2023 24th International Radar Symposium (IRS 2023)

Berlin, Germany 24 – 26 May 2023



IEEE Catalog Number: CFP23RAS-POD **ISBN:**

978-1-6654-5682-1

Copyright © 2023, German Institute of Navigation (DGON) All Rights Reserved

*** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.

IEEE Catalog Number: ISBN (Print-On-Demand): ISBN (Online): ISSN: CFP23RAS-POD 978-1-6654-5682-1 978-3-944976-34-1 2155-5745

Additional Copies of This Publication Are Available From:

Curran Associates, Inc 57 Morehouse Lane Red Hook, NY 12571 USA Phone: (845) 758-0400 Fax: (845) 758-2633 E-mail: curran@proceedings.com Web: www.proceedings.com



IRS 2023 Table of Content

Velocity Estimation of Maritime Targets in Spaceborne Single-Channel SAR images: Methods and Performance Assessment...1

Alejandro Testa, Elena Morando, Debora Pastina, Massimo Zavagli, Fabrizio Santi, Chiara Pratola, Michela Corvino

Real-Time Video SAR on Curved Trajectories

Making Use of Graphic Core Processing...11

Michael Brandfass, Falk Ringel, Ralf Stadelhofer, Franz Lang-Schnee

Efficient Performance Evaluation for Multistatic SAR Systems...21

Nida Sakar, Pau Prats-Iraola, Marc Rodriguez-Cassola

Introducing F-Scan to the Concurrent Imaging Mode...31

João Pedro Turchetti Ribeiro, Thomas Kraus, Markus Bachmann, Renato Machado

Compressed Sensing: OMP2D Based Algorithm for Fully Polarimetric ISAR...41

Daniele Bonicoli, Elisa Giusti, Marco Martorella

The Concept for High-Resolution ISAR-based Traffic Surveillance System...52 Maciej Wielgo, Jacek Misiurewicz

High Resolution Bistatic ISAR Imaging on Airliners...61

Fayin Yousfi, Pierre Bruneel

High Resolution 3D InISAR Imaging of Space Targets Based on PFA Algorithm with Single Baseline...70

Rui Gong, Ling Wang, Daiyin Zhu

An ISAR Autofocus Imaging Algorithm Based on FCN and Transfer Learning...80 Lianzi Wang, Ling Wang, Daiyin Zhu

Objects Classification and Clutter Types Mapping using Polarimetric Radar Detection Algorithms...88

Yiyang Song, O.A. Krasnov, A. Yarovoy

Bird and Micro-Drone Doppler Spectral Width and Classification...98

Daniel White, Mohammed Jahangir, Joseph P. Wayman, S. James Reynolds, Jon P. Sadler, Michail Antoniou

Object Classification With Micro-Doppler Spectra For Surveillance Applications...108

Hans-Günter Hirsch, Frederik Terstappen, Jan Hamacher, Manfred Hägelen, Rainer Jetten, Reinhard Kulke

Automatic Radar Target Classification: A New Idea for Distinguishing Drones and Birds From the Invention to Serial Production...118

Franz-Xaver Hofele, André Hanewinkel

Long Range Noise Radar Concept...128

Łukasz Maślikowski, Krzysztof Kulpa

From TOpAs to ESIT: Estimating Transponder Load using Digital Twins of Surveillance Infrastructure...134

H. Schreiber, W. Bösch, H. Paulitsch, A. Schlemmer, M. Schäfer, M. Kraft, A. Bartl, A. Oberluggauer, J. Bodart

Radar spectrum measurement from drone platform in situ...144

Károly Árpád Kis, Kornél Sarvajcz, István Balajti

Investigation Of Effective Medium Theory Concerning Applications For Skin Cancer Detection...154

Nicolas Treier, Herman Jalli Ng, Serdal Ayhan, Marlene Harter

UWB Radar-Based Pet Monitoring on Daily Basis in an Unconstrained Living Environment...164

Seongkwon Yoon, Shahzad Ahmed, Sung Ho Cho

Photonic Radar System Considerations for an Analog Optical Channel...171

Christoph Höhn, Can Çalışkan, Sebastian Kupijai, Hanjo Rhee, Ulrich Keil, Thomas Gisder, Marc-Michael Meinecke, Heiko Gustav Kurz

Distributed System Architecture for Software-Defined Radio / Radar with Optical Signal Distribution...179

Stephan Kruse, Pascal Kneuper, Tobias Schwabe, Marc-Michael Meinecke, Heiko G. Kurz, J. Christoph Scheyt

SiGe BiCMOS FMCW Photonic-Radar Transmitter for Automotive Applications...187

Christoph Höhn, Can Çalışkan, Christian Meuer, Hanjo Rhee, Ulrich Keil, Thomas Gisder, Marc-Michael Meinecke, Heiko Gustav Kurz

Nonlinear S-Parameter Behavioral Model of a Photonic Radar Transceiver Chipset for Automotive Applications...194

Stephan Kruse, Tobias Schwabe, Pascal Kneuper, Marc-Michael Meinecke, Heiko G. Kurz, J. Christoph Scheytt

Calibration of Large Coherent MIMO Radar Arrays: Channel Imbalances and 3D Antenna Positions...204

Christian Greiff, David Mateos-Núñez, Renato Simoni, María González-Huici, Stephan Kruse, J. Christoph Scheytt, Karl Kolk, Christian Höller, Heiko Gustav Kurz, Marc-Michael Meinecke, Thomas Gisder

Advances in Automotive Radar for 2023...214

Andreas Loeffler, Roy Zergiebel, Jonathan Wache, Mohamed Mejdoub

On the RCS Estimation from Camera Images...222

Christopher Grimm, Tai Fei, Ernst Warsitz, Ridha Farhoud, Tobias Breddermann, Reinhold Haeb-Umbach

Transfer Learning in Automotive Radar Using Simulated Training Data Sets...234

Felix Rutz, Ralph Rasshofer, Erwin Biebl

Fast Angular Processing For Sparse FMCW Radar Arrays With Non-uniform FFT...241

Gabriel Schnoering, Christian Höller, Takuya Kawaguchi, Kohei Kawajiri, Stefan Malterer

Experimental Evaluation of Interference Suppression using Interference Replica to Improve Spectrum Efficiency for Automotive CS Radars...252 Masahiro Umehira, Takahiro Maruyama, Xiaoyan Wang, Shigeki Takeda

Range Migration Algorithm for a Multistatic 3D Compressive Computational Imaging System with Dynamic Metasurface Aperture...263 Vasiliki

Skouroliakou, Amir Masoud Molaei, Maria Garcia-Fernandez, Guillermo Alvarez-Narciandi, Okan Yurduseven

Reconsidering the SAR Range Ambiguity to Signal Ratio: Theoretical Analysis and Measurement Results...273

Ozan Dogan, Vladimir Ignatenko, Risto Vehmas, Andrea Radius, Pierre Leprovost, Leszek Lamentowski, Darren Muff, Matthew Nottingham, Tino Seilonen, Patrik Vilja

A New 3-D Stepped Frequency SAR Signal Modeling and Imaging of Moving and Stationary Targets...283

Andon Lazarov, Chavdar Minchev

Design and Implementation of Staggered-SAR Azimuth-Processing...293

Johann Christian Marten, Marwan Younis, Gerhard Krieger, Johannes Pfau, Kai Unger, Jürgen Becker

GEO SAR GROUND MOVING TARGET VELOCITY ESTIMATION ALGORITHM...303

Mounir Melzi, Cheng Hu, Xichao Dong, Chang Cui

Drones Tracking Adaptation Using Reinforcement Learning: Proximal Policy Optimization...313

Esra Alhadhrami, Amal El Fallah Seghrouchni, Frederic Barbaresco, Raed Abu Zita

Multi-Target Tracking Resources Allocation Using Multi-Agent Modeling and Auction Algorithm...323

Maxence de Rochechouart, Amal El Fallah Seghrouchni, Frederic Barbaresco Raed Abu Zitar

Generating Realistic Aircraft Trajectories Using Generative Adversarial Networks...333

Petr Lukeš, Pavel Kulmon

Out-of-Library SAR Target Recognition with Deep Learning from Synthetic Data and Multiview Information Fusion...343

Zhe Geng, Wei Li, Xiang Yu, Dai-Yin Zhu, Gong Zhang

Radar Data Processing Workflow for Navigation Tasks in Harsh Environments...353

Arturs Ivanovs, Andrejs Zujevs, Martins Ekmanis, Gustavs Evalds, Maris Galauskis, Agris Nikitenko, Henri Liikanen

Radar for Industrial Vehicular Application...363

Lars Meyer, Rainer Jetten, Reinhard Kulke

Driver's Chest Position Detection using FMCW Radar Data Collected in a Vehicle Mock-up and CNN...372

Tanaya Viraj Palandurkar, Lap Yan Chan, Joed Lopes da Silva, Alessandro Zimmer, Ulrich Theodor Schwarz

Measurement of a Baby Dummy with a Channel Sounder in an Anechoic Chamber for Child Presence Detection...384

Gert Freiberger, Helmut Schreiber, Erich Leitgeb, Wolfgang Bösch, David Veit

Road Object Height Estimation Using Multipath Effect in Automotive Radar Measurements...393

Sergei Shishanov, Anna Dzvonkovskaya, Boya Qin, Dmitry Zakhryapin

Three-Dimensional Structure Inversion Through Wide Fractional Bandwidth, UAV-Based SAR Interferometry...400

Sumin Kim, Víctor Mustieles Pérez, Gerhard Krieger, Michelangelo Villano

PRISM: A Flexible Experimental Processing Framework For Present And Future SAR Missions...410

Matteo Nannini, André Barros Cardoso da Silva, Andrea Pulella, Nida Sakar, Johannes Kramp, Gustavo Martin del Campo Becerra, Marc Jäger, Vinicius Queiroz de Almeida, Jalal Matar, Maria Jose Sanjuan Ferrer, Marc Rodriguez-Cassola, Pau Prats-Iraola

150 GHz Radar Imagery using Doppler Beam Sharpening for Marine Sensing...420

Dillon Kumar, Liam Daniel, Anum Pirkani, Samuel Harris, Edward Hoare, Andrew Stove, Mikhail Cherniakov, Marina Gashinova

Mitigation of RFI in High-Resolution SAR Data – Algorithm Overview and Experimental Demonstration...430

Risto Vehmas, Andrea Radius, Ozan Dogan, Vladimir Ignatenko, Pierre Leprovost, Leszek Lamentowski, Darren Muff, Matthew Nottingham, Tino Seilonen, Patrik Vilja

Omega-K Algorithm extended with MIMO-SAR using Cascaded FMCW Radar...439

Kang Liu, Yuanhui Zhang, Yu Cao, Yuqi Tian, Xiangcheng Zhu

Convolutional Neural Network for Joint Communication and Radar Signals Classification...449

Amir Hosein Oveis, Amerigo Capria, Anna Lisa Saverino, Marco Martorella

Micro-Doppler based Deep Learning approaches for radar applications...459 Moritz Ufer, Vishal Mhasawade, Roland Graef, Holger Appel, Tobias Brosch

Approach to denoising of interfered 4-channel FMCW radar data using Convolutional Neural Network...467

Julius Geyer, Lars-Hendrik Crone, Clemens Klöck, Steffen Schober

Complex-Valued Neural Networks for Doppler Disambiguation in FMCW Radars...476

Chen Liu, Jiawei Li, Hector A. Gonzalez, Bernhard Vogginger, Christian Mayr

Concurrent Activity Classification and Human Identification Based on Point Cloud Data and Deep Learning...486

Chun Yuan, Youxuan Zhong, Yi Zou, Jiahao Qi

Multistatic Radar Applications in Combination With Two Target Simulators...496

Marc Schneebeli, Andreas Leuenberger, Urs Siegenthaler, Peter Wellig

Dynamic Two-way time transfer between moving platforms for netted radar applications...506

Ferran Valdes Crespi, Stephan Sandenbergh, Daniel O'Hagan, Peter Knott

5G Network-Based Passive Radar for Drone Detection...516

Radosław Maksymiuk*, Marek Płotka, Karol Abratkiewicz, Piotr Samczyński

Coherency limits of different transceivers within USRP X310 as a radar node...526

Angel Slavov, Ferran Valdes Crespi, Stephan Sandenbergh, Dominik Bok, Daniel O'Hagan, Peter Knott

Digital steerable antenna control system for IoO tracking in Starlink based Passive Radar applications...536

Pedro Gomez-del-Hoyo, Piotr Samczynski

In field demonstration of a Photonic Integrated Circuit for SAR Imaging...546

Filippo Scotti, Salvatore Maresca, Mirco Scaffardi, Fabrizio Novali, Domenico Lobifaro, Vito Centonze, Paolo Ghelfi, Antonella Bogoni

A ML-Driven Radar Imaging System to Detect Concealed Objects...553

Soumya Chakravarty, Arindam Ray, Arijit Chowdhury, Tapas Chakravarty, Achanna Anil Kumar, Chirabrata Bhaumik, Arpan Pal

Airborne Radar Forward-Looking Imaging Algorithm Based on Generative Adversarial Networks...563

Fangning Li, Di Wu, Baomin Gu, Jinke Dai, Wei Li

mmWave SAR Imaging of Superficial Tissue for Metallic Implant Monitoring...571

Anwesha Khasnobish, Smriti Rani, Amit Swain, Chirabrata Bhaumik, Tapas Chakravarty

Electromagnetic simulator based on graphical computing and physical optics for sub-THz ISAR imagery of space objects...581

E. Marchetti, E. Hoare, M. Cherniakov, M. Gashinova

Doppler Beam Sharpening for MIMO and Real Aperture Radars at mmwave and Sub-THz Maritime Sensing...590

Anum Pirkani, Liam Daniel, Dillon Kumar, Edward Hoare, Samuel Harris, Mikhail Cherniakov, Andrew Stove, Marina Gashinova

A CMOS-based 140 GHz 4x4 MIMO Radar Prototype with 10 GHz Bandwidth...600

André Bourdoux, Marc Bauduin, Kristof Vaesen, Miguel Glassée, Eddy De Greef, Thomas Gielen, Ilja Ocket

Compressive Sensing Techniques Applied to a Semi-Circular mmWave MIMO Array...610

Max Schurwanz, Jan Mietzner, Reinhold Herschel, Peter Adam Hoeher

3D SAR Imaging enabled by Terahertz Time-Domain Spectroscopy...620 Tobias Kubiczek, Vladyslav Cherniak, Kevin Kolpatzeck, Jan C. Balzer

Instantaneous 3D velocity estimation using coordinated OFDM Radar nodes...628

Yanhua Zhao, Lara Wimmer, Vladica Sark, Milos Krstic, Eckhard Grass

Improving FM-Based Passive Forward-Scattering Signature Readability Using Multitaper Reassignment...638

Marek Płotka, Karol Abratkiewicz, Mateusz Malanowski

Tracking mulitple targets with multiple radars using Distributed Auctions...648

Pierre Larrenie, Cédric L R Buron, Frédéric Barbaresco

Elimination of False Detections Caused by Strong Target Echo Sidelobes in Passive Radar...658

Marcin Bączyk, Mateusz Malanowski

Detection Performance of Distributed Coherent Aperture Radar...666

Luo Meng, Huang Baotao, Xing Wenge

Single Channel Degarbling of SIF/IFF Pulses Using Spectral Inverse Filtering...676

Ondřej Šimon, Jiří Veselý, Alexis Gabard

Designing Periodic Binary Sequence Sets for MIMO PMCW Radar Systems...684

Yutao Chen, Ronghao Lin , Xuchen Li

A Search Method for Binary Codes Compressed to Several Sub-pulses Using Multiple Field Programmable Gate Arrays...694 Keigo Kimura, Hiroshi Takase

Bistatic STAP with Continuous Wave Signals for generic Antenna Arrays...701

Volker Winkler, Christoph Fischer

Adaptive Super Resolution Array Radar Imaging based on Sparse Reconstruction and Effective Rank Theory...711 Guanqun Sun, Fangzheng Zhang, Shilong Pan, Hao Zhang, Yuewen Zhou

Design and Simulation of Ultra-Wideband Linearly TaperedSlot Antenna for mm-Wave Applications...718

Miroslav Sokol, Martin Pecovsky, Pavol Galajda, Patrik Jurik, Jaroslav Lacik

Intelligent reflective surfaces for multistatic radar networks...725 Thomas Dallmann

Characterization of Radar Self-Interference on Air Platforms Using **Physical Optics Approximations...734**

Max Schurwanz, Jan Mietzner, Peter Adam Hoeher

Aspects of Radar Cross Section Optimization for Dielectric Corner Reflectors...744

Christian Buchberger, Vera Kurz, Florian Pfeiffer, Erwin Biebl

Resolving Doppler-Ambiguity in OFDM-based Joint Radar and Communication Sensors...752

Barbara Iafrate, Pierfrancesco Lombardo

Performance Analysis of Phase-Coded FMCW for Joint Sensing and Communication...762

Utku Kumbul, Nikita Petrov, Cicero S. Vaucher, Alexander Yarovoy

Efficient Joint Broadband Radar and Single Carrier Communication System in Frequency Division Multiplexing for High-Range Applications...772

Winfried Johannes, Stephan Stanko, Ingmar Kallfass

Joint Radar and Communication System employing an adapted linear frequency modulated chirp combination...782 Matthias Weiß

Combining delta-phi velocity measurement and DBSCAN clustering to localize slowly moving objects in short ranges with limited slow-time radar data...792

Lap Yan Chan, Dieter Genschow, Ulrich Theodor Schwarz

Performance analysis of quadcopter drones to radar detection and track initialization characteristics optimization...803

Gyula Korsoveczki, Miklos Kende Orosz, Istvan Balajti

Real-Time Optimized Trajectories for 2D Emitter Localization using a UAVs team...813

Cesar Manuel Arrojo Lara, Juan Jose Navarro-Corcuera, Fabian Miehe, Felix Opitz

Extended Moving Ship Detection Based on Improved Variance Weighted Information Entropy in ATI-SAR Systems...820 M. Tian, R. Liao, G. Liao, G. Wu, D. Han, Q. Li