INTERACT 6th Technical Meeting

Poznan, September 12-14, 2023



On September 12-14, 2023, the 6th technical meeting of the COST CA20120 INTERACT was held at the Poznań University of Technology, organized by the Institute of Radiocommunications PUT. During the event, meetings of working groups were held, the considerations of which concerned "Intelligence-Enabling Radio Communications for Seamless Inclusive Interactions". During three days, 3 plenary lectures and 38 technical papers were delivered, prepared by scientists from all over Europe.

WIRELESS WORLD RESEARCH FORUM

Poznan, March 28-30, 2023



On March 28-30, 2023, the Institute of Radiocommunications hosted the 49th meeting of Wireless World Research Forum under the theme "Towards sustainable and automated communications". WWRF is a unique forum which brings together the wireless community to tackle key research challenges.



Selected publications (2021–2025)

Journal papers

- Zhiyi Tian, Chenhan Zhang, Weiqi Wang, H. Bogucka, Shui Yu, ROSE: A Receiver-Oriented Semantic Communication Framework", *IEEE Network*, 2025, vol. 39, no. 2, pp. 216-223
- J. Rajski, M. Trawka, J. Tyszer, B. Włodarczak, "A Nonlinear Stream Cipher for Encryption of Test Patterns in Streaming Scan Networks", *IEEE Transactions on Circuits and Systems I—Regular Papers*, 2025, vol. 72, no. 2, pp. 535-547
- S. Sabeeh, K. Wesołowski, "On Adaptation of Resources in New Radio Vehicle-to-Everything Mode 1 Dynamic Resource Allocation", *Electronics*, 2025, vol. 14, no. 1
- M. Wasilewska, H. Bogucka, "Protection Against Poisoning Attacks on Federated Learning-based Spectrum Sensing", *IEEE Journal on Selected Areas in Communications*, 2025, in press
- K. Lenarska, K. Wesołowski, "Antijamming Schemes for the Generalized MIMO Y Channel", *Sensors*, 2024, vol. 24, no. 10
- M. Hoffmann, M. Dryjański, "Energy Efficiency in Open RAN: RF Channel Reconfiguration Use Case", *IEEE Access*, 2024, vol. 12, pp. 118493-118501
- M. M. H. Alkalsh, A. Kliks, "Enhancing Wireless Network Efficiency with the Techniques of Dynamic Distributed Load Balancing: A Distance-Based Approach", *Sensors*, 2025, vol. 24, no. 16
- M. Krasicki, „Labeling-Based Recipient Identification with Low-Order Modulation", *Electronics*, 2024, vol. 13, no. 2
- M. Hoffmann, S. Janji, A. Samorzewski, Ł. Kułacz , C. Adamczyk, M. Dryjański, P. Kryszkiewicz, A. Kliks , H. Bogucka, „Open RAN xApps Design and Evaluation: Lessons Learnt and Identified Challenges", *IEEE Journal on Selected Areas in Communications*, 2024, vol. 42, no. 2, pp. 473-486
- P. Sroka, Ł. Kułacz, S. Janji, M. Dryjański, A. Kliks, Policy-Based Traffic Steering and Load Balancing in O-RAN-Based Vehicle-to-Network Communications", *IEEE Transactions on Vehicular Technology*, 2024, vol. 73, no. 7, pp. 9356-9369
- K. Cichoń, M. Nikiforuk, A. Kliks, "Vegetation Loss Measurements for Single Alley Trees in Millimeter-Wave Bands", *Sensors*, 2024, vol. 24, no. 10
- C. Adamczyk, A. Kliks, „Conflict Mitigation Framework and Conflict Detection in O-RAN Near-RT RIC", *IEEE Communications Magazine*, 2023, vol. 61, no. 12, pp. 199-205
- H. Bogucka, B. Kopras, F. Idzikowski, B. Bossy, P. Kryszkiewicz, „Green Time-Critical Fog Communication and Computing", *IEEE Communications Magazine*, 2023, vol. 61, no. 12, pp. 40-45
- M. Wasilewska, H. Bogucka, H. V. Poor, „Secure Federated Learning for Cognitive Radio Sensing", *IEEE Communications Magazine*, 2023, vol. 61, no. 3, pp. 68-73
- H. Bogucka, B. Kopras, „Uberization of telecom networks for cost-efficient communication and computing", *IEEE Communications Magazine*, 2023, vol. 61, no. 7, pp. 74-80
- R. Krenz, P. Sroka, M. Sybis, I. Zainutdinov, K. Wesołowski, „A Low-Cost High-Throughput C-Band Communication System for CubeSats", *Electronics*, 2023, vol. 12, no. 20
- M. Wachowiak, P. Kryszkiewicz, „Clipping noise cancellation receiver for the downlink of massive MIMO OFDM system", *IEEE Transactions on Communications*, 2023, vol. 71, no. 10, pp. 6061-6073
- K. S. Gill, P. Kryszkiewicz, P. Sroka, A. Kliks, A. M. Wyglinski, „Memory Enabled Bumblebee-based Dynamic Spectrum Access for Platooning Environments", *IEEE Transactions on Vehicular Technology*, 2023, vol. 72, no. 5, pp. 5612-5627
- P. Kryszkiewicz, P. Sroka, M. Sybis, A. Kliks, „Path Loss and Shadowing Modeling for Vehicle-to-Vehicle Communications in Terrestrial TV Band". *IEEE Transactions on Antennas and Propagation*, 2023, vol. 71, no. 1, pp. 984-998
- J. Rajski, M. Trawka, J. Tyszer, B. Włodarczak, „A Lightweight True Random Number Generator for Root of Trust Applications", *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, 2023, vol. 42, no. 9, pp. 2815-2825



- S. Eggersglüß, S. Milewski, J. Rajski, J. Tyszer, „A new static compaction of deterministic test sets", *IEEE Transactions on Very Large Scale Integration (VLSI) Systems*, 2023, vol. 31, no. 4, pp. 411-420
- M. Krasicki, „BICM-ID Labeling-Based Recipient Identification in a Heterogeneous Network", *Sensors*, 2023, vol. 23, no. 7, pp. 3605-1-3605-11
- S. Sabeeh, K. Wesołowski, „Congestion Control in Autonomous Resource Selection of Cellular-V2X", *IEEE Access*, 2023, vol. 11, pp. 7450-7460
- B. Kopras, B. Bossy, F. Idzikowski, P. Kryszkiewicz, H. Bogucka, "Task Allocation for Energy Optimization in Fog Computing Networks with Latency Constraints", *IEEE Transactions on Communications*, 2022, vol. 70, no. 12, pp. 8229-8243
- S. Janji, A. Samorzewski, M. Wasilewska, A. Kliks, "On the Placement and Sustainability of Drone FSO Backhaul Relays", *IEEE Wireless Communications Letters*, Aug. 2022, vol. 11, no. 8, pp. 1723-1727
- B. Kaczmarek, G. Mrugalski, N. Mukherjee, A. Pogiel, J. Rajski, Ł. Rybak, J. Tyszer, "LBIST for Automotive ICs with Enhanced Test Generation", *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, July 2022, vol. 41, no. 7, pp. 2290-2300
- P. Kryszkiewicz, C. Canfield, S. Bhada, A. M. Wyglinski, "A Systems Approach for Solving Inter-Policy Gaps in Dynamic Spectrum Access-Based Wireless Rural Broadband Networks", *IEEE Access*, March 2022, vol. 10, pp. 25165-25174
- B. Bossy, P. Kryszkiewicz, H. Bogucka, "Energy-Efficient OFDM Radio Resource Allocation Optimization With Computational Awareness: A Survey", *IEEE Access*, Sept. 2022, vol. 10, pp. 94100-94132
- E. Peltonen, et. al. (incl. P. Sroka), "The Many Faces of Edge Intelligence", *IEEE Access*, Sept. 2022, vol. 10, pp. 104769-104782
- J. Mongay Batalla, M. Mohsin, C. X. Mavromoustakis, K. Wesołowski, G. Mastorakis, K. Krzykowska-Piotrowska, "On Deploying the Internet of Energy with 5G Open RAN Technology Including Beamforming Mechanism", *Energies*, 2022, vol. 15, no. 7, pp. 2429-1 - 2429-19
- P. Sroka, E. Ström, T. Svensson, A. Kliks, "Autonomous Controller-Aware Scheduling of Intra-Platoon V2V Communications", *Sensors*, 2023, vol. 23, no. 1, pp. 60-1-60-21
- S. Sabeeh, K. Wesołowski, P. Sroka, "C-V2X Centralized Resource Allocation with Spectrum Re-Partitioning in Highway Scenario", *Electronics*, 2022, vol. 11, no. 2, pp. 279-1-279-20
- Ł. Kułacz, A. Kliks, "Dynamic Spectrum Allocation Using Multi-Source Context Information in OpenRAN Networks", *Sensors*, 2022, vol. 22, no. 9, pp. 3515-1-3515-11
- M. Wasilewska, H. Bogucka, A. Kliks, "Federated Learning for 5G Radio Spectrum Sensing", *Sensors*, 2022, vol. 22, no. 1, pp. 1-15
- M. J. Khafaji, M. Krasicki, "Uni-Cycle Genetic Algorithm as an Adaptation Engine for Wireless Channel Equalizers", *Electronics*, 2022, vol. 11, no. 2, pp. 171-1-171-11
- A. Chaoub, M. Giordani, B. Lall, V. Bhatia, A. Kliks, L. Mendes, K. Rabie, H. Saarnisaari, A. Singhal, N. Zhang, S. Dixit, M. Zorzi, "6G for Bridging the Digital Divide: Wireless Connectivity to Remote Areas", *IEEE Wireless Communications*, Feb. 2022, vol. 29, no. 1, pp. 160-168
- M. Hoffmann, P. Kryszkiewicz, A. Kliks, "Frequency Selection for Platoon Communications in Secondary Spectrum Using Radio Environment Maps", *IEEE Transactions on Intelligent Transportation Systems*, March 2022, vol. 23, no. 3, pp. 2637-2650
- M. Wasilewska, A. Kliks, H. Bogucka, K. Cichoń, J. Ruseckas, G. Molis, A. Mackutė-Varoneckienė, T. Krilavičius, "Artificial Intelligence for Radio Communication Context-Awareness", *IEEE Access*, 2021, vol. 9, pp. 144820-144856
- M. Hoffmann, P. Kryszkiewicz, "Reinforcement Learning for Energy-Efficient 5G Massive MIMO: Intelligent Antenna Switching", *IEEE Access*, 2021, vol. 9, pp. 130329-130339
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- M. Hoffmann, P. Kryszkiewicz, A. Kliks, "Increasing Energy Efficiency of Massive-MIMO Network via Base Stations switching using Reinforcement Learning and Radio Environment Map", *Computer Communications*, 2021, vol. 169, pp. 232-242
- H. Salim Ghazi, K. Wesołowski, "Application of an Interference Cancellation Detector in a Two-Way Relaying System with Physical Network Coding", *Electronics*, 2021, vol. 10, no. 11, s. 1294-1-1294-17
- N. Mukherjee, D. Tille, M. Sapati, Y. Liu, J. Mayer, S. Milewski, E. Moghaddam, J. Rajski, J. Solecki, J. Tyszer, "Time and Area Optimized Testing of Automotive ICs", *IEEE Transactions on Very Large Scale Integration (VLSI) Systems*, 2021, vol. 29, no. 1, s. 76-88
- Ł. Kułacz, A. Kliks, "Brain-Inspired Data Transmission in Dense Wireless Network", *Sensors*, No. 21(2), 576, pp. 1-20
- Ł. Kułacz, A. Kliks, P. Kryszkiewicz, B. Bossy, „Dynamic Transmit Profile Selection in Dense Wireless Networks, *Sensors*, 2021, vol. 21, no. 1, pp. 134(1) – 134(14)

Papers in conference proceedings

- S. Janji, P. Sroka, A. Kliks, "Enhancing V2X Communications with UAV-mounted Reconfigurable Intelligent Surfaces", IEEE International Conference on Pervasive Computing and Communications, PerCom 2024 Workshops and Affiliated Events, March 11-15, 2024, Biarritz, France
- M. Hoffmann, P. Kryszkiewicz, "O-RAN for Energy-Efficient Serving Cluster Formulation in User-Centric Cell-Free MMIMO", INFOCOM 2024 - IEEE Conference on Computer Communications Workshops, May 20-23, 2024, Vancouver, Canada
- K. Cichoń, Z. Buksch, Bartosz Gregorczyk, "Adaptive Indoor Positioning System Based on Fingerprinting Principle", 2024 20th IEEE International Conference on Wireless and Mobile Computing, Networking and Communications, Oct. 21-23, 2024, Paris
- D. Trock, S. Mahadevan, N. Mukherjee, L. Harrison, J. Rajski, J. Tyszer, "Deterministic In-Fleet Scan Test for a Cloud Computing Platform", 2024 IEEE International Test Conference, Nov. 3-8, 2024, San Diego, USA
- P. Hatka, M. Garczyk, P. Płaczkiwicz, D. Brząkała, K. Cichoń, A. Kliks, "RIS-measurements for Codebook Design", 2024 20th IEEE International Conference on Wireless and Mobile Computing, Networking and Communications, Oct. 21-23, 2024, Paris
- K. Wesołowski, "Separation of Jamming and Useful Signals Using Blind Source Separation and Bussgang Technique", 2024 IEEE 100th Vehicular Technology Conference (VTC2024-Fall), Washington DC, USA, Oct. 7-10, 2024
- A. Samorzewski, A. Kliks, "Signal Propagation in RIS-Aided 5G Systems", 20th IEEE International Conference on Wireless and Mobile Computing, Networking and Communications, Oct. 21-23, 2024, Paris
- J. Rajski, M. Trawka, J. Tyszer, B. Włodarczyk, "Test Data Encryption with a New Stream Cipher", 2024 IEEE International Test Conference, Nov. 3-8, 2024, San Diego, USA
- A. Samorzewski, M. Deruyck, A. Kliks, "Energy Consumption in RES-Aware 5G Networks", 2023 IEEE Global Communications Conference, Dec. 4-8, 2023, Kuala Lumpur, Malaysia
- C. Adamczyk, A. Kliks, "Detection and mitigation of indirect conflicts between xApps in Open Radio Access Networks", IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS), May 20, 2023, Hoboken, USA
- M. Hoffmann, P. Kryszkiewicz, "Signaling Storm Detection in IoT Network based on the Open RAN Architecture", IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS), May 20, 2023, Hoboken, USA
- K. Wesołowski, "A Simple Algorithm for Jamming Detection in OFDM Systems", IEEE 97th Vehicular Technology Conference (VTC2023-Spring), June 20-23, 2023, Florence, Italy
- M. Wasilewska, H. Bogucka, "Deep learning for Improved Spectrum Occupancy Prediction with Fading Estimation in 5G Radio," IEEE International Conference on Communications (ICC), May 28- June 1, 2023, Rome, Italy
- J. Rajski, M. Trawka, J. Tyszer (WIT), B. Włodarczyk, "Hybrid Ring Generators for In-System Test Applications," IEEE European Test Symposium (ETS), May 22-26, 2023, Venice, Italy
- P. Sroka, A. Kliks, "Distributed Learning for Vehicular Dynamic Spectrum Access in Autonomous Driving", IEEE International Conference on Pervasive Computing and Communications, PerCom Workshops 2022, March 21-25, 2022, Pisa, Italy
- K. Cichoń, M. Nikiforuk, "A Comparative Study of Vegetation Attenuation at Millimeter Waves Bandwidth", 30th International Conference on Software, Telecommunications and Computer Networks, SoftCOM 2022, Split, Croatia, Sept. 22-24, 2022
- C. Adamczyk, A. Samorzewski, M. Grzyb, A. Kliks, "Cloud-based Spectrum Access Control System for Dense IoT Networks", 30th International Conference on Software, Telecommunications and Computer Networks, SoftCOM 2022, Split, Croatia, Sept. 22-24, 2022
- M. Hoffmann, P. Kryszkiewicz, "Radio Environment Map and Deep Q-Learning for 5G Dynamic Point Blanking", 30th International Conference on Software, Telecommunications and Computer Networks, SoftCOM 2022, Split, Croatia, Sept. 22-24, 2022
- M. Hoffmann, P. Kryszkiewicz, "Similarity Measures for Location-Dependent MMIMO, 5G Base Stations On/Off Switching Using Radio Environment Map", IEEE 22nd International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM) 2021, June 7-11, 2021, Pisa, Italy, virtual conference
- P. Sroka, A. Kliks, M. Sybis, P. Kryszkiewicz, "Dynamic Power and Frequency Allocation Scheme for Autonomous Platooning", IEEE 93rd Vehicular Technology Conference (VTC2021-Spring), April 25-28, 2021, Helsinki, Finland, virtual conference
- S. Sabeeh, K. Wesołowski, "Resource Re-Selection with Adaptive Modulation and Collision Detection in LTE V2X Mode 4", IEEE 32nd Annual International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), Sept. 13-16, 2021, Helsinki, Finland
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