

Mohammad ALAEE-KERAHROODI

Radar Signal Processing | Research Scientist

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📁 RESEARCH PROJECTS

Current	Research Associate Interdisciplinary Centre for Security, Reliability and Trust - SnT, UNIVERSITY OF LUXEMBOURG, Luxembourg
December 2017	<ul style="list-style-type: none">> RDI 2.0 (Partnership program with IEE) : Distributed, collaborative and connected MIMO (September 2019 - August 2023)<ul style="list-style-type: none">> Leader of work packages which are dedicated to scenario modelling, waveform design, architecture design and receiver processing.> Leader of the prototyping and in-lab demonstration.> SPRINGER (The FNR CORE program) : Signal Processing for Next Generation Radar (September 2019 - August 2022)<ul style="list-style-type: none">> Contribution in writing the proposal and project acquisition.> Leader of WP2 and WP5 which are “Exploiting spatial diversity in WS-MIMO : enhanced detection, parameter estimation and classification” as well as “In-lab demonstration”.> AWARDS (The FNR BRIDGES program (formerly CORE-PPP)) : Adaptive mmWave Radar Platform for enhanced Situational Awareness : Design and Implementation (Dec 2017- Nov 2020)<ul style="list-style-type: none">> Work Package (WP) leader of FNR CORE-PPP funded project with IEE, Funding : 500k Euros, Team Size : 3.<ul style="list-style-type: none">— 3 journal papers, 11 conference papers and 1 magazine paper are published in this project by the end of second year.— In-lab demonstration of automotive radar systems using SDR/USRP and mmWave COTS (TI-AWR evaluation module).> PROSAT : On-board Processing techniques for High Throughput Satellites (May 2017- April 2020).<ul style="list-style-type: none">> FNR CORE-PPP funded project with SES, Funding : 500k Euros, Team Size : 4.<ul style="list-style-type: none">— Developer and leader of the first version of the DTP simulator.> RDI 1.0 (Partnership program with IEE) : Advanced Millimeter-wave technologies for Imaging Applications (2015 - August 2018)<ul style="list-style-type: none">> Design of adaptive waveforms (PMCW and possibly binary) for automotive applications.> Design of low complexity adaptive receiver algorithms with collaboration of IEE for automotive applications. <p>MATLAB USRP/SDR LabView mmWave COTS Code Composer Studio</p>

📁 HARDWARE-BASED EXPERIENCES

Current	In-charge of Radar Lab Interdisciplinary Centre for Security, Reliability and Trust - SnT, UNIVERSITY OF LUXEMBOURG, Luxembourg
December 2017	<ul style="list-style-type: none">> Developing different prototypes for the projects, including<ul style="list-style-type: none">> End-to-end MIMO radar prototype.<ul style="list-style-type: none">— Demonstrated in SnT partnership day 2019.> MIMO radar MIMO communications (MRMC) prototype<ul style="list-style-type: none">— Demonstrated in SPAWC2019.> mmWave people counting prototype.<ul style="list-style-type: none">— Demonstrated in SnT partnership day 2019. <p>MATLAB USRP/SDR LabView mmWave COTS Code Composer Studio</p>

SELECTED PUBLICATIONS

2020

- **M. Alae-Kerahroodi**, Aubry, A., Naghsh, M. M., De Maio, A., and Modarres-Hashemi, M. (2020) (Chapter 3). "A computational design of phase-only (possibly binary) sequences for radar systems". In A. F. Antonio De-Maio Guolong Cui and J. Li (Eds.), Waveform design based on the optimization theory(p.63 - 94). IET : IET Scitech Series on Radar.
- **M. Alae-Kerahroodi**, Aubry, A., Naghsh, M. M., De Maio, A., and Modarres-Hashemi, M. (2020) (Chapter 3). "A computational design of phase-only (possibly binary) sequences for radar systems". In A. F. Antonio De-Maio Guolong Cui and J. Li (Eds.), Waveform design based on the optimization theory(p.63 - 94). IET : IET Scitech Series on Radar.
- M. M. Feraidooni, D. Gharavian, **M. Alae-Kerahroodi** and S. Imani, "A Coordinate Descent Framework for Probing Signal Design in Cognitive MIMO Radars," in IEEE Communications Letters.
- M. M. Feraidooni, D. Gharavian, S. Imani and **M. Alae-Kerahroodi**, "Designing M-ary Sequences and Space-Time Receive Filter for Moving Target in Cognitive MIMO Radar Systems," Signal Processing, April 2020.

2019 and before

- **M. Alae-Kerahroodi**, M. Modarres-Hashemi, M.M. Naghsh, "Designing Binary Sequence Sets for MIMO Radar Systems", IEEE Transaction on Signal Processing, Volume : 67 , Issue : 13 , July1, 1 2019.
- **M. Alae-Kerahroodi**, K. V. Mishra, M. R. Bhavani Shankar and B. Ottersten, "Discrete-Phase Sequence Design for Coexistence of MIMO Radar and MIMO Communications," 2019 IEEE 20th International Workshop on Signal Processing Advances in Wireless Communications (SPAWC), Cannes, France, 2019, pp. 1-5.
- **M. Alae-Kerahroodi**, S. Sedighi, B. Shankar M. R., and B. Ottersten, "Designing (In)Finite-Alphabet Sequences via Shaping Radar Ambiguity Function," 2019 IEEE International Conference on Acoustics, Speech and Signal Processing, (ICASSP), 12 - 17 May, 2019. Brighton, UK.
- **M. Alae-Kerahroodi**, S. Imani, B. Shankar M. R., M.M. Nayebi, and B. Ottersten, "A Coordinate Descent Framework to Joint Design of MPSK Sequences and Receive Filter Weights in MIMO Radar Systems," IEEE Radar Conference 2019, 22 - 26 April 2019.
- **M. Alae-Kerahroodi**, A. Aubry, A. De-Maio, M.M. Naghsh and M. Modarres-Hashemi, "A Coordinate-Descent Framework to Design Low PSL/ISL Sequences", IEEE Transactions on Signal Processing, Volume : 65 , Issue : 22, Nov.15, 2017.
- M. Naghsh, M. Modarres-Hashemi, **M. Alae-Kerahroodi**, and E. H. M. Aian, "An information theoretic approach to robust constrained code design for MIMO radars," IEEE Transactions on Signal Processing, vol. 65, Issue 14, pp. 3647 - 3661. Year 2017.

EDUCATION

November 2017	PhD Student Department of Electrical and Computer Engineering, Isfahan University of Technology, ISFAHAN, Iran
September 2012	<ul style="list-style-type: none">➤ Thesis Title : "Waveform design with low autocorrelation sidelobes in RADAR systems".➤ Visiting Researcher from February to August 2016 with the University of Naples "Federico II", Naples, Italy.➤ Teaching assistance of "radar systems" in university of Isfahan, Iran.➤ Publishing two journal papers in "transaction of signal processing (TSP)" based on the innovation of the thesis in the waveform design for radar systems.➤ Developing a powerful toolbox for waveform design in radar systems using MATLAB and USRP. <div style="display: flex; gap: 5px;">MATLAB USRP/SDR FPGA</div>

CO-SUPERVISION

Current December 2017	Collaboration Waveform design for radar system, PHD STUDENTS, <ul style="list-style-type: none">➤ Sayed Hossein Dokhanchi.<ul style="list-style-type: none">➤ Joint Radar Communications.➤ Expected Graduation : March 2020 (SnT).➤ Saeid Sedighi.<ul style="list-style-type: none">➤ Compressive Sensing for Radar.➤ Expected Graduation : December 2020 (SnT).
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Current
December 2017

Co-supervision | Waveform design for radar system, PHD STUDENTS,

- > Ehsan Raei.
 - > Adaptive Radar Waveform Design.
 - > Started at October 2018 (SnT).
- > Gabriel TEDGUE BELTRAO.
 - > MIMO Distributed Radar for Indoor Applications (MIDIA).
 - > Started at October 2019 (SnT).
- > Mohammad Mahdi Feraidooni.
 - > Enhancing Detection of Moving Targets in MIMO Radar Systems.
 - > Shahid Beheshti University, G. C., Tehran, Iran.
- > Himani Joshi (Visiting Student).
 - > DoA estimation of wideband signals
 - > IIIT-Delhi, India.

Full list of publications can be found in https://wwwen.uni.lu/snt/people/mohammad_alaeekerahroodi2

More information can be found in <https://radarmimo.com/>

 **PROFESSIONAL EXPERIENCE**

November 2017
January 2008

Active/Passive Sensing | Primary and secondary radar systems, TEHRAN, Iran

- > MIMO Radar System
 - > Feasibility study and design of a colocated and a widely separated MIMO radar system.
- > Phased Array Radar System
 - > Design and simulation of signal processing unit of a phased array radar system, including pulse compression, range-Doppler estimation, beamforming and DOA estimation using MLE and MUSIC.
- > Passive/Secondary Radar System
 - > Implementation of an Automatic dependent surveillance - broadcast (ADS-B) signal processing unit on Xilinx Spartan-6 FPGA board using VHDL.
 - > Implementation pulse analyzer to detect Secondary Surveillance Radar (SSR) signals, including matched filtering, differentiating, integrator and CFAR blocks, on Xilinx Spartan-6 FPGA board using VHDL.
 - > Design and simulation of the localization algorithms for estimating location of the interrogator of SSR radar systems for passive detection.
 - > Clustering and classification of the SSR interrogators for passive localization.
 - > Design and implementation of α - β filter for plot enhancement.
- > Radar Target Emulator
 - > Development of a radar target emulator to generate radar echoes for the purpose of testing, calibration and training on a wide variety of radar systems using Software defined radio peripherals (SDR/USRPs).
- > Communication Transceiver
 - > Contribution in development of a transceiver for WiMAX using Xilinx ZC706 SDR module.
- > Meteorological Radar System
 - > Design of signal processing algorithms for an X-band non-coherent weather radar system, including reflectivity estimation, rainfall measurements, as well as clutter attenuation and receiver calibration.
- > Marine Radar System
 - > Design of signal processing algorithms, including pulse integration, Anti-See, Anti-Rain, and CFAR detection.
 - > Development of track while scan algorithm, using alpha-beta-gamma (α, β, γ) and Kalman filter.
- > Ground Surveillance Radar System
 - > Design and simulation of MTD signal processing unit, including pulse compression, range-Doppler estimation and CFAR (CA/OS/SO/GO) detection.
 - > Development of automatic target recognition algorithm to recognize and distinguish of three classes of targets : personnel, wheeled vehicles and animals, based on micro-Doppler signature.
 - > Investigate of various techniques to discriminate a target against the clutter in moving target indicator (MTI) radar system.

MATLAB USRP/SDR FPGA