SIGNAL PROCESSING SYMPOSIUM 2021

ABSTRACT BOOK

SPSympo-2021

21 - 23.09.2021

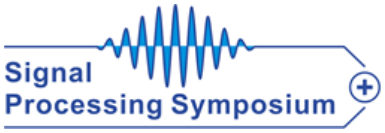
Lodz, Poland

SPSympo-2021

Abstract Book

September 21 – 23, 2021

Lodz, Poland



Editor:

Błażej Torzyk

Lodz University of Technology,

Stefana Żeromskiego 116,

90-924 Łódź

Poland

e-mail: blazej.torzyk@p.lodz.pl

Author of the book cover photography:

Dr. Łukasz Januszkiewicz, Lodz University of Technology (Poland)

Acknowledgement:

SPSympo-2021 abstract book is partially formed basing on the template developed by Dr. Tomasz Pięciak, AGH UST, Krakow (Poland)

Welcome to SPSympo 2021

Dear Colleagues,

Welcome to the
Signal Processing Symposium 2021.

SPSympo program consists of over 60 truly attention-grabbing papers and there are over 100 registered participants, even though this year's event is held online due to Covid-19.

The Signal Processing Symposium is a biannual international conference that brings together students, researchers and scientists representing a broad spectrum of computer science and radio-electronics disciplines, to present their latest findings and new trends shaping future research directions in science and technology. Since the first SPSympo in 2003, it has become well-established and an excellent forum for active participation in workshops, lectures, and scientific discussions in technical and evening sessions.

A main focus of SPSympo-2021 will be smart sensing systems that incorporate Information and Communications Technologies (ICT) for signal and image acquisition, transmission, processing and analysis in a broad range of applications covering remote sensing systems (radars, sonars, imaging, sensor networks), IoT, telemedicine, medical diagnosis, treatment and rehabilitation, robotics, human-system interaction, environment monitoring and space technologies.

We hope that this year's conference, despite of pandemic restrictions, will be another successful event that will enrich research in signal processing, expand its applications and strengthen international scientific ties.

Piotr Samczynski and Pawel Strumillo
SPSympo-Chairs

Signal Processing Symposium

Organizers

Lodz University of Technology
Institute of Electronics

MIKON

Warsaw University of Technology

ISE

Honorary Patronage of Polish Space Agency

POLISH SPACE AGENCY

SPSympo-2021 Co-Organiser Polish Academy of Science

PAN
POLISH ACADEMY of SCIENCES

Signal Processing Symposium

Financial Supporters

GOLD

PITRADWAR

PGZ

Instytut Łączności
PAŃSTWOWY INSTYTUT BADAWCZY

Partners

antmicro

XYsensing

Signal Processing Symposium

Co-Sponsors IEEE

AESS

IEEE Poland Section

IEEE Poland Section Signal Processing Chapter

AP/AES/MTT JOINT CHAPTER FOUNDED 1990 Poland Section IEEE

Media Partnership

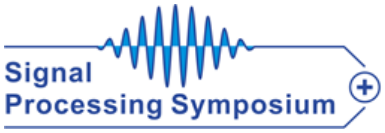
sensors

an Open Access Journal by MDPI

Special Issue *"Smart Sensing Systems: Algorithms and Applications - Selected Papers from Signal Processing Symposium 2021"*

remote sensing

Special Issue "Recent Advances in Signal Processing and Radar for Remote Sensing"


Signal
Processing Symposium

Keynote opening talk

Connecting the dots – Radar in an interconnected world!

Prof. Daniel O'Hagan, *Passive Radar and Anti-Jamming Techniques Department, Fraunhofer FHR (Germany)*

Prof. Daniel W. O'Hagan is Head of the Passive Radar and Anti-Jamming Techniques Department, Fraunhofer FHR, Wachtberg, Germany. His department consists of four groups focused on Passive and Networked Radar, Electronic Defence, Advanced Concepts and System Development. He is former convener of the internationally renowned University of Cape Town (UCT) Radar Masters Course. Daniel is Chair and DEU National Representative of NATO SET-268 "Bi-/Multi-static radar performance evaluation under synchronised conditions", Chair and DEU National Representative of NATO SET-296 on "Radar against Hypersonic Threats" and former Chair of SET-207, and SET-164. He is the recipient of the NATO SET Early Career Award in 2019.

Daniel is Editor-in-Chief of the IEEE AESS Magazine and Associate Editor for radar with the same publication. Daniel holds a PhD in radar and has lectured at some of the leading R&D establishments throughout the world.

Keynote abstract:

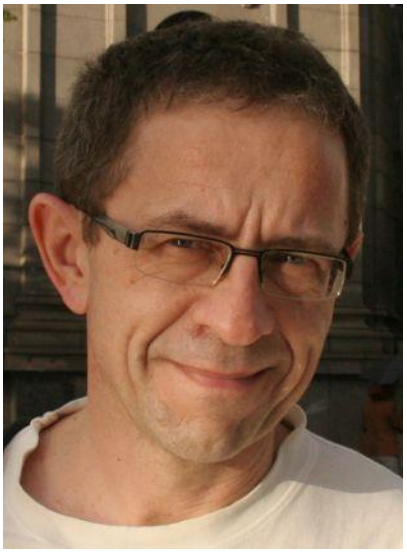
A modern technology trend in the domain of sensing is towards interconnectivity. Multiple sensor nodes will have to communicate with each other – sometimes centrally coordinated, but increasingly on a decentralised basis. The sensor nodes themselves will not be uniform. Rather a sensor mosaic could comprise radars of different frequency and type, optical sensors and acoustic sensors.

This keynote presentation will consider this trend more generally and then provide some examples of backbone infrastructure that is required to achieve a cohesive sensor (particularly radar) network. This presentation will focus strongly on Multi Platform RF Systems (MPRFS) and how every sensor-node in a given constellation achieves a common understanding of time.

Keynote opening talk

Bioinspired transforms in signal processing

Prof. Piotr Augustyniak, *AGH University of Science and Technology (Poland)*



Piotr Augustyniak graduated in 1989 in electronic engineering from the Electrical Engineering Department AGH University of Science and Technology, Krakow. In years 2005-2012, he headed the Multidisciplinary School of Engineering in Biomedicine. For 11 years he has worked at Aspel SA, the Poland-biggest manufacturer of ECG equipment as a Research Engineer. Since 2018 prof. Augustyniak is Head of Department of Biocybernetics and Biomedical Engineering AGH. His scientific interests include hardware and software problems of biosignal processing. He published nine books on electrodiagnostic signal processing, over 240 journal and conference papers and was program committee member of numerous international conferences.

Novel DL methods in SAR image processing

Prof. Feng Xu, *Fudan University (China)*

Prof. Feng Xu received the B.E. with honor in Information Engineering from Southeast University, Nanjing, China and the Ph.D. with honor in Electronic Engineering from Fudan University, Shanghai, China, in 2003 and 2008, respectively. From 2008 to 2010, he was a postdoctoral fellow with the NOAA Center for Satellite Application and Research (STAR), Camp Springs, MD. From 2010 to 2013, he was with at Intelligent Automation Inc. Rockville MD, while partly working for NASA Goddard Space Flight Center, Greenbelt, MD as a research scientist. In 2012, he was selected into China's Global Experts Recruitment Program, and subsequently returned to Fudan University in June 2013, where he currently is a professor in the school of information science and technology and the vice director of the MoE Key Lab for Information Science of Electromagnetic Waves. He has published more than 60 papers in peer-reviewed journals and co-authored 3 books, among many conference papers. Among other honors, he was awarded the second-class National Nature Science Award of China in 2011. He was the 2014 recipient of the Early Career Award of IEEE Geoscience and Remote Sensing Society and the 2007 recipient of the SUMMA graduate fellowship in the advanced electromagnetics area. He currently serves as the associate editor for IEEE Geoscience and Remote Sensing Letters. He is the founding chair of IEEE GRSS Shanghai Chapter and member of IEEE GRSS AdCom. His research interests include electromagnetic scattering modeling, SAR information retrieval and radar system development.

Keynote speech *Session 2* *Audio and video processing*

Indoor Scene analysis from Overhead Fisheye Cameras

Prof. Janusz Konrad, *Boston University (USA)*

Janusz Konrad received the Master's degree from Technical University of Szczecin, Poland in 1980 and the PhD degree from McGill University, Montréal, Canada in 1989. He joined INRS-Télécommunications, Montréal as a post-doctoral fellow and, since 1992, as a faculty member. Since 2000, he has been on faculty at Boston University, Boston, MA, USA. He is an IEEE Fellow and a Senior Editor of the IEEE Transactions on Image Processing. He has been actively involved in the IEEE Signal Processing Society as a Distinguished Lecturer and as Member-at-Large of the Conference Board. In the past, he served as an Area Editor of the EURASIP Signal Processing: Image Communications journal and Associate Editor of the IEEE Transactions on Image Processing, Communications Magazine, Signal Processing Letters and EURASIP Journal on Image and Video Processing. He is a co-recipient of the 2001 IEEE Signal Processing Magazine Award, the 2004-2005 EURASIP Image Communications Best Paper Award, the AVSS-2010 Best Paper Award and a co-winner of the 2010 ICPR Aerial View Activity Classification Challenge. He was the Technical Program Co-Chair of ICIP-2000 and AVSS-2010 as well as the General Chair of AVSS-2013. His current research interests include video processing and computer vision, visual sensor networks, stereoscopic and 3-D imaging and displays, and human-computer interfaces.

Keynote speech *Session 4* *Telecommunication/Radar signal processing*

Electromagnetic Metamaterials and Metasurfaces: Design, Fabrication, and Applications

Prof. Sławomir Hausman, *Lodz University of Technology (Poland)*

Sławomir Hausman received his M.Sc. (with honors) degree in electronics in 1982 from Lodz University of Technology (Poland) and Ph.D. degree from University of Strathclyde, Glasgow, UK in 1990. He obtained his habilitation (dr hab. degree) from Lodz University of Technology in 2009 where he is currently an Associate Professor. His research and more than 50 publications in peer-revied journals focus on radio propagation modelling, wireless body area networks, optimization of microwave systems, 5G cellular systems, electromagnetic compatibility, computational electromagnetics, digital signal processing, and recently metamaterials. He was a leader and/or team member in more than twenty R&D projects for industry. He also had several years of experience as small company owner, designer, specialist in industry (including electric power utilities, telecommunication operators, Polish Office of Electronic Communications). He was employed at Lodz Electric Power Utility as telecommunication network senior specialist (1994–1997). He is a Chairman of Polish National Committee of International Union of Radio Science URSI – Scientific Commission K: Electromagnetics in Biology and Medicine, Chair of Lodz Branch of Polish Society of Theoretical and Applied Electrical Engineering. He chaired technical program committees of three premier national radio communications and ICT conferences and is a TPC member of numerous international and national conferences and seminars. He has over 15 years of experience at various academic administrative positions, as Dean of the Faculty of Electrical, Electronic, Computer and Control Engineering and Head of the Telecommunication Division. Professor Hausman prepared and runs 13 academic courses (lectures) both in Polish and English (for International Faculty of Engineering) in the area of measurement systems, signal processing, and telecommunication systems. He also delivers lectures for MSE and PhD programmes at Pavia University, Italy.

Keynote speech *Session 5* *Signal Processing Components*

On enhancing data-driven structural health monitoring with explicit and implicit procedures

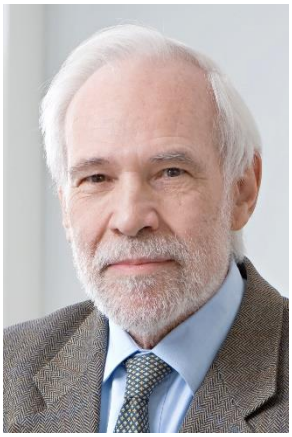
Dr. David García Cava, *University of Edinburgh, (Scotland)*

Dr. David García Cava has received his degree in Mechanical Engineering from the Technical University of Madrid, M.Sc in Advanced Structural Engineering from Edinburgh Napier University and his Ph.D in Mechanical Engineering from The University of Strathclyde, Glasgow in 2006, 2012 and 2016 respectively. He is currently a Chancellor Fellow in the School of Engineering at the University of Edinburgh, Scotland. From 2006 until 2010, before his PhD studies, David worked in the industry for 4 years as Structural Engineer where he put in practice his knowledge in engineering applications. From 2016 until 2017 he was a Teaching Associate and from 2017 until 2019 a Lecturer in the Department of Mechanical and Aerospace Engineering in the University of Strathclyde before he joined the University of Edinburgh. David's research interest varies from structural health monitoring, structural dynamics, structural system identification, virtual sensing, condition monitoring, data-driven & hybrid methods for condition assessment. David is leading a research group that blends his research expertise towards developing methodologies for reducing maintenance cost and extending the useful life of new and/or existing structures by adding value with intelligent algorithms for supporting decision-making. He has published numerous articles in scientific journals and on peer-reviewed conferences. David has been awarded with the prestigious John Moyes Lessells Travel Scholarship by The Royal Society of Edinburgh, and the Flatman grant by the Institution of Mechanical Engineers. David is a Charted Engineer by the Institution of Mechanical Engineers, where he is member since 2014 and an active member of the Edinburgh and South & East Scotland committee. He is also a Fellow of The Higher Education Academy, United Kingdom since 2018. He has co-organized a Mini-Symposia on Vibration-based Structural Health Monitoring: Data Analysis and Time Series Methods within the framework of the International Conference on Engineering Vibration2017 (ICoEV 2017), Bulgaria. He has been Associate Technical Program Chairs in Measurement for Renewable Energy Systems in the International Instrumentation & Measurement Technology Conference (I2MTC) 2021, Scotland and is also part of the technical advisory panel of the International Conference on Health Monitoring of Civil & Maritime Structures (HEAMES). David is a Topic Editor in Sensors MDPI Journal and member of the scientific board of Mechanics and Mechanical Engineering Journal.

Keynote speech *Session 6* *Geoscience and Remote Sensing*

Advances in Multi-Variable, *Non-Gaussian Stochastic Parametrization*

Prof. Patrick Dewilde, *Honorable Professor, Wroclaw University of Science and Technology (Poland)*



Patrick Dewilde (EE `66 KULeuven, Belgian Lic. Math. `68 and PhD `70 Stanford University) has been a professor in electrical engineering at the Technical University of Delft for 31 years, director of the Delft Institute for Micro-electronics DIMES for ten years, chairman of the Technology Foundation STW (a major Dutch research funding agency) for eight years and di-rector of the Institute of Advanced Study of the TU Munich for five years. His research, pub-lished in the international scientific literature and some books, has focused on mathematical issues related to the design, control and operations of dynamical systems in general and in particular circuits and systems for signal processing. He is an IEEE Fellow since 1981, an elected member of the Dutch Royal Academy of Arts and Science, has been elevated to the rank of Knight of the Dutch Lion and is presently a honorary professor both at the Technische Universität München and the Technical University of Wroclaw.

Keynote speech *Session 7* *Localization and Tracking*

Recent advances in 3D Radar Imaging of Non-Cooperative Target

Prof. Marco Martorella, *University of Pisa (Italy)*

Marco Martorella received his Laurea degree (Bachelor+Masters) in Telecommunication Engineering in 1999 (cum laude) and his PhD in Remote Sensing in 2003, both at the University of Pisa. He is now an Associate Professor at the Department of Information Engineering of the University of Pisa and an external Professor at the University of Cape Town where he lectures within the Masters in Radar and Electronic Defence. Prof. Martorella is also Director of the CNIT's National Radar and Surveillance Systems Laboratory. He is author of more than 200 international journal and conference papers, 3 books and 17 book chapters. He has presented several tutorials at international radar conferences, has lectured at NATO Lecture Series and organised international journal special issues on radar imaging topics. He is a member of the IEEE AES Radar Systems Panel, a member of the NATO SET Panel, where he sits as co-chair of the Radio Frequency Technology Focus Group, and a member of the EDA Radar Captech. He has chaired several NATO research activities, including three Research Task Groups, one Exploratory Team and two Specialist Meetings. He has been recipient of the 2008 Italy-Australia Award for young researchers, the 2010 Best Reviewer for the IEEE GRSL, the IEEE 2013 Fred Nathanson Memorial Radar Award, the 2016 Outstanding Information Research Foundation Book publication award for the book Radar Imaging for Maritime Observation and the 2017 NATO Set Panel Excellence Award. He is a co-founder of ECHOES, a radar systems-related spin-off company. His research interests are mainly in the field of radar, with specific focus on radar imaging, multichannel radar and space situational awareness. He is a Fellow of the IEEE.

Keynote speech *Session 9* *Radar systems and application*

The Trust and Truth od Digitalisation in Maritime Domain: where are we?

Dr. Michele Fiorini, *The Institution of Engineering and Technology in London (United Kingdom)*

Educated at Ancona (Italy), Bath (United Kingdom) and Gdańsk (Poland) Universities, **Michele Fiorini** holds a Ph.D. in electronic and telecommunications engineering in Italy and an M.B.A. in strategy, programme and project management in Poland. He is a principal engineer and engineering manager for Leonardo s.p.a. in Rome (Italy) and industrial member of the e-navigation committee at the International Association of marine aids to navigation and Lighthouse Authorities (IALA) in Paris (France). He is an active volunteer at the Institution of Engineering and Technology (IET) in London (UK), where he served on different boards and committees including Council (2003-06 and 2015-18) and Qualification Board (2006-09) where he was the first non-UK member elected ever.

Dr Fiorini has been consortium leader for the realisation of the "Zautomatyzowanego Systemu Radarowego Nadzoru (ZSRN) polskich obszarów morskich / Automatic National System of Radar Control for Maritime Areas of Poland" realized by Selex – Sistemi Integrati (now Leonardo s.p.a.) in consortium with local partners. In June 2018 he was invited to provide special lecture and advices at Mokpo National Maritime University (MMU), Republic of Korea on how to solve navigational risk based on vulnerability of maritime accidents for e-Navigation. Michele Fiorini has been appointed Expert Evaluator for the Baltic Sea research programme BONUS, science for a better future of the Baltic Sea region, funded EUR 100 million for the years 2011-'17 and was session chair at the 2013 Euro-Asia Economic Forum in Xi'an, China.

Dr Fiorini is a serving member of the Advisory Board of the MBA Programme -AMBA accredited- at the Gdańsk University of Technology in Poland and has been the Chair of the Institution of Engineering and Technology (IET) Council 2017-2018 in London, UK. He is on judging panel of the E&T Trust and Truth Award 2021.

Alienation – how does it manifest itself and how to prevent it?

Dorota Myko, *Faculty of Electronics and Information Technologies, Warsaw University of Technology (Poland)*

Dorota Myko graduated from Warsaw University, Paris-Nord University XIII and Warsaw School of Economics (SGH). Since 2005 she has been working at Warsaw University of Technology at the Faculty of Electronics and Information Technologies in the Department of Promotion and Information.

We would like to invite all the participants of the symposium to join the presentation on the theme of alienation. Alienation and isolation express a similar state or feeling of loneliness. A person feels isolated from others for various reasons, such as bad relationships, loss of love, impairment and so on. Criminals are isolated from the society and detained in prison for punishment. Isolation is also a method of treatment and a preventive measure to limit the person's negative influence on others.

The word alienation comes from the Latin word alienus - alien, which is the opposite of the word native. The concept of alienation was first used by the German philosopher Georg Hegel (at the turn of the 19th century) and then widely described by Karl Marx in his writings on work and the worker. However, the phenomenon of alienation itself was noticed even by Plato and has since found a significant place in culture and literature.

There are different types of alienation: social, cultural, emotional, parental, religious, economic, and technological… Alienation is also the subject of research by neurobiologists in the context of the areas in the brain responsible for the so-called "social brain". In the brain, we have neural networks that serve to establish social contacts, and hormones, oxytocin and vasopressin, facilitate this process. The proper or improper functioning of this whole system may determine whether a child will or will not develop autism.

A sense of alienation can be very depressing and frustrating when an individual feels unaccepted and lacks the sense of belonging to the place or society in which they live. In many countries a number of communities or minorities feel alienated due to repression or government policies. It has been observed that participation in various social movements may be a way of combating the alienation of discriminated groups or a way for individuals to gain solidarity within the group. When we intend to deal with a sense of alienation, we often oscillate between self-confidence in achieving of goals and conformism in decisions making.

American sociologist, David Riesman, in the 1950s, spoke extensively about alienation in his most famous work, The Lonely Crowd. In his book he describes the passage of the American society from an internal-control personality type to an external-control type and a special role of a tradition-driven society. However, the problem from a psychological point of view was taken up by Dr Elaine Aron in the book: Highly Sensitive. A highly sensitive person, will absorb moods from people around them and thus risk feeling distanced, uncomprehended and finally alienated from the environment. Researchers have special tests to see if we are affected by this problem or not.

How can we deal with alienation and still be in harmony with ourselves? Should the solution be to take the courage to become a person disliked by part of people, that means be authentic and controversial, to conduct self-therapy and to focus on spiritual development? Or maybe it would be enough to develop a healing and creative personality and follow in the footsteps of Howard S. Friedman or Josif Brodski? Or maybe we should read the essays by philosopher, sociologist, psychologist and psychoanalyst Erich Fromm? And what if it finally turns out that we can gain power from a diet, trees or mysterious oriental herbs and potions of St. Hildegard from Bingen?… The speaker will try to answer these and other questions in her speech.

Symposium Chair:

Prof. Paweł Strumiłło, Lodz University of Technology (Poland)
Prof. Piotr Samczyński, Warsaw University of Technology (Poland)

TPC Chairs:

Prof. Andrzej Materka, Lodz University of Technology (Poland)
Prof. Jacek Misiurewicz, Warsaw University of Technology (Poland)

Publications Chairs:

Dr. Artur Klepaczko, Lodz University of Technology (Poland)
Prof. Konrad Jędrzejewski, Warsaw University of Technology (Poland)

Organizing Committee Chair:

Ms. Aleksandra Sibińska, Lodz University of Technology (Poland)
Ms. Marta Malik, Warsaw University of Technology (Poland)

Organizing Committee:

Ms. Anna Borowska-Terka, Lodz University of Technology (Poland)
Ms. Anna Janisz, Lodz University of Technology (Poland**)**
Dr. Paweł Poryzała, Lodz University of Technology (Poland)
Mr. Błażej Torzyk, Lodz University of Technology (Poland)

Symposium Coordinator:

Mr. Marcin Żywek, Warsaw University of Technology (Poland)

Honorary Chair:

Prof. Krzysztof Kulpa, Warsaw University of Technology (Poland)

Industry Councellor:

Dr. Andrzej Sieradz, PIT-RADWAR (Poland)

Technical Programme Committee Members:

Dr. Yuliya Averyanova, National Aviation University (Ukraine)
Prof. Chris Baker, University of Birmingham (UK)
Prof. Alessio Balleri, Cranfield University (United Kingdom)
Prof. William Barrot, Embry-Riddle Aeronautical University (USA)
Mr. Marcin Bączyk, Warsaw University of Technology (Poland)
Prof. Fabrizio Berizzi, University of Pisa (Italy)
Dr. Tadeusz Brenner, PIT-RADWAR S.A. (Poland)
Dr. Amerigo Capria, CNIT-RaSS Lab (Italy)
Dr. Simona Caraiman, Technical University of Iasi (Romania)
Prof. Alberto Carini, University of Trieste (Italy)
Prof. Aleksandr Cariow, West Pomeranian University of Technology Szczecin (Poland)
Prof. Mikhail Cherniakov, University of Birmingham (UK)
Prof. Fabiola Colone, Sapienza University of Rome (Italy)
Mr. Zbigniew Czekała, PIT-RADWAR S.A. (Poland)
Prof. Adam Dąbrowski, Poznan University of Technology (Poland)
Dr. Andreas Deistung, University Hospital Halle (Saale) (Germany)
Prof. Marek Domański, Poznan University of Technology (Poland)
Dr. Krzysztof Duda, AGH University of Science and Technology (Poland)
Prof. Alfonso Farina, Selex-ES (Italy)
Prof. Gaspare Galati, Tor Vergata University (Italy)
Dr. Jakub Galka, AGH University of Science and Technology (Poland)
Prof. Fulvio Gini, University of Pisa (Italy)
Dr. Elisa Giusti, CNIT (Italy)
Dr. Ievgen Gorovyi, It-Jim (Ukraine)
Prof. Maria Sabrina Greco, University of Pisa (Italy)
Prof. Pamela Guevara, University of Concepción (Chile)
Dr. Braham Himed, US Air Force Research Laboratory (USA**)**
Prof. Konrad Jędrzejewski, Warsaw University of Technology (Poland)
Prof. Hristo Kabakchiev, Sofia University “St. Kliment Ohridski” (Bulgaria)
Prof. Piotr Kaniewski, Military University of Technology (Poland)
Prof. Adam Kawalec, Military University of Technology (Poland)
Prof. Jan Kelner, Military University of Technology (Poland)
Prof. Peter Knott, Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR(Germany)
Prof. Krzysztof Kulpa, Warsaw University of Technology (Poland)
Dr. Mikolaj Leszczuk, AGH University of Science and Technology (Poland)
Dr. Lorenzo Lo Monte, Telephonics (USA)
Dr. Tom Lukowski, (Canada)
Prof. Mateusz Malanowski, Warsaw University of Technology (Poland)
Prof. Paulo Marques, ISEL – Instituto de Telecomunicacoes de Lisboa (Portugal)
Prof. Marco Martorella, University of Pisa (Italy)
Prof. Andrzej Materka, Lodz University of Technology (Poland)
Prof. Bogdan Matuszewski, University of Central Lancashire (United Kingdom)
Prof. Maciej Niedźwiecki, Gdansk University of Technology (Poland)
Prof. Katarzyna Osińska-Skotak, Warsaw University of Technology (Poland)
Prof. Mateusz Pasternak, Military University of Technology (Poland)
Prof. Jerzy Pietrasiński, Military University of Technology (Poland)
Dr. Tomasz Pięciak, AGH University of Science and Technology (Poland)
Prof. Jarabo Maria Pilar, University of Alcalá (Spain)
Prof. Anton Popov, Igor Sikorsky Kyiv Polytechnic Institute (Ukraine)

Technical Programme Committee Members:

Prof. Jürgen R Reichenbach, Jena University Hospital (Germany)
Dr. Marek Wojciech Rupniewski, Warsaw University of Technology (Poland)
Dr. Sinitsyn Rustem, National Aviation University (Ukraine)
Prof. Bartłomiej Salski, Warsaw University of Technology (Poland)
Prof. Piotr Samczyński, Warsaw University of Technology (Poland)
Dr. Andrzej Skalski, AGH University of Science and Technology (Poland)
Prof. Paweł Strumiłło, Lodz University of Technology (Poland)
Prof. Michał Strzelecki, Lodz University of Technology (Poland)
Prof. Janusz Szczepański, Polish Academy of Sciences (Poland)
Dr. Bogusław Szlachetko, Wroclaw University of Science and Technology (Poland)
Dr. Magdalena Szymczyk, AGH University of Science and Technology (Poland)
Prof. Ewa Świercz, Bialystok University of Technology (Poland)
Prof. Miroslaw Świercz, Bialystok University of Technology (Poland)
Dr. Matthias Weiß, Fraunhofer FHR (Germany)
Prof. Felix Yanovsky, National Aviation University (Ukraine)
Prof. Yimin Daniel Zhang, Temple University (USA)
Prof. Tomasz Zieliński, AGH University of Science and Technology (Poland)

TIME (UTC)	**MONDAY 20.09.2021**, Pre-Conference Tutorials
08:45 – 09:00	*Testing and linking time…*
09:00 – 10:45 **Title:** **Room: A**	*Tutorial 1:* **Phased Array Radar Adaptive Digital Beamforming** Prof. Antonio de Maio, *University "Federico II" of Napoli (Italy)*

Antonio De Maio received the Dr.Eng. (Hons.) and Ph.D. degrees in information engineering from the University of Naples Federico II, Naples, Italy, in 1998 and 2002, respectively. From October to December 2004, he was a Visiting Researcher with the U.S. Air Force Research Laboratory, Rome, NY, USA. From November to December 2007, he was a Visiting Researcher with the Chinese University of Hong Kong, Hong Kong. He is currently a Professor with the University of Naples Federico II. His research interest lies in the field of statistical signal processing, with emphasis on radar signal processing, waveform diversity, cognitive radar, optimization theory applied to radar signal processing, and electronic defense. He is the recipient of the 2010 IEEE Fred Nathanson Memorial Award as the young (less than 40 years of age) AESS Radar Engineer 2010 whose performance is particularly noteworthy as evidenced by contributions to the radar art over a period of several years, with the following citation for "robust CFAR detection, knowledge-based radar signal processing, and waveform design and diversity". He is the corecipient of the 2013 best paper award (entitled to B. Carlton) of the IEEE TRANSACTIONS ON AEROSPACE AND ELECTRONIC SYSTEMS with the contribution "Knowledge-Aided (Potentially Cognitive) Transmit Signal and Receive Filter Design in Signal-Dependent Clutter". Dr. De Maio is a Fellow of IEEE, a Distinguished Lecturer for the IEEE AES (biennium 2020-2021), and a co-author (with A. Farina and S. Haykin) of the book "The Impact of Cognition on Radar Technology", Scitech Publishing, Radar, Sonar & Navigation, 2017.

TIME (UTC)

MONDAY 20.09.2021, Pre-Conference Tutorials

11:00 – 12:45

Title:

Room: A

Tutorial 2:

Target Detection and Imaging with Multi-static Passive Radar

Dr. Hui Ma, *Xidian University (China)*

Hui Ma received the B.Sc. degree in electronic and information engineering and the Ph.D. degree in electromagnetics and microwave technology from Beihang University, Beijing, China, in 2009 and 2015, respectively. From 2012 to 2014, she was a visiting Ph.D. student with the University of Birmingham, Birmingham, U.K., where she continued as a Research Fellow from 2015 to 2017, under the grants funded by the European Space Agency. She is currently an associate Professor with the National Laboratory of Radar Signal Processing, Xidian University, Xi'an, China. Her research interests include multi-static radar, passive radar, electromagnetic vortex radar, real-aperture radar imaging, and signal processing. She has more than 30 publications in peer reviewed international journals and conferences.

01:00 – 02:45

Title:

Room: A

Tutorial 3:

An overview of passive radar imaging techniques and results

Dr. Diego Cristallini, *Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR (Germany)*

Dr. Diego Cristallini was born in Terni, Italy, in 1981. He graduated cum laude in Telecommunication Engineering in May 2006 from the University of Rome "La Sapienza". In received April 2010 Dr. Cristallini received the Ph.D. degree in Radar Remote Sensing also from the University of Rome "La Sapienza" with a thesis entitled "Innovative adaptive techniques for multi-channel spaceborne SAR systems". From December 2009 to February 2015 he has been with the Array-based Radar Imaging Department of the Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR in Wachtberg, Germany. During this time, he has been working on the development of innovative space-time adaptive techniques for clutter suppression in multi-channel airborne radar systems, with special attention to bistatic systems and to highly non-homogeneous clutter environments. Since March 2015, he is leading the Team on Passive Covert Radar in the Passive Radar and Anti-Jamming Techniques Department of Fraunhofer FHR, Germany. From March to June 2020, he has been visiting scientist at Defence Science and Technology (DST) Group in Edinburgh, South Australia. Cristallini is co-chair of the NATO-SET 242 group on "PCL on moving platforms" and he has been lecturing for the NATO LS-243 "Passive Radar Technology". Dr. Cristallini received the Best Paper Award at EUSAR 2014, co-authored the Best Poster Award at EUSAR 2018, and he was co-recipient of the 2018 Premium Award for Best Paper in IET Radar, Sonar and Navigation.

TIME (UTC)

MONDAY 20.09.2021, Pre-Conference Tutorials

03:00 – 04:45 **Title:** **Room: A**	*Tutorial 4:* **Starting SP in 5G** Prof. Tomasz Zieliński, *AGH University of Science and Technology in Krakow (Poland)* **Professor Tomasz Zieliński**, a former worker of the Instrumentation and Measurement Department and a present worker of the Telecommunications Department of the AGH University of Science and Technology in Krakow, Poland, is specializing for almost 40 years in frequency and time-frequency signal analysis, especially in telecommunication, biomedical and power engineering applications. He is recognizable in Poland as an author (a scientific story-teller) of a few books, mainly student textbooks: “Time-Frequency and Time-Scale Signal Analysis” (1996), “From Theory to Digital Signal Processing” (2003), “Digital Signal Processing. From Theory to Applications” (2005) and “DSP in Telecommunications. Principles. Multimedia. Transmission” (2014 – a main editor and an individual author of three chapters). In 2021 he authored the book “Starting Digital Signal Processing in Telecommunication Engineering. A Laboratory-based Course” published by Springer.

TIME (UTC)	**TUESDAY 21.09.2021**, Contents
08:45 – 09:00	*Testing and linking time …*
09:00 – 09:30	**ROOM A: *SPSympo 2021 OPENING***
09:30 – 10:45 *(all talks)* **Room: A**	***Keynote opening talks***

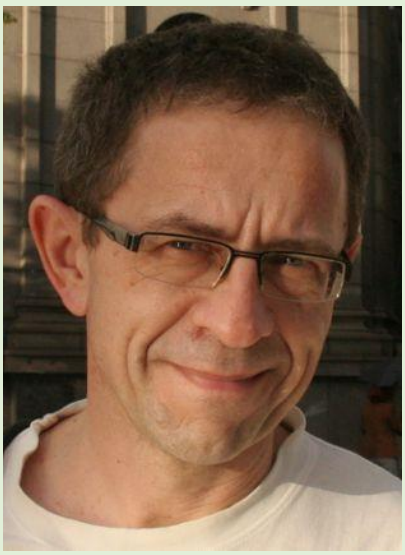
Connecting the dots – Radar in an interconnected world!

Prof. Daniel O'Hagan, *Passive Radar and Anti-Jamming Techniques Department, Fraunhofer FHR (Germany)*

Prof. Daniel W. O'Hagan is Head of the Passive Radar and Anti-Jamming Techniques Department, Fraunhofer FHR, Wachtberg, Germany. His department consists of four groups focused on Passive and Networked Radar, Electronic Defence, Advanced Concepts and System Development. He is former convener of the internationally renowned University of Cape Town (UCT) Radar Masters Course. Daniel is Chair and DEU National Representative of NATO SET-268 "Bi-/Multi-static radar performance evaluation under synchronised conditions", Chair and DEU National Representative of NATO SET-296 on "Radar against Hypersonic Threats" and former Chair of SET-207, and SET-164. He is the recipient of the NATO SET Early Career Award in 2019.

Bioinspired transforms in signal processing

Prof. Piotr Augustyniak, *AGH University of Science and Technology (Poland)*



Piotr Augustyniak graduated in 1989 in electronic engineering from the Electrical Engineering Department AGH University of Science and Technology, Krakow. In years 2005-2012, he headed the Multidisciplinary School of Engineering in Biomedicine. For 11 years he has worked at Aspel SA, the Poland-biggest manufacturer of ECG equipment as a Research Engineer. Since 2018 prof. Augustyniak is Head of Department of Biocybernetics and Biomedical Engineering AGH. His scientific interests include hardware and software problems of biosignal processing. He published nine books on electrodiagnostic signal processing, over 240 journal and conference papers and was program committee member of numerous international conferences.

TIME (UTC)	TUESDAY 21.09.2021, Contents
09:30 – 10:45 *(all talks)* **Room: A**	**Keynote opening talk** ***Novel DL methods in SAR image processing*** Prof. Feng Xu, *Fudan University (China)*  **Prof. Feng Xu** received the B.E. with honor in Information Engineering from Southeast University, Nanjing, China and the Ph.D. with honor in Electronic Engineering from Fudan University, Shanghai, China, in 2003 and 2008, respectively. From 2008 to 2010, he was a postdoctoral fellow with the NOAA Center for Satellite Application and Research (STAR), Camp Springs, MD. From 2010 to 2013, he was with at Intelligent Automation Inc. Rockville MD, while partly working for NASA Goddard Space Flight Center, Greenbelt, MD as a research scientist. In 2012, he was selected into China's Global Experts Recruitment Program, and subsequently returned to Fudan University in June 2013, where he currently is a professor in the school of information science and technology and the vice director of the MoE Key Lab for Information Science of Electromagnetic Waves. He has published more than 60 papers in peer-reviewed journals and co-authored 3 books, among many conference papers. Among other honors, he was awarded the second-class National Nature Science Award of China in 2011. He was the 2014 recipient of the Early Career Award of IEEE Geoscience and Remote Sensing Society and the 2007 recipient of the SUMMA graduate fellowship in the advanced electromagnetics area. He currently serves as the associate editor for IEEE Geoscience and Remote Sensing Letters. He is the founding chair of IEEE GRSS Shanghai Chapter and member of IEEE GRSS AdCom. His research interests include electromagnetic scattering modeling, SAR information retrieval and radar system development.
10:45 – 11:00	***Coffee break***

TIME (UTC) **TUESDAY 21.09.2021**, Contents

Session	***S1 Image Processing and Recognition*** *Chair: Dr. Artur Klepaczko & Prof. Feng Xu*	***S4 Telecommunication/Radar signal processing*** *Chair: Prof. Fabrizio Berizzi & Prof. Konrad Jędrzejewski*
11:00 – 11:20 **Speech 1:** **(Room: A)**	**Room: A** *Human Detection and Action Classification Based on Millimeter Wave Radar Point Cloud Imaging Technology* jiayu wu	**Room: B** *Electromagnetic Metamaterials and Metasurfaces: Design, Fabrication, and Applications* Prof. Sławomir Hausman
11:00 – 11:40 **Keynote talk:** **(Room: B)**		
11:20 – 11:40 **Speech 2:** **(Room: A)**	**Room: A** *Sparse Neural Networks With Topologies Inspired by Butterfly Structures* Dariusz Puchala	**Room: B** *Power and Energy Efficiency Optimization of Baseband Transmission Links* Christoph Lange
11:40 – 12:00 **Speech 1:** **(Room: B)**		
11:40 – 12:00 **Speech 3:** **(Room: A)**	**Room: A** *Composition of Similarity Metrics for Correspondence Matching in Depth Estimation* Hubert Żabiński	**Room: B** *Traffic Modelling for Mobile Ad-hoc Networks Simulation* Piotr Gajewski
12:00 – 12:20 **Speech 2:** **(Room: B)**		
12:00 – 12:20 **Speech 4:** **(Room: A)**	**Room: A** *Human Sleep Posture Recognition Based On Millimeter-Wave Radar* Tao Zhou	**Room: B** *Multitaper Time-Frequency Reassigned Spectrogram in Micro-Doppler Radar Signal Analysis* Karol Abratkiewicz
12:20 – 12:40 **Speech 3:** **(Room: B)**		

TIME (UTC) **TUESDAY 21.09.2021**, Contents

Session	***S1 Image Processing and Recognition*** *Chair: Dr. Artur Klepaczko & Prof. Feng Xu*	***S4 Telecommunication/Radar signal processing*** *Chair: Prof. Fabrizio Berizzi & Prof. Konrad Jędrzejewski*
12:20 – 12:40 **Speech 5:** **(Room: A)**	**Room: A** *Wavelet transform applied to coffee entomology* Everton Silva Fonseca	**Room: B** *Target HRRP Reconstruction Based on Waveform Delay Dictionary with Phase-coded Pulse in Anechoic Chamber* Xiaobin Liu
12:40 – 01:00 **Speech 4:** **(Room: B)**		
12:40 – 01:00 **Speech 6:** **(Room: A)**	**Room: A** *Fast Selection of INTRA CTU Partitioning in HEVC Encoders using Artificial Neural Networks* Everton Silva Fonseca	**Room: B** *PA Distortions on Radar Signals for Spectral Coexistence* Vincenzo Carotenuto
01:00 – 01:20 **Speech 5:** **(Room: B)**		
01:20 – 02:00	***Dinner break***	
02:00 – 03:00	**ROOM A: Industrial Session 1** ***Business Partner***	
Session	***S2 Audio and video processing*** *Chair: Prof Janusz Kondrad & Prof. Piotr M. Szczypiński*	***S3 Synthetic aperture radars and radar*** *Chair: Prof. Paulo Marques & Prof. Jerzy Pietrasiński*
03:00 – 03:40 **Keynote talk** **(Room: A)**	**Room: A** *Indoor Scene analysis from Overhead Fisheye Cameras* Prof. Janusz Konrad	**Room: B** *Experimental Results of SAR Imaging Using aLow-Cost X-band Radar with a PLL with DirectModulation for UAV Applications* Damian Gromek
03:00 – 03:20 **Speech 1:** **(Room: B)**		
03:40 – 04:00 **Speech 1:** **(Room: A)**	**Room: A** *Modeling multipath propagation of acoustic signal in a swimming pool* Jacek Misiurewicz	**Room: B** *A Novel Criterion for Array Geometry Optimization* Meysam Eskandari
03:20 – 03:40 **Speech 2:** **(Room: B)**		

TIME (UTC) **TUESDAY 21.09.2021**, Contents

Session	***S2 Audio and video processing*** *Chair: Prof Janusz Kondrad & Prof. Piotr m. Szczypiński*	***S3 Synthetic aperture radars and radar*** *Chair:Prof. Paulo Marques & Prof. Jerzy Pietrasiński*
04:00 – 04:20 **Speech 2:** **(Room: A)**	**Room: A** *Localization of an Acoustic Emission Source Based on Time Difference of Arrival* Mariia Khyzhniak	**Room: B** *Non-coherent change detection in real SAR satellite imagery with usage of the CFAR algorithms* Artur Gromek
03:40 – 04:00 **Speech 3:** **(Room: B)**		
04:20 – 04:40 **Speech 3:** **(Room: A)**	**Room: A** *Analysis of error in sound sources position estimation with microphone arrays* Manuel Rosa Zurera	**Room: B** *High-Resolution SAR Imaging with Orthogonal Sub-Band Frequency Diverse Array* Mengdi Zhang
04:00 – 04:20 **Speech 4:** **(Room: B)**		
04:40 – 05:00 **Speech 4:** **(Room: A)**	**Room: A** *Motion-Based Multiple Object Detection and Tracking in Video Stream* Piotr Sadura	**Room: B** *ISAR IMAGING PHASE CORRECTION ALGORITHM BASED ON ENTROPY MINIMIZATION* Andon Lazarov
04:20 – 04:40 **Speech 5:** **(Room: B)**		
05:00 – 05:20 **Speech 5:** **(Room: A)**	**Room: A** *Analysis of mouth click sounds used in echolocation* Michał Bujacz	**Room: B** *Polarimetric Calibration of Mini SAR based on UAV Platform* Jiaxuan Liu
04:40 – 05:00 **Speech 6:** **(Room: B)**		
05:00 – 05:20 **Speech 7:** **(Room: B)**		**Room: B** *Effects of SAR Resolution in Automatic Building Segmentation Using CNN* Sandhi Wangiyana,

TIME (UTC)

TUESDAY 21.09.2021, Contents

05:20 – 05:40	***Coffee break***
06:00 – 08:00	***Online-integration: wonder.me***

WEDNESDAY 22.09.2021, Contents

TIME (UTC)	
08:45 – 09:00	*Testing and linking time …*
09:00 – 10:45 **Tutorial** **Room: A**	***Ambiguous free staring radar – new frontiers in MIMO for detection and communication*** Prof. Krzysztof S. Kulpa, *Warsaw University of Technology (Poland)*  **Prof. Krzysztof S. Kulpa** received his M. Sc., Ph.D. and Dr Sc. degrees from the Department of Electronic Engineering, Warsaw University of Technology (WUT) in 1982, 1987 and 2009 respectively. In 2014 he obtained the title of State Professor, granted by the President of Poland. Since 1990 - Professor at the Institute of Electronic Systems (WUT). In the years 1995-2014 - head of the Digital Signal Processing Laboratory, and since 2008 - the head of the Radar Technology Research Group at WUT. Since 2011 he has held the position of Scientific Director of the Defense and Security Research Center of the Warsaw University of Technology. He is a Chairman of Microwave and Radar Chapter of the Committee of Electronics and Telecommunication, Polish Academy of Science, member of IEEE (SM) member of IEEE AES Radar Panel, EUMA and AOC. He is very active worldwide, presenting lectures, seminars and invited talks – being the Distinguish Lecturer of IEEE. Technical Program Committees member of several major international conferences in the field of radar, such as the International Radar Symposium IRS, European Synthetic Aperture Radar Conference EUSAR (since 2002), European Radar Conference EURAD, RADARxx, Fusion,Chairman of many SPSympo, MIKON, and IRS conferences. Presently he is an associate editor for the International Journal of Microwave and Wireless Technologies, the International Journal of Electronics and Telecommunications, and Telecommunications and IEEE Transactions on Aerospace and Electronic Systems. His area of interest is Radar Signal Processing including SAR, ISAR, PCL and EW technologies. In his professional life he has always combined the management of objectives, team and partner cooperation, leadership, teaching, and theoretical research and applications.
10:45 – 11:00	***Coffee break***

TIME (UTC)

WENESDAY 22.09.2021, Contents

Session	***S10 Signal and Image Processing for Medical Application I*** *Chair: Prof Anton Popov &* *Prof. Piotr Augustyniak*	***S6 Geoscience and Remote Sensing*** *Chair: Prof. Hanna Rothkaehl &* *Prof. Krzysztof Kulpa*
11:00 – 11:20 **Speech: 1** **(Room: A)**	**Room: A** *Distance Metrics for Classification of Arbitrarily Sampled Patterns – an ECG Example* Piotr Augustyniak	**Room: B** *Advances in Multi-Variable, Non-Gaussian Stochastic Parametrization* Prof. Patrick Dewilde
11:00 – 11:40 **Keynote talk** **(Room: B)**		
11:20 – 11:40 **Speech: 2** **(Room: A)**	**Room: A** *Mutual Information Analysis of Brain-Heart Interactions in Epileptic Children* Ivan Kotiuchyi	**Room: B** *Detection of periodic disturbances in LOFAR calibration solutions* Katarzyna Budzinska
11:40 – 12:00 **Speech: 1** **(Room: B)**		
11:40 – 12:00 **Speech: 3** **(Room: A)**	**Room: A** *Hand measurement based on integrated vision system- Leap Motion* Martyna Samowicz	**Room: B** *Algorithm for Creating Propagation Attenuation Maps Based on Parabolic Equation Method* Michał Kryk
12:00 – 12:20 **Speech: 2** **(Room: B)**		
12:00 – 12:20 **Speech: 4** **(Room: A)**	**Room: A** *A Study on Selection of HRV-based Features for Different Classifiers in Atrial Fibrilation Detection* Szymon Buś	**Room: B** *Ionospheric scintillation diagnostic on LOFAR ILT network in single station mode* Mariusz Pozoga
12:20 – 12:40 **Speech: 3** **(Room: B)**		
12:20 – 12:40 **Speech: 5** **(Room: A)**	**Room: A** *Motivating wearable device for plegic hand rehabilitation* Ilona Dominik	**Room: B** *Polarimetric-radar drop size evaluation for wind speed estimate based on Weber criterion* Yuliya Averyanova
12:40 – 01:00 **Speech: 4** **(Room: B)**		

TIME (UTC)

WENESDAY 22.09.2021, Contents

Session	***S10 Signal and Image Processing for Medical Application I*** *Chair: Prof Anton Popov &* *Prof. Piotr Augustyniak*	***S6 Geoscience and Remote Sensing*** *Chair: Prof. Hanna Rothkaehl &* *Prof. Krzysztof Kulpa*
12:40 – 01:00 **Speech: 6** **(Room: A)** **01:00 – 01:20** **Speech: 5** **(Room: B)**	**Room: A** *TELASSISTENT SERVICES USING THE 5G NETWORK ON A REMOTE GUIDE FOR THE BLIND PERSONS* Robert Kawecki	**Room: B** *Determining ionospheric drift and anisotropy of irregularities from LOFAR core measurements* Marcin Grzesiak
01:20 – 02:00	***Dinner break***	
02:00 – 03:00	**Room A: Industrial Session 2** ***Business Partner***	**Room B: IEEE Signal Processing Society Chapter Poland meeting**
Session	***S11 Signal and Image Processing for Medical Application II*** *Chair: Prof. Tomasz Pięciak &* *Dr. Paweł Badura*	***S12 Geoscience and Remote Sensing*** *Chair: Dr. Michele Fiorini &* *Dr. Łukasz Maślikowski*
03:00 – 03:20 **Speech 1:**	**Room: A** *Experimental studies on the efficiency of people authentication using EEG data from the same and different examinations* Renata Plucińska	**Room: B** *A Modeling Problem of a Continuous Time Domain Signal by its Discrete Counterpart* Boguslaw Szlachetko
03:20 – 03:40 **Speech 2:**	**Room: A** *Improved Wireless Capsule Endoscope Localization with Phase Detection Algorithm* Paweł Oleksy	**Room: B** *TRISH — a Triggerless Random Interleaved Sampling Hardware* Marek Wojciech Rupniewski
03:40 – 04:00 **Speech 3:**	**Room: A** *Detection of Dyslexia Using Eye Tracking* Boris Nerusil	**Room: B** *Mitigating of received signal power loss caused by multipath effect in phased array radars* Jacek Gambrych

TIME (UTC) **WENESDAY 22.09.2021**, Contents

Session	***S11 Signal and Image Processing for Medical Application II*** *Chair: Prof. Tomasz Pięciak &* *Dr. Paweł Badura*	***S12 Geoscience and Remote Sensing*** *Chair: Dr. Michele Fiorini &* *Dr. Łukasz Maślikowski*
04:00 – 04:20 **Speech 4:**	**Room: A** *Analysis of Brain Reaction to Emotional Faces* Bohdan Vodianyk	**Room: B** *Ground Clutter Analises in Noise Radar using Unmatched Filter Concept* Maślikowski Łukasz
04:20 – 04:40 **Speech 5:**	**Room: A** *Cross-domain human motion recognition* Xianghan Yang	**Room: B** *Calibration of Transmitting and Receiving Array of a Radar using MIMO Measurement* Maślikowski Łukasz
04:40 – 05:00 **Speech 6:**		**Room: B** *A Hybrid Algorithm for Radar Cross Section Calculation of Electrically Large Targets* Zhuo Liu

THURSDAY 23.09.2021, Contents

TIME (UTC)		
08:45 – 09:00	*Testing and linking time …*	
09:00 – 10:45 **Tutorial** **Room: A**	***Feature engineering in signal analysis*** Prof. Anton Popov, *National Technical University of Ukraine "Igor Sikorsky Kyjv Polytechnic Institute" (Ukraine)*  **Anton Popov** is an Associate professor of Electronic Engineering Department of Igor Sykorsky Kyiv Polytechnic Institute (Ukraine), He is a lecturer for the courses "Theory of signals", "Biomedical Electronic Systems", "Machine Learning and signal processing in biomedical systems". He also hods a position of AI/Deep Learning Technical Lead in Ciklum (UK). Anton is an IEEE Senior Member and a member of IEEE Engineering in Medicine and Biology Society since 2001. Anton Popov authored 150 publications in peer-reviewed journals and conference proceedings and supervised more than 60 bachelors, masters, and PhD students. His research interests include applications of signal processing methods to the analysis and interpretation of biomedical signals and images. Currently, his group works on methods for epileptic seizure management based on electroencephalograms and cardiorythmograms, techniques for quantification of cognitive workload and emotions, recognition of imaginary movements, muscle synergies detection, stabilography, as well as other biosignals and medical images for diagnosis of diseases and evaluating the human physical conditions.	
10:45 – 11:00	***Coffee break***	
Session	***S5 Signal Processing Components*** *Chair: Prof. Mario Greco &* *Dr. Garcia Cava David*	***S9 Radar systems and application*** *Chair: Prof. Gaspare Galati &* *Prof. Jacek Misiurewicz*
11:00 – 11:40 **Keynote talk:**	**Room: A** *On enhancing data-driven structural health monitoring with explicit and implicit procedures* Dr. David García Cava	**Room: B** *The Trust and Truth od Digitalisation in Maritime Domain: where are we?* Dr. Michele Fiorini

TIME (UTC) **THURSDAY 23.09.2021**, Contents

Session	***S5 Signal Processing Components*** *Chair: Prof. Mario Greco &* *Dr. Garcia Cava David*	***S9 Radar systems and application*** *Chair: Prof. Gaspare Galati &* *Prof. Jacek Misiurewicz*
11:40 – 12:00 **Speech 1:**	**Room: A** *Resource Allocation in Correlated and Non-Correlated MIMO Systems* Stefan Klobe	**Room: B** *Estimation of Rotational Speed of Helicopter Rotor Through Horizontal Synchrosqueezing* Karol Abratkiewicz
12:00 – 12:20 **Speech 2:**	**Room: A** *Comparison of slip-compensated odometry for tracked, four- and six-wheel vehicles* Łukasz Chlebowicz	**Room: B** *Four-Channel Ground-Based C-Band FMCW Radar Demonstrator* Jakub Kamil Julczyk
12:20 – 12:40 **Speech 3:**	**Room: A** *Human Behavior Recognition Based on Multi-Dimensional Feature Learning of Millimeter-Wave Radar* Xiangfeng Wang	**Room: B** *Analysis of Spectrum Signatures from Rotating Blades of Small Drone* Ekaterina Plotnitskaya
12:40 – 01:00 **Speech 4:**	**Room: A** *Evaluation of EMD and SSA sensitivity for efficient detection of aerodynamic instabilities in centrifugal compressors* Mateusz Stajuda	

TIME (UTC)

THURSDAY 23.09.2021, Contents

01:00 – 02:00	***Dinner break***	
		Room B: On the Fringe **Alienation – how does it manifest itself and how to prevent it?** Dorota Myko, *Warsaw University of Technology (Poland)*
02:00 – 03:00	**Room A: Industrial Session 3** ***Digital Innovation Hub 5G*** Prof. Sławomir Hausman	
Session	***S7 Localization and Tracking*** *Chair: Dr. Rupniewski Marek & Prof. Marco Martorella*	***S8 Passive Radar*** *Chair: Dr. Mateusz Malanowski & Prof. Gomez-del-Hoyo, Pedro-Jose*
03:00 – 03:40 **Keynote talk** **(Room: A)**	**Room: A** *Recent advances in 3D Radar Imaging of Non-Cooperative Target* Prof. Marco Martorella	**Room: B** *2D Ground Target Location Using GPS based Passive Radar* Pedro-Jose Gomez-del-Hoyo
03:00 – 03:20 **Speech 1:** **(Room: B)**		
03:40 – 04:00 **Speech 1:** **(Room: A)**	**Room: A** *3D Localization for Multiplatform Radar Networks with Deployable Nodes* Angela Marino	**Room: B** *Preliminary detection results obtained with experimental airborne passive radar* Rafał Rytel-Andrianik
03:20 – 03:40 **Speech 2:** **(Room: B)**		

TIME (UTC) **THURSDAY 23.09.2021**, Contents

Session	***S7 Localization and Tracking*** *Chair: Dr. Rupniewski Marek & Prof. Marco Martorella*	***S8 Passive Radar*** *Chair: Dr. Mateusz Malanowski & Prof. Gomez-del-Hoyo, Pedro-Jose*
04:00 – 04:20 **Speech 2:** **(Room: A)**	**Room: A** *Adaptive Anchor Pairs Selection in a TDOA-based System Through Robot Localization Error Minimization* Marcin Kolakowski	**Room: B** *Field Trials of Passive Radiolocation using LOFAR Radio Telescope and External Reference Receiver* Konrad Jędrzejewski
03:40 – 04:00 **Speech 3:** **(Room: B)**		
04:20 – 04:40 **Speech 3:** **(Room: A)**	**Room: A** *Measurement Error Correlation in Processing of Overlapping Blocks in FMCW Radar* Krzysztof Stasiak	**Room: B** *Performance Optimization for Passive Bistatic Radar Based on Detection Range Predictions* Marcin Żywek
04:00 – 04:20 **Speech 4:** **(Room: B)**		
04:40 – 05:00 **Speech 4:** **(Room: A)**	**Room: A** *Overlaping-based Radio Signal Processing for SDF Location Method* Rafał Szczepanik	**Room: B** *Signal conditioning for DAB-illuminated passive radar* Gustaw Mazurek
04:20 – 04:40 **Speech 5:** **(Room: B)**		
05:30 – 06:00	***SPSympo CLOSING*** **SPSympo-Chairs**	

Session ***Image Processing and Recognition*** Tuesday **21.09.2021**

Chair: Dr. Artur Klepaczko & Prof. Feng Xu

TIME (UTC)	Speech 1:	
11:00 – 11:20		Millimeter-wave radar has high cost performance and environmental adaptability. As the degree of integration of millimeter-wave radar increases, it is widely used in the field of autonomous driving. To reduce the background noise of point cloud and poor data relevance millimeter-wave radar, this paper studies the output point cloud characteristics based on the 77GHZ millimeter wave MIMO radar AWR1443 verification system. We propose a point cloud filtering method based on the millimeter wave radar point cloud. Furthermore, the point cloud data set from four gestures of traffic police is created and sent to classification neural network Point GNN. The four gestures, including stopping, turning right, turning left and holding can be recognized by point cloud classification. The recognition accuracy rate is up to 83%.
Title:	**Human Detection and Action Classification Based on Millimeter Wave Radar Point Cloud Imaging Technology**	
Room: A		
	jiayu wu[1], zhanyu zhu[2], Haipeng wang[1]	
Organization(s):	*[1] Fudan University (China), [2] Suzhou University (China)*	
Session:	*Image Processing and Recognition*	

11:20 – 11:40	Speech 2:	In this paper we propose sparse neural networks with topologies inspired by fast computational butterfly structures of selected linear transforms, namely: fast discrete cosine transform, and Beneus network like topologies. It should be emphasized that sparse neural networks allow to obtain high reduction in the number of arithmetic operations and weights needed by neural structures while preserving good efficiency in selected tasks where dense neural networks find their applications. In order to verify the efficiency of the considered structures we conducted a series of experiments in data compression and image recognition. The obtained experimental results confirm good efficiency of the considered sparse neural structures and reveal that such topologies allow for significant reduction in the number of required arithmetic operations and weights that must be trained and stored in order to re-use trained neural networks.
Title:	**Sparse Neural Networks With Topologies Inspired by Butterfly Structures**	
Room: A		
	Dariusz Puchala, Kamil Stokfiszewski	
Organization(s):	*Lodz University of Technology (Poland)*	
Session:	*Image Processing and Recognition*	

Session ***Image Processing and Recognition*** Tuesday **21.09.2021**

Chair: Dr. Artur Klepaczko & Prof. Feng Xu

TIME (UTC) **11:40 – 12:00** **Title:** **Room: A** *Organization(s):* *Session:*	Speech 3: **Composition of Similarity Metrics for Correspondence Matching in Depth Estimation** Hubert Żabiński, Olgierd Stankiewicz *Poznan University of Technology (Poland)* *Image Processing and Recognition*	Correspondence matching is a prerequisite step in dense depth estimation techniques. In this paper we consider various similarity metrics for correspondence matching and we present an approach which can be used to optimize it, which is based on statistical analysis of the training dataset. Experimental results show that by careful selection of similarity metric can have positive impact on depth estimation quality and that the differences between various metrics range up to 60 percent points of bad-pixel depth map quality ratio. It has also been shown that usage of proposed composite similarity can lead to improved depth map quality, expressed as lower bad-pixel ratio.
12:00 – 12:20 **Title:** **Room: A** *Organization(s):* *Session:*	Speech 4: **Human Sleep Posture Recognition Based On Millimeter-Wave Radar** Tao Zhou, Zhaoyang Xia, Xiangfeng Wang, Feng Xu *Fudan University (China)* *Image Processing and Recognition*	In this paper, we propose a robust human sleep posture recognition method via multidimensional feature representation and learning based on millimeter-wave (mmw) radar. Firstly, through time-frequency processing of the radar echo signal reflected by the human body, the range spectrum, Doppler spectrum, range-Doppler spectrum, horizontal angle spectrum and vertical angle spectrum of the estimated target are obtained. By setting a fixed frame window time length and splicing the above feature spectrums, 5 single-channel 2D radar features are obtained, and combining them in parallel can get a variety of different multi-channel 2D radar feature representations. Finally, a lightweight multi-channel convolutional neural network (CNN) with Inception-Residual module (IRM) is designed to learn and classify multidimensional features. Extensive experiments were carried out using the developed system, and a large amount of data was obtained to train and test the classifier. The results show that the proposed sleep posture recognition method can effectively distinguish different sleep postures and achieve robust performance and generalization compared to other methods.

Session ***Image Processing and Recognition*** Tuesday **21.09.2021**

Chair: Dr. Artur Klepaczko & Prof. Feng Xu

TIME (UTC) **12:20 – 12:40** **Title:** **Room: A** *Organization(s):* *Session:*	Speech 5: **Wavelet transform applied to coffee entomology** João Paulo Lemos Escola[1,3], Rodrigo Capobianco Guido[2], Ivan Nunes da Silva[1], Everton Silva Fonseca[3] [1]*Universidade de São Paulo (Brazil),* [2]*Universidade Estadual Paulista (Brazil),* [3]*Instituto Federal de São Paulo (Brazil)* *Image Processing and Recognition*	In this work, the studies, the design and the development of a computational algorithm to assist in the management of insect pests in coffee plantations are documented, particularly detecting the presence of cicadas in the middle of the plantations. Acoustic signals captured previously are submitted to the system, which reads the raw data, converts them to the wavelet domain and groups them based on the Bark Scale. Then, Paraconsistent Characteristics Analysis, appearing as a technique recently presented in the scientific literature and which had not yet been used for this purpose, serves as a basis for selecting the best filter banks so that they can be later delivered to a Support Vector Machine, responsible for the final phase of signal identification. The accuracy of 100% was achieved in most of the 3600 tests performed, proving the viability of the implemented strategy, which has become minimally complex due to the optimization provided by the paraconsistent methodology. Finally, a prototype in the scope of Internet of Things is described to serve as a possibility of implantation in the field.
12:40 – 13:00 **Title:** **Room: B** *Organization(s):* Session:	Speech 6: **Fast Selection of INTRA CTU Partitioning in HEVC Encoders using Artificial Neural Networks** Mateusz Lorkiewicz[1], Olgierd Stankiewicz[1], Marek Domański[1], Hsueh-Ming Hang[2], Wen-Hsiao Peng[2] *Poznan University of Technology (Poland)* *Geoscience and Remote Sensing*	The paper deals with reduction of the computational complexity of the widely employed HEVC video encoders in the intra-frame mode. The work is focused on the laborious selection of the best partition of each coding three unit (CTU). The idea is to use a pre-trained neural network that mimics the decisions of the classic encoder control algorithms developed in the MPEG reference software. In the first part of the paper, an attempt for straightforward approach is considered where CTUs are classified according to their content into classes corresponding to the partitions of CTUs. It is demonstrated why such an approach cannot be successful. In the second part of the paper, context-based training of a neural network is considered. The context consists of a number of the previously encoded CTUs. First of all, the problem of the choice of the context is considered. Then, the results obtained with HEVC intra-frame coding are provided for the selections of the CTU partitions made by the pre-trained neural network.

Session ***Audio and video processing*** Tuesday **21.09.2021**

Chair: Prof. Janusz Konrad & Prof. Piotr M. Szczypiński

TIME (UTC) **03:00 – 03:40**	**Keynote talk**	
Title: **Room: A**	**Indoor Scene Analysis from Overhead Fisheye Cameras** Prof. Janusz Konrad	
03:40 – 04:00 **Title:** **Room: A**	Speech 1: **Modeling multipath propagation of acoustic signal in a swimming pool** Jacek Misiurewicz[1], Konrad Bruliński[2], Wiesław Klembowski[3], Krzysztof Kulpa[1]	The paper deals with a problem of severe multipath propagation of underwater acoustic signal in a swimming pool. The problem appeared during a study of a system for pool safety enahcement. The system idea is to detect pre-drowning symptoms with a wearable device given to all pool users, and to signal an emergency situation with ultrasonic message. Finally, the system should locate the alarm signal source in the pool. A swimming pool acoustic environment differs from the sea environment by presence of large flat reflecting planes and by a small size of the water cube. Then, the reflections are numerous and very strong, heavily influencing the localization process. The paper presents an attempt to create a model of the swimming pool response, suitable for simulation experiments with detection and localization of emergency signal. The model is verified with live hydroacoustic recordings from real pools. Then, a study of possible remedies for the localization system, applied on the trasmit side (waveform design) and on the receive side (receiver placement and signal processing) is presented.
Organization(s):	*[1]Warsaw University of Technology (Poland), [2]Lemontech s.c. (Poland), [3]Berserg sp. z o.o. (Poland)*	
Session:	*Audio and video processing*	
04:00 – 04:20 **Title:** **Room: A**	Speech 2: **Localization of an Acoustic Emission Source Based on Time Difference of Arrival** Mariia Khyzhniak, Mateusz Malanowski	The paper presents results of localization of an acoustic emission source in the two-dimensional space based on signals acquired using microphones and the TDoA (Time Difference of Arrival) technique. The delay between signals in the channels is measured using their cross-correlation. Then the location is obtained using multilateration. The Firefly Algorithm and Gradient Descent Algorithm are used for the purpose of estimating the location.
Organization(s):	*Warsaw University of Technology (Poland)*	
Session:	*Audio and video processing*	

Session ***Audio and video processing*** Tuesday **21.09.2021**

Chair: Prof. Janusz Konrad & Prof. Piotr M. Szczypiński

TIME (UTC) **04:20 – 04:40** **Title:** **Room: A** *Organization(s):* *Session:*	Speech 3: **Analysis of error in sound sources position estimation with microphone arrays** Manuel Rosa Zurera, Manuel Utrilla-Manso, Roberto Gil-Pita, Joaquín Garcia-Gomez *University of Alcalá (Spain)* *Audio and video processing*	This paper presents a study of errors in sound source position estimation with two microphone arrays. The position is determined as the intersection of two lines which pass through the centres of the arrays with slopes equal to the angle of arrival. Due to errors in the direction of arrival estimation, the estimated position of the sound source could be erroneous. An analytical method is presented to study the vector norm of positioning error, which is complemented with a methodology based on Monte-Carlo simulations. This methodology has been applied to a system of two arrays, resulting that the area where position is estimated accurately is small, suggesting the usage of networks of arrays for the surveillance of wide areas.
04:40 – 05:00 **Title:** **Room: A** *Organization(s):* *Session*:	Speech 4: **Motion-Based Multiple Object Detection and Tracking in Video Stream** Piotr Sadura *Warsaw University of Technology (Poland)* *Audio and video processing*	Detecting and tracking objects is recently very important problem in computer vision field. It is widely used in areas like surveillance, security, automated vehicle systems and many more. This application is capable of detecting and tracking multiple objects in video sequences captured by a static camera.
05:00 – 05:20 **Title:** **Room: A** *Organization(s):* *Session*:	Speech 5: **Analysis of mouth click sounds used in echolocation** Magdalena Bogus, Michał Bujacz *Lodz University of Technology (Poland)* *Audio and video processing*	The aim of the thesis was to determine and compare basic signal properties of mouth clicks made for the purpose of echolocation. It was possible thanks to the involvement of 30 sighted volunteers, who prepared mouth clicks' recordings according to the received instructions. The volunteers recorded three types of clicks – loudest, highest and lowest repeating each 10 times. All samples were automatically analysed using a program written in Python, that calculated the main frequency and relative amplitude for each sound. The gathered data were used to prepare statistics. The majority of frequencies from all mouth clicks were obtained in the range of 0.5-2kHz, with lowest amplitudes for lower frequency clicks. These results were consistent with expectations, however, they were obtained with quite a high standard deviation.

Session ***Telecommunication/Radar signal processing*** Tuesday **21.09.2021**

Chair: Prof. Fabrizio Berizzi & Prof. Konrad Jędrzejewski

TIME (UTC)	**Keynote talk**	
11:00 – 11:40		
Title:	***Electromagnetic Metamaterials and Metasurfaces: Design, Fabrication, and Applications***	
Room: B	Prof. Sławomir Hausman	
11:40 – 12:00	Speech 1:	Power and energy consumption of communication networks contribute to the resource demand and hence the sustainability of society. Transmission links form important basic parts of communication networks and thus they add to the overall communication networks' resource demand. Therefore it is important to optimize transmission links in order to support the energy-efficient design of communication networks. In transmission systems the constellation size in general is a degree of freedom when designing a transmission link. In this contribution, baseband transmission via additive white Gaussian noise (AWGN) channels and copper cables is optimized with respect to minimum power usage and energy demand, respectively -- for the practically relevant case of fixed throughput and given transmission quality of a link. The results are two-fold: In the AWGN case the minimum power and energy is used at the smallest possible constellation sizes. In contrast, in the practical case of band-limited baseband transmission over twisted-pair copper wires the optimum constellation size increases as the band limitation becomes stronger, i.,e., as the cable gets longer at constant bit rate or the bit rate is increased at constant link length.
Title:	**Power and Energy Efficiency Optimization of Baseband Transmission Links**	
Room: B	Christoph Lange[1], Andreas Ahrens[2]	
Organization(s):	*[1]Hochschule für Technik und Wirtschaft Berlin, University of Applied Sciences (Germany), [2] Hochschule Wismar, University of Technology, Business and Design (Germany)*	
Session:	*Telecommunication/Radar signal processing*	
12:00 – 12:20	Speech 2:	This paper is devoted to modelling of telecommunication traffic, generated by nodes in mobile ad hoc networks (MANET), according to different categories in MANET topology. Each category of nodes is characterized by its traffic profile, described by intensity of use of specific services. The overall traffic generated by the node is a combination of traffics related to specific services, and their statistical parameters are coming from real exercises.
Title:	**Traffic Modelling for Mobile Ad-hoc Networks Simulation**	
Room: B	Piotr Gajewski, Jerzy Lopatka, Piotr Lubkowski	
Organization(s):	*Military University of Technology (Poland)*	
Session:	*Telecommunication/Radar signal processing*	

Session ***Telecommunication/Radar signal processing*** Tuesday **21.09.2021**

Chair: Prof. Fabrizio Berizzi & Prof. Konrad Jędrzejewski

TIME (UTC) **12:20 – 12:40** **Title:** **Room: B**	Speech 3: **Multitaper Time-Frequency Reassigned Spectrogram in Micro-Doppler Radar Signal Analysis** Karol Abratkiewicz, Piotr Samczyński *Warsaw University of Technology (Poland)* *Telecommunication/Radar signal processing*	This paper presents the concept of using the multitaper time-frequency (TF) reassigned spectrogram in the context of micro-Doppler signal analysis used in radar applications. Firstly, the theoretical background essential for understanding further analysis and implementation of the considered method is presented. Next, the simulation results highlighting the advantages of multitaper reassignment in the context of applying it in micro-Doppler analyses are illustrated. Finally, real data collected by the compact short-range radar system is processed. The obtained results show significant improvement in the separability of components on the TF plane. Thanks to using the multitaper technique, only the most contributing components remained visible on the TF distribution. Thus, the target movement parameters can be further distinguished thanks to the possibility of both the concentration of energy on the plane and averaging noise.
12:40 – 01:00 **Title:** **Room: B**	Speech 4: **Target HRRP Reconstruction Based on Waveform Delay Dictionary with Phase-coded Pulse in Anechoic Chamber** Xiaobin Liu, Feng Zhao, Qihua Wu, Xiaofeng Ai *National University of Defense Technology (China)* *Telecommunication/Radar signal processing*	Pulse radar signal is utilized in anechoic chamber for target measurement based on the interrupted transmitting and receiving (ITR). However, the target echo is partly received after ITR of the phase-coded pulse. Then, the precise target high resolution range profile (HRRP) is difficult to be obtained. As the distance range between the target and antenna can be known previously, the waveform delay dictionary is proposed in this paper to construct the transform matrix of compressive sensing (CS). Then, the target HRRP can be reconstructed by solving the optimization problem. Simulations are conducted and the results indicate that the proposed waveform delay dictionary shows good HRRP reconstruction performance in anechoic chamber for the target measurement.

Organization(s):

Session:

Session ***Telecommunication/Radar signal processing*** Tuesday **21.09.2021**

Chair: Prof. Fabrizio Berizzi & Prof. Konrad Jędrzejewski

TIME (UTC) **01:00 – 01:20** **Title:** **Room: B**	Speech 5: **PA Distortions on Radar Signals for Spectral Coexistence** Vincenzo Carotenuto[1], Augusto Aubry[1], Antonio De Maio[1], Alessio Izzo[1], Alfonso Farina[2], Rosario Schiano Lo Moriello[1]	This paper deals with the effects of Power Amplifiers (PAs) on radar waveforms designed to ensure spectral compatibility with other Radio Frequency (RF) wireless systems cohabitating in the same frequency band. To this end, a specific hardware-in-the-loop test-bed composed of a Personal Computer (PC), an Arbitrary Waveform Generator (AWG), a nonlinear PA, and a Signal Analyser (SA) is designed. It allows to gather measurements of the amplified signal and to grasp unwanted modifications of its spectral features due to the PA nonlinear distortion. Besides, it permits a quantitative assessment of the discrepancies between the nominal and the actual interference power injected by the radar in the shared frequency bandwidths. To alleviate the spectral distortions induced by the PA and improve spectral coexistence, the use of a Digital Pre-Distortion (DPD) stage upstream the PA is investigated. Modeling techniques together with parameters inference are discussed and applied to the measured waveforms. The obtained experimental results highlight that pairing a suitable waveform design strategy with a DPD processing represents a viable means to mitigate the PA distortions and to realize spectral coexistence.
Organization(s):	*[1]University of Naples Federico II (Italy),* *[2]Technical consultant*	
Session:	*Telecommunication/Radar signal processing*	

Session ***Synthetic aperture radars and radar imagery*** Tuesday **21.09.2021**

Chair: Prof Paulo Marques & Prof. Jerzy Pietrasiński

TIME (UTC) **03:00 – 03:20** **Title:** **Room: B** *Organization(s):* *Session:*	Speech 1: **Experimental Results of SAR Imaging Using aLow-Cost X-band Radar with a PLL with DirectModulation for UAV Applications** Damian Gromek, Piotr Samczynski, Krzysztof Stasiak, Jakub Julczyk, Maciej Wielgo, Karol Abratkiewicz *Warsaw University of Technology (Poland)* *Synthetic aperture radars and radar*	This paper presents the system design, imaging algorithm, and first trial results of an X-band frequency modulated continuous wave (FMCW) synthetic aperture radar (SAR) with the transmitted waveform synthesized by a PLL with direct modulation. The instant growth of autonomous vehicle technology puts a demand on sensors, precision, and affordability. The latest navigation and avionics trends lead to miniaturization, highly appreciated in unmanned aerial vehicle (UAV) applications. In particular, low cost, small size, and high precision of remote sensors find a wide range of applications in civilian and military domains (e.g., autonomous delivery systems, driving assistance systems, self-driving cars, military surveillance missiles, or fire guidance, among others). The SAR sensor presented in this paper was designed to be a small and affordable radar sensor dedicated to small UAV platforms and radar imaging. System architecture and a brief description of the signal processing algorithms are illustrated in this paper. The utility of the system is supported by preliminary results from ground-based and airborne trials.
03:20 – 03:40 **Title:** **Room: B** *Organization(s):* *Session:*	Speech 2: **A Novel Criterion for Array Geometry Optimization** Meysam Eskandari, Seyed Mohammad Karbasi *Sharif University of Technology (Iran)* *Synthetic aperture radars and radar*	The multiple signal classifier (MUSIC) is a popular sub-space based method to estimate Angle of Arrival (AoA) of narrow-band and uncorrelated signals. With the same number of antennas, the placement of array elements has a significant effect on the array steering vectors, which directly affects the accuracy of AoA estimation employing the MUSIC algorithm. In this paper, relation of array geometry and AoA estimation accuracy is studied with some theoretic and simulation analysis, and a novel method for array design (placement of antennas) is proposed to improve the accuracy in AoA estimation. Several practical and simulation experiments are given to justify the performance of the proposed method.

Session ***Synthetic aperture radars and radar imagery*** Tuesday **21.09.2021**
Chair: Prof Paulo Marques & Prof. Jerzy Pietrasiński

TIME (UTC) **03:40 – 04:00** **Title:** **Room: B** *Organization(s):* Session:	Speech 3: **Non-coherent change detection in real SAR satellite imagery with usage of the CFAR algorithms** Artur Gromek *Warsaw University of Technology (Poland)* *Synthetic aperture radars and radar*	Change detection in SAR radar imagery can be divided onto coherent (CCD) and non-coherent (NCCD) methods. In the case of coherent methods, we have an increased sensitivity to changes (due to taking into account phase information) at the expense of the incorporating phase noise, which in turn increases the level of false detections. In the case of incoherent methods, we do not take into account signal phase information but only its amplitude, which results in a~lower sensitivity to changes and a~lower level of false detections. Therefore, incoherent detectors often demonstrates better operating performance (ROC curves) than coherent ones -- while being simpler and easier.
04:00 – 04:20 **Title:** **Room: B** *Organization(s):* *Session:*	Speech 4: **High-Resolution SAR Imaging with Orthogonal Sub-Band Frequency Diverse Array** Mengdi Zhang, Guisheng Liao, Jingwei Xu *National Lab of Radar Signal Processing, Xidian University (China)* *Synthetic aperture radars and radar*	In this paper, a novel method is proposed to achieve high range resolution imaging with orthogonal sub-band frequency diverse array. In the proposed system, the signals transmitted by adjacent subarray has a frequency increment which is close to signal bandwidth. When transmits narrow band signal, this system has the ability of Moving Target Indication (MTI). Meanwhile, this system is capable of high-resolution imaging by splicing spectrum technique. This papers focuses on the application of this system in SAR imaging and proposes an approach to high range resolution imaging by spectrum splicing. Simulation results have verified the effectiveness of the proposed method.

Session ***Synthetic aperture radars and radar imagery*** Tuesday **21.09.2021**
Chair: Prof Paulo Marques & Prof. Jerzy Pietrasiński

TIME (UTC) **04:20 – 04:40** **Title:** **Room: B** *Organization(s):* *Session:*	Speech 5: **ISAR IMAGING PHASE CORRECTION ALGORITHM BASED ON ENTROPY MINIMIZATION** Andon Lazarov, Christo Kabakchiev *Nikola Vaptsarov Naval Academy (Bulgaria)* *Synthetic aperture radars and radar*	In the present paper, a 2-D ISAR geometry and image reconstruction technique are discussed. Based on the discrete geometry of the observed object and linear frequency modulation of emitted waveform, ISAR signal model is constructed. A Range-Doppler image reconstruction algorithm with phase correction is developed. First, phases induced by radial displacement of the mass center along line of sight (LoS) is compensated. Second, phases of higher order on azimuth direction due to long synthetic aperture length is compensated. Third, 2-D Fourier transform is applied for range and azimuth compression. A signal's phase correction algorithm based on entropy cost function is created to compensate for higher order phase terms due to long aperture length and illustrated by numerical experiment.
04:40 – 05:00 **Title:** **Room: B** *Organization(s):* *Session:*	Speech 6: **Polarimetric Calibration of Mini SAR based on UAV Platform** Jiaxuan Liu, Yixiang Luomei, Xudong Yuan, Feng Xu *Fudan University (China)* *Synthetic aperture radars and radar*	The Miniaturized Synthetic Aperture Radar has the characteristics of 'anytime imaging', day or night from an airborne platform, so it is a promising candidate for many applications, such as high-resolution terrain elevation mapping, coherent change detection, and crevasse detection. To reduce the phase difference, channel crosstalk, channel imbalance, and other effects between the channels (single, dual, or full Polarimetric), the author adopts a new Polarimetric calibration method. This method uses the reflector corner as the reference calibration point to accurately calibrate the vertical channel system gain and the unbalance factor of the four polarimetric channels, without the need to make assumptions about the scattering characteristics of the scene. This method is suitable for Ku-band multi-rotor UAVs Miniaturized SAR data. Compared with the Qengan algorithm, it can obtain more accurate amplitude estimation and channel imbalance estimation.

Session ***Synthetic aperture radars and radar imagery*** Tuesday **21.09.2021**
Chair: Prof Paulo Marques & Prof. Jerzy Pietrasiński

TIME (UTC) **05:00 – 05:20** **Title:** **Room: B** *Organization(s):* *Session*:	Speech 7: **Effects of SAR Resolution in Automatic Building Segmentation Using CNN** Sandhi Wangiyana, Piotr Samczyński, Artur Gromek *Warsaw University of Technology (Poland)* *Synthetic aperture radars and radar*	Successful deep learning (DL) models for Synthetic Aperture Radar (SAR) images mostly require high-resolution images. The lack of datasets for historical and publicly available SAR images in high-resolution quality limits DL methods applications for SAR. We simulate SAR resolution scaling by applying filters with varying strength in the preprocessing step of the dataset. A segmentation model is trained on each dataset along with different model architecture and backbone. The Feature Pyramid Network (FPN) model achieved the best results while being robust for datasets with weak filtering.

Session ***Signal and Image Processing for Medical Application I*** Wednesday **22.09.2021**

Chair: Prof. Anton Popov & Prof. Piotr Augustyniak

TIME (UTC) **11:00 – 11:20** **Title:** **Room: A**	Speech 1: **Distance Metrics for Classification of Arbitrarily Sampled Patterns – an ECG Example** Piotr Augustyniak	Compression, Compressed Sensing and Arbitrary Sampling are all data reduction techniques challenging the general sampling theory and investigated towards maintaining of original information untouched. In geology, astronomy, meteorology or medicine data are available in irregular intervals, other domains apply a priori knowledge about limitations of signal source. To the latter category belongs the ECG, where all recorders worldwide produce daily ca. 600TB of data with expected average storage time of order of 40 years. Unfortunately direct processing of non-uniformly sampled time series is rarely applied due to lack of appropriate methods. In this paper we propose a Distance Metric and its usage to classification of 1-D non-uniform signals such as heart beats. The classification error and computational complexity both are greater than in the case of uniform patterns, however the proposed algorithm is sampling model independent and may also be applied to uniform data.
Organization(s):	*AGH University of Science and Technology (Poland)*	
Session:	*Signal and Image Processing for Medical Application I*	
11:20 – 11:40 **Title:** **Room: A**	Speech 2: **Mutual Information Analysis of Brain-Heart Interactions in Epileptic Children** Ivan Kotiuchyi[1,2], Riccardo Pernice[3], Anton Popov[1,2], Volodymyr Kharytonov[4], Luca Faes[3]	In this work, we apply the network physiology paradigm to retrieve information from central and autonomic nervous systems before the focal epileptic seizure, represented respectively by electroencephalogram (EEG) signals and R-R intervals (RRI), and investigate the presence and strength of brain-heart interactions by computing mutual information (MI) measures. Statistical significance of MI values was tested through surrogate time series generated with the random shuffle approach. Our results suggest that the proposed method for aligning signals representing brain and heart activity measured with different sampling rates is capable of revealing coupling between RRI representing heart system, and aligned averaged power spectrum of brain processes, measured with EEG, resulting in significant MI. For electrodes C3, Fp2, Cz, and T4 in correspondingly α, β, γ, and total frequency bands, we obtain significantly smaller values of MI in the pre-ictal period in comparison with the baseline period, as well as a general decrease of significant and all estimated MI values before the focal seizure can be observed.
Organization(s):	*[1]National Technical University of Ukraine (Ukraine),* *[2]Ciklum Data & Analytics,* *[3]University of Palermo (Italy)* *[4]TMO "Psychiatry", Kyiv (Ukraine)*	
Session:	*Signal and Image Processing for Medical Application I*	

Session ***Signal and Image Processing for Medical Application I*** Wednesday **22.09.2021**
Chair: Prof. Anton Popov & Prof. Piotr Augustyniak

TIME (UTC) **11:40 – 12:00** **Title:** **Room: A** *Organization(s):* *Session:*	Speech 3: **Hand measurement based on integrated vision system- Leap Motion** Martyna Samowicz[1], Anna Wieteska[1], Justyna Redlicka[2], Katarzyna Koter[1], Igor Zubrycki[1], *[1]Lodz University of Technology (Poland), [2]Medical University of Lodz* *Signal and Image Processing for Medical Application I*	This paper presents a measurement system for after-stroke patients with plegic hands, based on an integrated vision system – Leap Motion. The device provides a simplified way to measure a set of hand parameters such as hand size, wrist and fingers range of motions. Using the homogenous-matrix-based notation, we derive medically relevant medical values. We provide a user interface for ease of data processing, experiments, and tracking patient progress.
12:00 – 12:20 **Title:** **Room: A** *Organization(s):* *Session:*	Speech 4: **A Study on Selection of HRV-based Features for Different Classifiers in Atrial Fibrilation Detection** Szymon Buś[1], Konrad Jędrzejewski[1], Przemysław Guzik[2] *[1]Warsaw University of Technology (Poland), [2]Poznan University of Medical Sciences (Poland)* *Signal and Image Processing for Medical Application I*	We investigated selection of features used in various machine learning algorithms employed for the detection of atrial fibrillation. The features were derived from the analysis of Heart Rate Variability from ECG. We show how the feature selection impacts the statistical metrics of the atrial fibrillation detection and identify the best feature sets for particular classifiers.

Session ***Signal and Image Processing for Medical Application I*** Wednesday **22.09.2021**
Chair: Prof. Anton Popov & Prof. Piotr Augustyniak

TIME (UTC) **12:20 – 12:40** **Title:** **Room: A** *Organization(s):* *Session:*	Speech 5: **Motivating wearable device for plegic hand rehabilitation** Ilona Dominik[1], Ewa Praczko[2], Igor Zubrycki[1] *[1]Lodz University of Technology (Poland),* *[2]Neurological Rehabilitationand Rehabilitation Ward Municipal Medical Centre Jonsche (Poland)* *Signal and Image Processing for Medical Application I*	We present an inexpensive, passive device supporting patient's hand rehabilitation while their hand is in a plegic state. The device's stand-alone capabilities allow patients to train their hands while in bed by reminding them to train using the set of exercises. A simple gamification scheme using flexion sensors and an accelerometer as input provides a way to motivate patients. Wifi connectivity to a cloud-based therapist interface allows monitoring of patient activity. The resulting device can support the hospital and house rehabilitation.
12:40 – 13:00 **Title:** **Room: A** *Organization(s):* *Session*:	Speech 6: **TELASSISTENT SERVICES USING THE 5G NETWORK ON A REMOTE GUIDE FOR THE BLIND PERSONS** Robert Kawecki, Paweł Oleksy, Jarosław Kawecki, Piotr Korbel, Slawomir Hausman *Lodz University of Technology (Poland)* *Signal and Image Processing for Medical Application I*	This article presents a teleassistant system for blind people used to navigate them during the movement. The system uses a smartphone, Intel RealSense depth camera and a dedicated Red5 server. The data sent from the depth camera allows for accurate measurement of the distance of the blind person from the obstacles that they include, which improves the quality of their navigation. The signal quality was ensured through the use of the 5G network, which was launched in a pilot version at the Lodz University of Technology. The article also presents the possibilities and options offered by the new generation of the telecommunications network.

Session ***Signal and Image Processing for Medical Application II*** Wednesday **22.09.2021**

Chair: Prof. Tomasz Pięciak & Dr. Paweł Badura

TIME (UTC)

03:00 – 03:20

Title:

Room: A

Speech 1:

Experimental studies on the efficiency of people authentication using EEG data from the same and different examinations

Renata Plucińska[1]
Konrad Jędrzejewski[1]
Jacek Rogala[2]
Urszula Malinowska[2]
Marek Waligóra[2]

Organization(s):

[1]Warsaw University of Technology (Poland),
[2]Nencki Institute of Experimental Biology (Poland)

Session:

Signal and Image Processing for Medical Application II

The paper presents the results of studies on authentication of human subjects, using electroencephalography (EEG) signals. Many research results presented in the literature assume that the data used both for training and testing may come from the same set. In this work, we verified how the authentication results change if the data used for training and testing are from separated recording sessions. The examinations used in the studies were collected from 36 healthy adults, and 20 EEG sessions planned for each person. We evaluated the statistical metrics of the considered authentication methods based on the analysis of signal features (parameters) from different EEG bands: separately for delta, theta, alpha, beta, and gamma, as well as for the combinations of features from the different EEG bands. In the first approach, the first 15 examinations from each participant were used for training and the remaining 5 for testing. In the second approach, 75 % of features from each session were used for training and the remaining 25 % for testing. The results show that the statistical metrics of authentication analyzes that were obtained using signals from the same set, both for training and testing, turned out to be better than when we split the data using individual sets for training and examination. In practice, the authentication is performed based on a current examination which is different from the examinations used for training. Therefore, for the proper evaluation of the authentication methods, only the metrics obtained when the examinations used for training and testing are separated. The results suggest also that while increasing the number of the frequency bands from which the features are used in the neural networks, the differences between the two approaches are less significant but still visible.

Session ***Signal and Image Processing for Medical Application II*** Wednesday **22.09.2021**

Chair: Prof. Tomasz Pięciak & Dr. Paweł Badura

TIME (UTC) **03:20 – 03:40** **Title:** **Room: A** *Organization(s):* Session:	Speech 2: **Improved Wireless Capsule Endoscope Localization with Phase Detection Algorithm** Paweł Oleksy, Łukasz Januszkiewicz *Lodz University of Technology (Poland)* *Signal and Image Processing for Medical Application II*	Wireless capsule endoscopes record and transmit pictures that are used to diagnose the human digestive tract. The localization of the capsule allows precise identification of regions with lesions. This can be performed basing on the processing of signal received from the capsule. Since human body is complex heterogenous environment, that influences the propagation of wireless signal it is difficult to precisely determine the distance between the transmitter and the receiver upon the analysis of received power level. The article presents the improved method of locating endoscope capsules with the use of phase detection algorithm. This algorithm uses adaptive estimation of human body model permittivity for each capsule position. Also the influence of helical and dipole antennas on the localization accuracy were examined.
03:40 – 04:00 **Title:** **Room: A** *Organization(s):*	Speech 3: **Detection of Dyslexia Using Eye Tracking** Boris Nerusil, Jaroslav Polec, Juraj Skunda *Slovak University of Technology in Bratislava(Slovakia)*	Relationship between cognitive impairment and irregularities in eye movements during monitoring visual or textual information has been the target of many scientific studies. The results diagnostics based on data obtained from the eye tracker actually showed differences between healthy and diagnosed individuals. For example, early diagnosis of Alzheimer's disease [1], the results of the study showed that the technology of eye tracking with comparison cognitive functions can be successfully used to differentiate older adults and older patients diagnosed with a neurological disorder. The method can also be used for detection of memory impairment associated with mild cognitive impairment (MCI). Another publication deals with the detection of autism spectrum disorder (ASD) during Internet searches, or web browsing [2] and have been demonstrated differences between healthy and diagnosed individuals. An experiment comparing differences in eye movement in schizophrenia and ASD [3]. It did not show the characteristics of eye movements that occurred in people with schizophrenia abnormalities in people with ASD. The results showed that abnormalities in eye movement in individuals with ASDs were not as severe as schizophrenia, at least in terms of the characteristics examined here. Published experiments also dealt with the detection of signs of Amyotrophic Lateral Sclerosis (ALS) [4] or by detecting dyslexia in children while reading text [5]. According to the analysis of the current state and

Session:	*Signal and Image Processing for Medical Application II*	available scientific research, the connection is thus proven with specific eye movement in the subjects and the possible occurrence of any of defined failures based on previous tests. That's why we focused our research to a specific group diagnosed with dyslexia and designed to test and test a method that can be a useful tool in the diagnosis of dyslexic disorder. This paper presents a method for detection of cognitive disorder based on eye tracking during reading. The goal of this research is to give another perspective and extend the experiments conducted in Sweden recently published in the article Screening for Dyslexia Using Eye Tracking during Reading. Our experiments are accomplished on dataset that comprises of 185 recordings of participants that was provided by the Swedish researchers. The participants were categorized into two groups – High Risk (HR) and Low Risk (LR). 97 subjects (76 males and 21 females) were allocated to the HR group and 88 subjects (69 males and 19 females) were identified without dyslexia belonging to the LR group. An early detection of subjects suffering from cognitive impairment is beneficial in order to undergo therapy at an early stage and that is why the experiments were conducted on subjects attending the third grade of primary school (9 to 10 years old). It has been well-known for a long time that the eye movements of dyslexic subjects differ compared to healthy subjects without reading difficulties. Eye movements captured by using eye tracker provide an unique visual path of attention and perception during reading activity. If we analyze these visual paths, it is possible to obtain useful information. The eye movements were recorded whilst a short text was presented to participants. This text contained 10 simple sentences adapted to the age of subjects Fig. 1. To detect eye movements was used goggle-based system Obe-2 TM (formerly Permobil Meditech Inc., Woburn MA,). System operates on recording infrared corner reflection of subject. The eye movements were recorded in horizontal and vertical direction at frequency 100 Hz.

Session ***Signal and Image Processing for Medical Application II*** Wednesday **22.09.2021**

Chair: Prof. Tomasz Pięciak & Dr. Paweł Badura

TIME (UTC) **04:00 – 04:20** **Title:** **Room: A** *Organization(s):* *Session:*	Speech 4: **Analysis of Brain Reaction to Emotional Faces** Bohdan Vodianyk[1], Ivan Seleznov[1,2], Mariia Chernykh[3], Igor Zyma[3], Anton Popov[1,4], Ken Kiyono[2] *[1]Igor Sikorsky Kyiv Polytechnic Institute (Ukraine),* *[2] Osaka University (Japan),* *[3:]National University of Kyiv (Ukraine),* *[4] Ciklum Data & Analytics (Ukraine)* *Signal and Image Processing for Medical Application II*	The research is aimed to study the changes of the emotion-induced variations in the brain electrical activity. We focused on revealing alterations in cognitive mechanisms, caused by the presentation of neutral human faces among stimuli among faces with either negative or positive expression. To access the changes, Fourier Power Spectral Density (PSD) and the scaling exponent values obtained from the detrended moving average analysis (DMA) were compared for the series when emotionally neutral stimuli were presented after positive and negative images with faces. In the results, the cortical mapping of the evoked responses were obtained and analyzed to reveal the manifestations of the specific brain activity.
04:20 – 04:40 **Title:** **Room: A** *Organization(s):*	Speech 5: **Cross-domain human motion recognition** Xianghan Yang, Zhaoyang Xia, Feng Xu, Yinan Mo *Fudan University (Chiny)*	One of the most important issues in radar-based pattern recognition is how to efficiently obtain a large amount of reliable labeled data to train the classification model. We train classification models based on simulated samples to classify measured samples across domains to solve the problem of labeled data acquisition in human motion recognition. First, we use the motion capture dataset of Carnegie Mellon University (CMU MOCAP) to simulate the frequency modulated continuous wave (FMCW) radar echo signals of 41 target points of human body and generate a certain amount of simulated labeled feature data to perform supervised learning to train a Convolutional Neural Network (CNN) classification model. After that we apply TI's 77~81Ghz AWR1642 BOOST ODS millimeter wave radar evaluation board to collect the echo signals of 5 classes of human motion and then perform data processing to generate measured feature data. Experiment results show that there are similar characteristics between the feature spectrograms of 5 classes of human motions generated by simulation and those of the measured data. And the classification model based on micro-Doppler (MD) spectrogram feature and micro-Doppler-Horizontal Angle-Vertical Angle (MD-HA-VA) combined spectrogram feature in the simulation

Session:	*Signal and Image Processing for Medical Application II*	domain can achieve the average classification accuracy of 92.0% and 94.4% respectively in the real domain, which proves the feasibility and practicability for cross-domain human motion recognition.

Session ***Geoscience and Remote Sensing*** Wednesday **22.09.2021**

Chair: Prof Hanna Rothkaehl & Prof. Krzysztof Kulpa

TIME (UTC) **11:00 – 11:40** **Title:** **Room: A**	**Keynote talk** ***Advances in Multi-Variable, Non-Gaussian Stochastic Parametrization*** Prof. Patrick Dewilde	
11:40 – 12:00 **Title:** **Room: B**	Speech 1: **Detection of periodic disturbances in LOFAR calibration solutions** Katarzyna Budzinska[1], Maaijke Mevius[2], Marcin Grzesiak[1], Hanna Rothkaehl[1]	Calibration solutions of astronomical observations contain information on ionospheric disturbances with sensitivity of less than 1 mTECU. We investigate a method to extract the wave parameters of periodic disturbances by means of a wavelet transform analysis. We obtain results consistent with the results from other radio interferometers regarding frequency components. More research is needed to improve the determination of a wavenumber vector.
Organization(s):	*[1]Space Research Centre PAS (Poland),* *[2]ASTRON (Netherlands)*	
Session:	*Geoscience and Remote Sensing*	
12:00 – 12:20 **Title:** **Room: B**	Speech 2: **Algorithm for Creating Propagation Attenuation Maps Based on Parabolic Equation Method** Michał Kryk, Krzysztof Malon, Jan M. Kelner	Modern wireless communication systems use various technological solutions to increase the efficiency of created radio networks. This efficiency also applies to radio resources. To improve it, radio environment maps (REMs) are used. It is common to use the REM in modern ad-hoc mobile networks (MANETs), which are used, e.g., in the military. In this case, the use of new technologies such as software-defined radio and network, cognitive radio, sensing, and building electromagnetic situational awareness made it possible to implement REM in modern MANETs. Propagation attenuation maps are one of the crucial REM elements that allow for determining the ranges of radio network nodes. In this case, considering the topography in propagation maps enables a more realistic analysis. For this aim, in the paper, we propose a novel algorithm of creation propagation attenuation maps based on the parabolic equation method.
Organization(s):	*Military University of Technology (Poland)*	
Session:	*Geoscience and Remote Sensing*	

Session ***Geoscience and Remote Sensing*** Wednesday **22.09.2021**

Chair: Prof Hanna Rothkaehl & Prof. Krzysztof Kulpa

TIME (UTC) **12:20 – 12:40** **Title:** **Room: B**	Speech 3: **Ionospheric scintillation diagnostic on LOFAR ILT network in single station mode** Mariusz Pozoga, Helena Ciechowska, Marcin Grzesia, Hanna Rothkaehl, Roman Wronowski, Barbara Matyjasiak, Łukasz Tomasik, Katarzyna Budzińska	The aim of the study is to obtain quantitative information on the conditions of ionospheric plasma and its variability at mid-latitudes. For this purpose, we use the S4scintillation index parameter, which is widely used in other diagnostic techniques, such as GNSS. This paper presents a method for determination of ionospheric scintillation intensity with the use of single LOFAR (LOw-Frequency ARray for radio astronomy) station - PL610. We show the specificity ofLOFAR measurements, related problems, and methods to obtain ionospheric scintillation index
Organization(s):	*Space Research Centre Polish Academy of Science (Poland)*	
Session:	*Geoscience and Remote Sensing*	
12:40 – 01:00 **Title:** **Room: B**	Speech 4: **Polarimetric-radar drop size evaluation for wind speed estimate based on Weber criterion** Yuliya Averyanova, Felix Yanovsky, Olga Shcherbina, Ivan Ostroumov, Nataliia Kuzmenko, Maksym Zaliskyi, Oleksandr Solomentsev, Olha Sushchenko	In this paper, the algorithm for wind speed estimate on the base of Weber numbers is demonstrated using one the connection between backscattering from liquid hydrometeors and drop sized in reflecting volume. The method of drop size evaluation with polarimetric radar is demonstrated and an algorithm for wind speed estimate on the base of Weber criterion, breakup conditions, and hydrometeors discrimination with similar polarization properties was proposed
Organization(s):	*National Aviation University (Ukraine)*	
Session:	*Geoscience and Remote Sensing*	

Session ***Geoscience and Remote Sensing*** Wednesday **22.09.2021**

Chair: Prof Hanna Rothkaehl & Prof. Krzysztof Kulpa

TIME (UTC) **01:00 – 01:20** **Title:** **Room: B**	Speech 5: **Determining ionospheric drift and anisotropy of irregularities from LOFAR core measurements** Marcin Grzesiak, Mariusz Pożoga, Barbara Matyjasiak, Dorota Przepiórka, Hanna Rothkaehl *Polish Academy of Sciences (Poland)* *Geoscience and Remote Sensing*	We take the frozen-in assumption of the scatter evolution and derive simple formulas for characteristics of the spatiotemporal correlation function of the observed diffraction pattern. Using Low-Frequency Array (LOFAR) Cassiopeia intensity observation, we can validate the assumptions qualitatively and compute diffraction pattern velocities for three different geophysical conditions. The results allow us to attribute estimated quantities to ionospheric irregularities.
Organization(s):		
Session:		

Session ***Radar Signal Processing*** Wednesday **22.09.2021**

Chair: Dr. Michele Fiorini & Dr. Łukasz Maślikowski

TIME (UTC) **03:00 – 03:20** **Title:** **Room: B** *Organization(s):* *Session:*	Speech 1: **A Modeling Problem of a Continuous Time Domain Signal by its Discrete Counterpart** Boguslaw Szlachetko, Zbigniew Swietach *Wroclaw University of Science and Technology (Poland)* *Radar Signal Processing*	In the paper, a new class of continuous time domain signals is proposed. Also, discrete equivalent signals are deliberated. The paper presents necessary analytical formulae to prove desired properties of a continuous, as well as a discrete spectrum e.g. these signals are practically passband restricted up to the level of relevance equals -120 ~ dB. the proposed signals can be used to test any passband system like radar, telecommunication, and others. The paper presents promising results of computer simulations, which are accurate enough to be suitable for engineering applications. Also, the influence of the protective band placed at both ends of a usable frequency band on the quality of representation of a continuous spectrum in a finite computer memory is considered.
03:20 – 03:40 **Title:** **Room: B** *Organization(s):* *Session:*	**Speech 2:** **TRISH — a Triggerless Random Interleaved Sampling Hardware** Marek Wojciech Rupniewski *Warsaw University of Technology (Poland)* *Radar Signal Processing*	We present a sampling hardware that can be used as a demonstration system for the triggerless random interleaved sampling method. The hardware is capable of acquiring sample-trains of lengths 2, 3 and 4 with a programmable inter-sample distance. Each sample-train consists of samples which originate from separate ADC channels. The whole system is supervised by a single board computer (Raspberry Pi), which also forms a communication interface for the system. The paper proposes a calibration method, which allows for equalization of the voltage gains in the individual ADC channels, as well as equalization of the inter-sample time distances.
03:40 – 04:00 **Title:** **Room: B** *Organization(s):* *Session:*	Speech 3: **Mitigating of received signal power loss caused by multipath effect in phased array radars** Jacek Gambrych *Warsaw University of Technology (Poland)* *Radar Signal Processing*	The author presents a method to mitigate received signal power loss in presence of the multipath effect. The method is dedicated to phased array radars. It is based on the observation that signal amplitudes from various antenna elements may significantly vary between each other in the multipath scenario and uses beamforming with modified weights adjusted to these amplitudes. As a result, the improvement of Signal-to-Noise Ratio of 2-3 dB is possible to obtain. The results of the method were based on simulations performed. Moreover, a negative impact on the antenna receiving pattern and sensitivity to changes in surface reflection coefficient has been discussed.

Session ***Radar Signal Processing*** Wednesday **22.09.2021**

Chair: Dr. Michele Fiorini & Dr. Łukasz Maślikowski

TIME (UTC) **04:00 – 04:20** **Title:** **Room: B** *Organization(s):* *Session:*	Speech 4: **Ground Clutter Analises in Noise Radar using Unmatched Filter Concept** Krzysztof Kulpa, Maślikowski Łukasz, Marcin Kamil Bączyk *Warsaw University of Technology (Poland)* *Radar Signal Processing*	The ground clutter is one of the limiting factors for efficient target detection in noise radar. Thus, full understanding of clutter return is vital for designing and exploitation of noise radar. The paper presents enhanced method for analyzing ground clutter return free from masking effects originated by direct crosstalk or strong clutter return. The paper presents theoretical consideration and analyses of recorded echoes. The method can be apply for clutter analyses in noise based scaterometer, e.g used for measuring scattering effects and also for better understanding of ground clutter effects in noise radars
04:20 – 04:40 **Title:** **Room: B** *Organization(s):* *Session:*	Speech 5: **Calibration of Transmitting and Receiving Array of a Radar using MIMO Measurement** Łukasz Maślikowski *Warsaw University of Technology (Poland)* *Radar Signal Processing*	This paper presents a simple method allowing to extract information of unknown phase offsets between elements of transmit and receive antenna arrays of a collocated MIMO radar. It is shown how to extract independent vectors of phase offsets between receiving and transmitting elements using normalization with averaging as well as SVD decomposition of measurement matrix obtained for observation of calibration target placed at known angular position.
04:40 – 05:00 **Title:** **Room: B** *Organization(s):* *Session:*	Speech 6: **A Hybrid Algorithm for Radar Cross Section Calculation of Electrically Large Targets** Zhuo Liu, Xu Zhang, HaiPeng Wang, Feng Wang *Fudan University (China)* *Radar Signal Processing*	The bidirectional analytical ray tracing (BART) is based on geometrical optics (GO) and physical optics (PO), to calculate the multiple reflections of electromagnetic waves by dividing the target into many small facets, which can calculate the radar cross section (RCS) of electrically large targets quickly. However, due to that GO can only calculate the contribution of incident and reflection in some facets, cannot solve the diffraction problem such as edge and vertex. This problem causes the calculation results of BART to be inaccurate under certain angles. The uniform geometrical theory of diffraction (UTD) can compensate for the shortcomings of GO to overcome the failure of GO in the shadow area and the discontinuity at the boundary between shadow area and bright area. A hybrid algorithm combining the BART and UTD is proposed in this paper. UTD is introduced into the BART to solve the problem that there is no electric field in the shadow area and compensate for the discontinuity at the boundary. While ensuring calculation efficiency, it improves the accuracy of BART in calculating the RCS of electrically large targets.

Session ***Signal Processing Components*** Thursday **23.09.2021**

Chair: Prof. Mario Greco & Dr. Garcia Cava David

TIME (UTC)	**Keynote talk**	
11:00 – 11:40 **Title:** **Room: A**	**On enhancing data-driven structural health monitoring with explicit and implicit procedures** Dr. David García Cava	
11:40 – 12:00 **Title:** **Room: A** *Organization(s):* *Session*:	Speech 1: **Resource Allocation in Correlated and Non-Correlated MIMO Systems** Stefan Klobe[1], Andreas Ahrens[1], Christoph Lange[2], Ingo Müller[1], Petra Leitert[1], Jelena Zascerinska[1] *[1]University of Technology, Business and Design (Germany),* *[2]Hochschule für Technik und Wirtschaft Berlin, University of Applied Sciences (Germany)* *Signal Processing Components*	The multiple-input multiple-output (MIMO) transmission concept targets at increasing the throughput of communication links by employing multiple transmit and receive antennas. As regularly in digital transmission, for such systems the bit-error probability is the crucial quality criterion --- also known as the bit-error ratio (BER). If simple MIMO transmission channel and data source models are assumed, the BER can be computed analytically and the system under consideration can be optimized with the respect to a minimum BER. In this contribution, we consider BER minimization for MIMO links with uncertainty in their channel parameters under good and poor scattering conditions. Optimal solutions such as the Lagrange multiplier method regarding bit and power allocation in the transmitter are designed to achieve the best link performance. However, sub-optimum solutions are able to achieve a similar performance with a significantly lower complexity. The obtained analytical results show that the achievable performance strongly depends on the number of active MIMO layers as well as the assigned transmit power per layer and the number of bits per transmitted symbol. Furthermore it will be shown that the natural choice of creating MIMO layers with identical BER's does not guarantee the best performance.

Session ***Signal Processing Components*** Thursday **23.09.2021**

Chair: Prof. Mario Greco & Dr. Garcia Cava David

TIME (UTC) **12:00 – 12:20** **Title:** **Room: A**	Speech 2: **Comparison of slip-compensated odometry for tracked, four- and six-wheel vehicles**	Wheel slippage is mostly an unwanted but sometimes inevitable disturbance, especially in mobile robots with over-constrained suspension or operating on slippery surfaces. Improving odometry alone can increase overall localization accuracy, especially when other sources of position information are unavailable. There are several publications dealing with slippage detection and odometry correction, however, they are mostly related to identification of surface for single specific robot type and they require external measurement system for tests. This paper presents a methodology and experiment comparing slip-compensated odometry and tries to extrapolate it to three different suspensions. The main idea behind this article was to check, if different mechanical suspensions with the same kinematic structure (skid-steering), could achieve similar localization accuracy according to the same slip compensation method and using only onboard sensors. The research platform was a custom modular robot. Its chassis allows it to swap the suspension to skid steer six- and four-wheel and tracks. Four chapters of the paper are organized as follows: in the Introduction, the problem is described in mathematical formulas, then the experiment setup, process and a method for calculating an algorithm-specific coefficient are discussed, followed by presentation of results and summary.
	Łukasz Chlebowicz, Mateusz Kujawiński, Damian Wroński, Bartłomiej Cybulski, Grzegorz Granosik	
Organization(s):	*Lodz University of Technology (Poland)*	
Session:	*Signal Processing Components*	

Session ***Signal Processing Components*** Thursday **23.09.2021**

Chair: Prof. Mario Greco & Dr. Garcia Cava David

TIME (UTC) **12:20 – 12:40** **Title:** **Room: A** *Organization(s):* *Session:*	Speech 3: **Human Behavior Recognition Based on Multi-Dimensional Feature Learning of Millimeter-Wave Radar** Xiangfeng Wang, Zhaoyang Xia, Haipeng Wang, Feng Xu *Fudan University (China)* *Signal Processing Components*	In this paper, a multi-dimensional feature learning method is proposed to improve the classification accuracy and generalization performance of human behavior recognition on millimeter-wave radar. First, through the analysis of the radar echo reflected by the human body, we get the range-Doppler spectrum, the Doppler spectrum, the azimuth spectrum and the elevation spectrum. Then, a fixed frame-length sliding window method is designed to extract 6 single-channel image features and 6 three-channel image features that can effectively represent human behaviors. Finally, a lightweight convolutional neural network (CNN) is used to learn and recognize multi-dimensional behavior features. In order to evaluate the effectiveness of the proposed method, a dataset of six categories of behavior were collected from 3 people at multiple positions. The experimental results show that, compared with other features, the combined feature of range-time map (RTM), Doppler-time map (DTM) and azimuth-elevation-time map (AETM) has best classification performance for 6 human behaviors. The recognition accuracy rates for untrained people B and C are 91.7% and 86.7%, respectively.
12:40 – 01:00 **Title:** **Room: A** *Organization(s):* *Session:*	Speech 4: **Evaluation of EMD and SSA sensitivity for efficient detection of aerodynamic instabilities in centrifugal compressors** Mateusz Stajuda[1,2], David Garcia Cava[2], Grzegorz Liskiewicz[1] [1]Lodz University of Technology (Poland), [2]University of Edinburgh (UK) *Signal Processing Components*	Aerodynamic instabilities in centrifugal compressors are harmful phenomena affecting machines efficiency and in severe cases leading to failures of the compressing system. Efficient instabilities detection during compressor operation is a challenge, but of utmost importance from economical and safety point of view. The most sensitive detection is possible with use of a pressure signal from inside of the compressor because the instabilities effect is first visible there. Detection of aerodynamic instabilities results in specific challenges, as the pressure signal is often very noisy and contains high amount of randomness. What is more, the surge – most severe instability, can develop very quickly. In some cases fractions of seconds are enough for it to happen. Therefore, the method of detection should be sensitive to instabilities, but also robust and quick. The aim of this study is to investigate and compare the performance of Empirical Mode Decomposition (EMD) and Singular Spectrum Analysis (SSA) in the context of aerodynamic instabilities detection. The comparison focuses on the robustness, sensitivity and pace of detection – crucial parameters for a successful detection system.

Session ***Localization and Tracking*** Thursday **23.09.2021**

Chair: Dr. Rupniewski Marek & Prof. Marco Martorella

TIME (UTC)	**Keynote talk**	
03:00 – 03:40 **Title:** **Room: A**	**Recent advances in 3D Radar Imaging of Non-Cooperative Targets** Prof. Marco Martorella	
03:40 – 04:00 **Title:** **Room: A** *Organization(s):* *Session*:	Speech 1: **3D Localization for Multiplatform Radar Networks with Deployable Nodes** Angela Marino[1], Augusto Aubry[1], Antonio De Maio[1], Paolo Braca[2] *[1]University of Naples Federico II (Italy), [2]Centre for Maritime Research and Experimentation (CMRE) (Italy)* *Localization and Tracking*	A new algorithm for 3D localization in multiplatform radar networks, comprising one transmitter and multiple receivers, is proposed. To take advantage of the monostatic sensor radiation pattern features, ad-hoc constraints are imposed in the target localization process. Therefore, the localization problem is formulated as a non-convex constrained Least Square (LS) optimization problem which is globally solved in a quasi-closed-form leveraging Karush-Kuhn-Tucker (KKT) conditions. The results corroborate the effectiveness of the new strategy which is capable of ensuring a lower RMSE than counterpart methodologies, especially in the low Signal to Noise Ratio (SNR) regime.
04:00 – 04:20 **Title:** **Room: A** *Organization(s):* *Session*:	Speech 2: **Adaptive Anchor Pairs Selection in a TDOA-based System Through Robot Localization Error Minimization** Marcin Kolakowski *Warsaw University of Technology (Poland)* *Localization and Tracking*	The following paper presents an adaptive anchor pairs selection method intended for use in ultra-wideband (UWB) Time Difference of Arrival (TDOA) based positioning systems. The method consist in dividing the area covered by the system into several zones and assigning them anchor pair sets. The pair sets are determined during calibration, based on localization root mean square error (RMSE). The calibration assumes driving a mobile platform equipped with a LiDAR sensor and an UWB tag through the specified zones. The robot is localized separately based on a large set of different TDOA pairs and using a LiDAR, which acts as the reference. For each of the zones, the TDOA pairs set for which the registered RMSE is lowest is selected and used for localization in the routine system work. The proposed method has been tested with simulations. The results for both static and dynamic scenarios have proven that the adaptive selection of the anchor nodes leads to an increase in localization accuracy.

Session ***Localization and Tracking*** Thursday **23.09.2021**

Chair: Dr. Rupniewski Marek & Prof. Marco Martorella

TIME (UTC) **04:20 – 04:40** **Title:** **Room: A** *Organization(s):* *Session:*	Speech 3: **Measurement Error Correlation in Processing of Overlapping Blocks in FMCW Radar** Krzysztof Stasiak, Marek Ciesielski, Mariia Khyzhniak, Marcin Żywek, Marek Rupniewski *Warsaw University of Technology (Poland)* *Localization and Tracking*	The paper investigates measurement error correlation caused by processing of overlapping blocks in FMCW (Frequency-Modulated Continuous-Wave) radar. The problem is analyzed theoretically by discussing impact of measurement error correlation on tracking and mathematical evaluation of the effect. The results are confronted with simulation and data from an actual experiment. The paper describes predicting measurement error correlation to allow for proper addressing the issue in the tracking subsystem
04:40 – 05:00 **Title:** **Room: A** *Organization(s):* *Session*:	Speech 4: **Overlaping-based Radio Signal Processing for SDF Location Method** Rafał Szczepanik, Jan M. Kelner, Cezary Ziółkowski *Military University of Technology (Poland)* *Localization and Tracking*	The localization of radio emitters is commonly used in the positioning of nodes, e.g., cellular network, radio navigation, search and rescue operations, as well as in military applications such as blue force tracking (i.e., positioning of own troops), communication (COMINT) or electronic intelligence (ELINT), and electronic warfare. Depending on the location technique used, different signal processing methods are used. In this paper, we present an efficient and adaptive signal processing method for the signal Doppler frequency (SDF) location method. This method is based on the variability of the Doppler curve, the shape of which is distinctive for the mutual position of the transmitter in relation to the receiver trajectory or vice versa. The proposed approach is based on an overlap technique that enables obtaining a sufficient number of Doppler frequency shifts for the SDF. The effectiveness of this solution is presented on the example of signals recorded in a real environment. The proposed method could be used in signal processing in real-time SDF applications as well as in simulation studies.

Session ***Radar systems and application*** Thursday **23.09.2021**

Chair: Prof. Gaspare Galati & Prof. Jacek Misiurewicz

TIME (UTC)	**Keynote talk**	
11:00 – 11:40 **Title:** **Room: B**	**The Trust and Truth of Digitalisation in Maritime Domain: where are we?** Dr. Michele Fiorini	
11:40 – 12:00 **Title:** **Room: B**	Speech 1: **Estimation of Rotational Speed of Helicopter Rotor Through Horizontal Synchrosqueezing** Karol Abratkiewicz[1], Jacek Gambrych[1], Krzysztof Stasiak[1,2], Piotr Samczyński[1,2]	This paper presents preliminary results of estimating the rotational speed of the helicopter rotor using the short-time Fourier transform (STFT) and its concentrated form referred to as a horizontal synchrosqueezing (HS) in the time-frequency (TF) domain. The presented theory is supported by real-life data obtained using a small, high-resolution radar system during a measurement campaign. The outcomes illustrated in the paper show a pronounced potential of using TF techniques in the analysis of micro-Doppler radar signals and extracting additional content on target parameters that can be used in classification and parametrization procedures. It is presented that using the concentrated version of the spectrogram, one can distinguish more details about a non-cooperative target than the classical STFT, which in this work was used for assessing target parameters.
Organization(s):	*[1]Warsaw University of Technology (Poland),* *[2]XY-Sensing Ltd., Warsaw, (Poland)*	
Session:	*Radar systems and application*	
12:00 – 12:20 **Title:** **Room: B**	Speech 2: **Four-Channel Ground-Based C-Band FMCW Radar Demonstrator** Jakub Kamil Julczyk, Krzysztof Stasiak, Damian Gromek, Marek Ciesielski	Based on the long-known and well-described FMCW radar design techniques, this paper introduces a four-channel FMCW radar system build from COTS (Commercial Off-The-Shelf) elements, for imaging purposes. Starting from a short historical view of the matter in question, general advantages, and motivations standing behind the developed solution, the article presents the theory of operation of FMCW radar, as well as the construction of analog part, digital part, and developed software. Signal processing algorithms are also covered as a starting point for more advanced techniques which may be further implemented. The developed radar system allows using of wide bandwidth – up to 1 GHz – which gives the resolution up to tenths of centimeters, and a high rate of pulse repetition frequency (8 kHz), which gives the opportunity to detect high-speed objects..
Organization(s):	*Warsaw University of Technology (Poland)*	
Session:	*Radar systems and application*	

Session ***Radar systems and application*** Thursday **23.09.2021**

Chair: Prof. Gaspare Galati & Prof. Jacek Misiurewicz

TIME (UTC) **12:20 – 12:40** **Title:** **Room: B** *Organization(s):* *Session*:	Speech 3: **Analysis of Spectrum Signatures from Rotating Blades of Small Drone** Ekaterina Plotnitskaya, Evgenii Vorobev, Vladimir Veremyev *Saint Petersburg Electrotechnical University "LETI"* *(Russian Federation)* *Radar systems and application*	The periodical Doppler spectrum signatures originated from rotating blades of multi-rotor drones are promising features for their classification in radar systems. The structure of the spectrum signature varies not only with the drone types but also with the parameters of the illuminating wave and the radar geometry. This paper focuses on theoretical and experimental analysis of spectrum signatures from rotating blades made of different materials for different frequency bands, polarizations, and bistatic angles.

Session ***Passive Radar*** Thursday **23.09.2021**

Chair: Dr. Mateusz Malanowski & Prof. Gomez-del-Hoyo, Pedro-Jose

TIME (UTC) **03:00 – 03:20** **Title:** **Room: B**	Speech 1: **2D Ground Target Location Using GPS based Passive Radar** Pedro-Jose Gomez-del-Hoyo, María-Pilar Jarabo-Amores, David Mata-Moya, Nerea Rey-Maestre, Javier Rosado-Sanz *University of Alcalá (Spain)* *Passive Radar*	Global Positioning System (GPS) satellites are promising illumination opportunity for Passive Radar systems due to their global coverage and the availability of multiple satellites wherever over the world, but their low power at ground level limits system coverage. In this paper, a GPS based Passive Radar exploiting digital array processing techniques is presented for ground target location. To face signal level problems, a processing scheme combining reconstructed reference signals, adaptive filtering techniques and spatial filtering is implemented. Conventional beamforming techniques are used to increase target echo level before the detection stage, and high resolution DoA estimation techniques are applied to estimate targets' azimuth. Tacking into account the system geometry, range and azimuth information, ground targets can be located. Real radar data is used to analyse system operation. During the measurement campaign, a cooperative vehicle was employed for validation purposes. Results confirm GPS signals for ground targets detection and localization.
03:20 – 03:40 **Title:** **Room: B**	Speech 2: **Preliminary detection results obtained with experimental airborne passive radar** Rafał Rytel-Andrianik, Krzysztof Kulpa, Krzysztof Stasiak, Mateusz Malanowski *Warsaw University of Technology (Poland)* *Passive Radar*	The advantages of passive radars include quiet operation and ability to detect targets that were designed to be ”stealth” for active monostatic radars utilizing higher frequency bands. As the technology of ground based passive radars is already quite established, airborne passive radars are rather new and are being actively developed. In the proposed paper we present first results obtained in the prototype airborne passive radar that instead of its own transmitter utilizes omnipresent DVB-T television broadcast. The radar system structure and algorithms are described. Then examples of clearly visible echoes of a fighter jet and a ship are presented.

Session ***Passive Radar*** Thursday **23.09.2021**

Chair: Dr. Mateusz Malanowski & Prof. Gomez-del-Hoyo, Pedro-Jose

TIME (UTC) **03:40 – 04:00** **Title:** **Room: B** *Organization(s):* *Session:*	Speech 3: **Field Trials of Passive Radiolocation using LOFAR Radio Telescope and External Reference Receiver** Konrad Jędrzejewski[1], Krzysztof Kulpa[1], Mariusz Pożoga[2] *[1]Warsaw University of Technology (Poland), [2]Space Research Centre Polish Academy of Science (Poland)* *Passive Radar*	The paper presents the results of studies related to the possibility of cooperation of a LOFAR radio telescope with an external reference receiver in a passive radiolocation system in which the LOFAR radio telescope serves as a receiver. In particular, the problem of synchronization of signal registrations performed by LOFAR and the external reference receivers based on Universal Software Radio Peripheral (USRP) device is considered. The field trials, whose results are presented in the paper, were one of the first stages of our research devoted to the practical verification of the capability of space target detection using the LOFAR station as a receiver in passive radiolocation system.
04:00 – 04:20 **Title:** **Room: B** *Organization(s):* *Session:*	Speech 4: **Performance Optimization for Passive Bistatic Radar Based on Detection Range Predictions** Marcin Żywek, Mateusz Malanowski *Warsaw University of Technology (Poland)* *Passive Radar*	The receiver of the passive radar has a limited number of frequency channels that it can handle simultaneously. This number is usually smaller than the number of available illuminators of opportunity that could be potentially used by the passive radar. The problem is, therefore, how to select transmitters so that optimum performance is obtained. The performance considered here is the area where the target with a given value of RCS can be detected by the passive radar with at least 3 Tx-Rx pairs. In the paper we consider two algorithms for optimal selection of the illuminators of opportunity based on predicted detection range.

Session ***Passive Radar*** Thursday **23.09.2021**

Chair: Dr. Mateusz Malanowski & Prof. Gomez-del-Hoyo, Pedro-Jose

TIME (UTC) **04:20 – 04:40**	Speech 5:	Broadcast DAB transmitters can be considered as a good source of illumination for Passive Coherent Location (PCL) due to their broadband nature. In this paper, we deal with the processing of the PCL signals that were acquired during the NATO measurement campaign APART-GAS 2019 (Active Passive Radar Trials Ground-based, Airborne, Sea-borne) in Poland, September 2019. Due to the time-domain structure of DAB signal, there are artifacts clearly visible in bistatic velocity/range that repeat on a regular basis and distort images with detection results. In this paper, we will present a method of signal preprocessing in the time domain designed to eliminate the mentioned artifacts. This will allow us to obtain clearer images with detected objects, and to increase the integration time to detect weak echoes without a penalty of more intensive artifacts. We will also investigate the impact of increasing the integration time to the operating range of the experimental PCL system in case of detection of accidentally flying cruise airplanes. Finally, we will discuss a tradeoff between the increased processing gain and range-cell migration effect for the considered system.
Title:	**Signal conditioning for DAB-illuminated passive radar**	
Room: B	Gustaw Mazurek	
Organization(s):	*Warsaw University of Technology (Poland)*	
Session:	*Passive Radar*	

Karol Abratkiewicz	*Warsaw University of Technology, Poland*
Yuliya Averyanova	*National Aviation University, Ukraine*
Chris Baker	*University of Birmingham, United Kingdom*
Marcin Kamil Bączyk	*Warsaw University of technology, Poland*
Fabrizio Berizzi	*University of Pisa, Italy*
Philippe Brouard	*ONERA - The French Aerospace Lab, France*
Szymon Buś	*Politechnika Warszawska, Poland*
Amerigo Capria	*CNIT, Italy*
Simona Caraiman	*Technical University of Iasi, Romania*
Alberto Carini	*University of Trieste, Italy*
Aleksandr Cariow	*West Pomeranian University of Technology Szczecin, Poland*
Mikhail Cherniakov	*University of Birmingham, United Kingdom*
Zbigniew Czekała	*PIT-RADWAR S.A., Poland*
Andreas Deistung	*University Hospital Halle (Saale), Germany*
Marek Domański	*Poznań University of Technology, Poland*
Jędrzej Drozdowicz	*Warsaw University of Technology, Poland*
Gaspare Galati	*Dep. of Electronic Engineering- Tor Vergata Univarsity, Italy*
Selenia Ghio	*RaSS-CNIT, Italy*
Elisa Giusti	*CNIT, Italy*
Maria Sabrina Greco	*University of Pisa, Italy*
Artur Gromek	*Warsaw University of Technology, Poland*
Damian Gromek	*Warsaw University of Technology, Poland*
Braham Himed	*US Air Force Research Laboratory, United States of America*
Maria Pilar Jarabo Amores	*University of Alcalá, Spain*
Konrad Jędrzejewski	*Warsaw University of Technology, Poland*
Hristo Kabakchiev	*Sofia University "St. Kliment Ohridski", Bulgaria*
Piotr Kaniewski	*Military University of Technology, Poland*
Adam Kawalec	*Military University of Technology, Poland*
Jan M. Kelner	*Military University of Technology, Poland*
Artur Klepaczko	*Lodz University of Technology, Poland*
Benjamin Knödler	*Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE, Germany*

Peter Knott	*Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR, Germany*
Krzysztof Kulpa	*Warsaw University of Technology, Poland*
Mikołaj Leszczuk	*AGH University of Science and Technology, Poland*
Alberto Lupidi	*CNIT, Italy*
Steffen Lutz	*HENSOLDT, Germany*
Mateusz Malanowski	*Warsaw University of Technology, Poland*
Paulo Marques	*ISEL – Instituto de Telecomunicacoes de Lisboa, Portugal*
Marco Martorella	*University of Pisa, Italy*
Łukasz Maślikowski	*Warsaw University of Technology, Poland*
Andrzej Materka	*Lodz University of Technology, Poland*
Bogdan Matuszewski	*University of Central Lancashire, United Kingdom*
Gustaw Mazurek	*Warsaw University of Technology, Poland*
Jacek Misiurewicz	*Warsaw University of Technology, Poland*
Lorenzo Monte	*Telephonics, United States of America*
Charles Mott	*Home, United States of America*
Katarzyna Osińska-Skotak	*Warsaw University of Technology, Poland*
Thomas Ott	*HENSOLDT, Germany*
Mateusz Pasternak	*Military University of Technology, Poland*
Jerzy Pietrasiński	*Military University of Technology, Poland*
Tomasz Pięciak	*University of Valladolid, Valladolid, Spain, Spain*
Iole Pisciottano	*Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR, Germany*
Renata Maria Plucińska	*Warsaw University of Technology, Poland*
Anton Popov	*Igor Sikorsky Kyiv Polytechnic Institute, Ukraine*
Jürgen Reichenbach	*Jena University Hospital, Germany*
Marek Wojciech Rupniewski	*Warsaw University of Technology, Poland*
Piotr Samczyński	*Warsaw University of Technology, WEiTI, ISE, Poland*
Rustem Sinitsyn	*National Aviation University, Ukraine*
Andrzej Skalski	*AGH University of Science and Technology, Poland*
Christian Steffes	*Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE, Germany*
Paweł Strumiłło	*Lodz University of Technology, Poland*

Michał Strzelecki	*Lodz University of Technology, Poland*
Boguslaw Szlachetko	*Wroclaw University of Science and Technology, Poland*
Magdalena Szymczyk	*AGH University of Science and Technology, Poland*
Mirosław Świercz	*Bialystok University of Technology, Poland*
Ewa Świercz	*Bialystok University of Technology, Poland*
Martin Ummenhofer	*Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR, Germany*
Matthias Weiß	*Fraunhofer FHR, Germany*
Philipp Wojaczek	*Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR, Germany*
Yimin Daniel Zhang	*Temple University, United States of America*
Tomasz Zieliński	*AGH University of Science and Technology, Poland*
Marcin Żywek	*Warsaw University of Technology, Poland*

SPSympo-2023

To the next Signal Processing Symposium we would like to invite you to Wrocław in September 2023.

On the 20th anniversary of the first SPS conference (in 2003) the jubilee SPSympo 2023 will be held in the convivial setting of Wrocław University of Science and Technology.


Lodz University of Technology
Institute of Electronics