Damir Rakhimov

Research and Development in Wireless & DSP

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SUMMARY

I am a researcher with 10+ years of R&D experience and a focus on signal processing/machine learning. I have strong knowledge in (multi) linear algebra and probability theory. I am interested in research/development tasks on the intersection between theory and practice and involving solutions to various challenges. My work background includes experience in measurements/testing, programming microcontrollers/FPGAs, developing wireless systems prototypes, and organizing work processes.

TECHNICAL SKILLS

- **Languages**: Python, C++, System Verilog, VHDL, Matlab, LabView
- **Frameworks**: Matlab/GNU Octave, QuaDRiGa, GNU Radio, USRP, LabView/RFSA/RFSG/LV-FPGA, Python, PyTorch, TensorFlow, Scikit-Learn, NumPy, OpenCV, OpenCL, CUDA
- **Technologies**: MIMO-OFDM, mmWave, Machine Learning, FPGA
- **Methods**: Channel Estimation, Beamforming, Adaptive Array Signal Processing, Statistical Processing, Linear Algebra, Multidimensional Processing, Numerical Optimization

PROFESSIONAL EXPERIENCE

CRL | TU-Ilmenau | Ilmenau, Germany

A leading German public research university located in Thuringia, central Germany.

Senior Researcher in Wireless & DSP   Apr '22 – Present

- Research / Development of new mmWave algorithms
- Computer simulations and tests / Preparation of research reports
- Preparation of research proposals / Contacts with industrial partners

Research Assistant / MSCSP Program Manager   Aug '18 – Apr '22

- Research / Development of new mmWave algorithms
- Computer simulations and tests / Preparation of research reports
- Preparation of research proposals / Contacts with industrial partners

RTS | KNRTU-KAI | Kazan, Tatarstan

One of the largest technical universities in Russia with over 110,000 alumnies.

Lead Engineer / Research Assistant   Sep '13 – Aug '18

- Research in the field of wireless communications and transmission systems
- Prototyping of wireless systems / FPGA development
- Preparation of scientific/technical documentation and reports

Engineer   Sep '10 – Aug '13

- Software development for automated testing stands
- Development of algorithms for digital signal processing

EDUCATION

Doctor Engineer (PhD)   Jan '19 – Present

CRL | TU-Ilmenau | Ilmenau, Germany

- **Topic**: Channel estimation for mmWave MIMO-OFDM based on tensor-based signal processing
- **Advisor**: Univ. – Prof. Dr. Martin Haardt

Master of Science in Communications and Signal Processing (with Honor, GPA: 5.0/5.0)   Sep '11 – Jun '13

RTS | KNRTU-KAI | Kazan, Tatarstan

- **Topic**: Development and implementation of a software-hardware testbed for research of time and frequency synchronization methods for OFDM-based communication systems
- **Advisor**: Prof. Dr. Adel F. Nadeev

Bachelor of Science in Info-communication Systems and Networks (with Honor, GPA: 4.8/5.0)   Sep '07 – Jun '11

RTS | KNRTU-KAI | Kazan, Tatarstan

- **Topic**: Development of a testbed for automated measurements of multi-beam antenna systems
- **Advisor**: Prof. Dr. Adel F. Nadeev

WORK / RESEARCH INTERESTS

► MIMO-OFDM Wireless Communications / Adaptive Array Signal Processing / Beamforming / Channel Estimation
► Statistical Methods / Machine Learning / Artificial Intelligence / Autonomous Systems
► Real-Time Signal Processing / SoC / FPGA / GPU / TPU
► Linear Algebra / Multidimensional (Tensor) Processing / Optimization Methods and Algorithms

LANGUAGE ABILITIES

► **English**:   Full professional proficiency - Oral (C2), Reading (C2), Writing (C1)
► **German**:   Limited working proficiency - Oral (B2), Reading (B1), Writing (A2)
► **Russian**:   Native language
► **Tatar**:   Native language

PROJECTS

CRL | TU-Ilmenau | Ilmenau, Germany

Reconfigurable Intelligent Surfaces and Holographic Beamforming for Non-Terrestrial Networks   Jan '22 – Aug '23

► Senior Team Member
► Design and simulation of wireless communications and software design.

The project investigated the application of the new emerging technology of reconfigurable intelligent surfaces (RISs) and holographic beamforming to improve the performance of satellite communication networks.

Advanced Hybrid Analog-Digital Massive MIMO Techniques for Millimeter Wave Wireless Systems   Apr '19 – Dec '21

► Senior Team Member
► Design and simulation of wireless communications and software design.

Associated with Technische Universität IlmenauAssociated with Technische Universität Ilmenau The goal of this project is to design advanced massive hybrid analog-digital mMIMO techniques together with the required channel acquisition schemes to improve the performance of future broadband mmWave wireless communication systems in the 28 GHz band using multiple antennas.

RTS | KNRTU-KAI | Kazan, Tatarstan

Design and hardware verification of pattern distortion compensation algorithms for multi-beam antenna systems   Jan '17 – Dec '17

► Lead Team Member
► Implementation of algorithms in hardware, software design, system performance evaluation, and hardware verification.

The goal of the project was the development of algorithms and a testbed for digital pattern distortion compensation for multi-beam antenna systems.

Research and development of a prototype of the video processing unit of the adaptive front-light control system   Jan '16 – Feb '17

► Lead Team Member
► Algorithms design and verification, hardware implementation, and system performance evaluation.

The goal of the project was to design a processing chain for object detection and control of an adaptive-front light system (part of ADAS).

Development of waveguide mode converter for radio direction finder and test equipment to it.   Mar '15 – Nov '15

► Senior Team Member
► System modeling, development of software to control test equipment for direction finder, designing of system structure, verification of measuring algorithm.

The goal of the project was to simulate the work of a radio direction finder for the K-band and then develop test equipment. The measurement platform was built on the equipment from NI. The software was designed in LabView. The complex could measure radiodirection finder response characteristics, store signals in real time to RAID, and extract quality parameters from the measured data.

Development of a digital processing module for a prototype of a beacon transponder   Sep '13 – Jan '14

► Senior Team Member
► Algorithms design and verification, hardware implementation, system performance evaluation.

System modeling, development of software to control equipment (prototype), programming FPGA board, research and development of algorithms to receive and process data.

Research and development of a prototype for OFDM based communication system   Jan '12 – Dec '12

► Team Member
► System modeling, development of software for USRP testbed, research and development of time and frequency synchronization algorithms for OFDM based communication systems prototype.

The goal of the project was the investigation of the OFDM technology. Special focus was placed on the analysis of the time- and frequency-synchronization algorithms. During the project, I created the architecture for the transceiver design and developed the corresponding algorithms for signal processing. Further, the performance was analyzed at the NI-SDR testbed with physical signals.

Development of software for an automated system for antenna measurements   Apr '11 – Oct '11

► Team Member
► Development of software for equipment control, software for measurement data processing and software for data visualization.

The goal of the project was to build the control software for an automatic antenna measurement system. The corresponding measurement system was built on the vector network analyzer from National Instrument equipment. The control systems facilitated the measurements of antenna parameters, such as diagram pattern, matching coefficient, polarization, etc. Within the project, all software was developed in the graphical programming environment Labview.

MAIN PUBLICATIONS

- ► G. C. Nwalozie, **D. Rakhimov**, and M. Haardt, "Robust near-field beamforming for millimeter wave communication systems with aperture perturbation," in Proc. 49th IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2024), Seoul, Korea, April 2024.
- ► **D. Rakhimov**, and M. Haardt, "Analytical performance assessment of 2-D Tensor ESPRIT in terms of physical parameters," IEEE Open Journal of Signal Processing, vol. 5, pp. 122-131, 2023
- ► **D. Rakhimov**, and M. Haardt, "Analytical performance assessment of 1-D ESPRIT in DFT beamspace," in Proc. 57th Asilomar Conference on Signals, Systems, and Computers (Asilomar-2023)
- ► G. C. Nwalozie, **D. Rakhimov**, and M. Haardt, "Near-field Beamforming for MU-MIMO Millimeter Wave Communication System," in Proc. 31st European Signal Processing Conference (EUSIPCO-2023)
- ► **D. Rakhimov**, B. Peng, E. Jorswieck, M. Haardt, "Robust Reflective Beamforming for Non-Terrestrial Networks under Thermal Deformations,", in Proc. 48th IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP-2023)
- ► **D. Rakhimov**, M. Haardt, "Equivalence of aperture reduction in element space and constrained combination of DFT beams in beamspace,", in Proc. 48th IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP-2023)
- ► **D. Rakhimov**, A. Rakhimov, A. Nadeev, M. Haardt, "Tensor Formulation of the Cramer-Rao Lower Bound for Beamspace Channel Estimation in mmWave MIMO-OFDM", in Proc. 25th International ITG Workshop on Smart Antennas (WSA-2021)
- ► J. Zhang, **D. Rakhimov**, M. Haardt, "Gridless channel estimation for hybrid mmWave MIMO systems via tensor-ESPRIT algorithms in DFT beamspace", IEEE Journal of Selected Topics in Signal Processing 15 (3), 816-831, 2022
- ► **D. Rakhimov**, J. Zhang, A. de Almeida, A. Nadeev, M. Haardt, "Channel Estimation for Hybrid Multi-Carrier mmWave MIMO Systems Using 3-D Unitary Tensor-ESPRIT in DFT beamspace", in Proc. 53rd Asilomar Conference on Signals, Systems, and Computers (Asilomar-2019), 447-451, invited paper.
- ► **D. Rakhimov**, S. P. Deram, B. Sokal, K. Naskovska, A. L. F. de Almeida, and M. Haardt, "Iterative tensor receiver for MIMO-GFDM systems," in Proc. 11th IEEE Sensor Array and Multichannel Signal Processing Workshop (SAM-2020)