

Mohammad ALAEE-KERAHROODI

Radar Signal Processing | Research Associate

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Mohammad Alaee-Kerahroodi was born in 1981, City of Ray, IRAN. In 2007, he received the M.Sc. degree in communication engineering at the Electrical Engineering department of Amirkabir University of Technology (Tehran Polytechnic), Tehran, IRAN. After graduating from the university, he was a key engineer for the development of the different radar systems including meteorological, primary/secondary air traffic control radar systems, marine radar system, ground surveillance radar system, etc. In 2012, he started his PhD in communication engineering at the Department of Electrical and Computer Engineering, Isfahan University of Technology, Isfahan, IRAN. From February to August 2016, he was a Visiting Researcher with the University of Naples “Federico II”, Naples, ITALY. In November 2017, he received the PhD degree and thereupon he joined to the Signal Processing and Satellite Communications group, SIGCOM, at the Interdisciplinary Centre for Security, Reliability and Trust (SnT), University of Luxembourg, LUXEMBOURG. Within this research tenure, he is currently working on innovative radar signal processing solutions for automotive MIMO radar systems as well as pursuing academic research in the area of radar waveform design and signal processing. In addition, he is participating in developing radar lab is SIGCOM and writing national and European projects to attract funding as well as supervising students. His research interests are related to waveform design for active sensing and communication systems, optimization theory applied to radar signal processing, design and optimization of MIMO radar systems and statistical/array signal processing.

📁 ACADEMIC AND PROFESSIONAL EXPERIENCE

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.

MATLAB USRP/SDR LabView mmWave COTS Code Composer Studio

Novembre 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.
	MATLAB USRP/SDR FPGA
November 2017	Active/Passive Sensing Primary and secondary radar systems, TEHRAN, Iran
January 2008	<ul style="list-style-type: none"> > MIMO Radar System <ul style="list-style-type: none"> > Feasibility study and design of a colocated and a widely separated MIMO radar system. > Phased Array Radar System <ul style="list-style-type: none"> > 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 <ul style="list-style-type: none"> > 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 <ul style="list-style-type: none"> > 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 <ul style="list-style-type: none"> > Contribution in development of a transceiver for WiMAX using Xilinx ZC706 SDR module. > Meteorological Radar System <ul style="list-style-type: none"> > 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 <ul style="list-style-type: none"> > 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 <ul style="list-style-type: none"> > 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
December 2007	MSc Student : Department of Electrical and Computer Engineering, Amirkabir University of Technology (Tehran Polytechnic), TEHRAN, Iran
September 2004	<ul style="list-style-type: none"> > Thesis Title : “Recognition of Moving Terrestrial Targets in the Presence of Terrestrial Clutters with a Pulse Doppler RADAR” > Performing real data capturing and evaluating the proposed algorithm based on the real data > Publishing three conference papers in radarconf2008, SAM2008 and UKSIM2008.
	MATLAB

<p>Current December 2017</p>	<p>Collaboration Waveform design for radar system, PHD STUDENTS,</p> <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).
<p>Current December 2017</p>	<p>Co-supervision Waveform design for radar system, PHD STUDENTS,</p> <ul style="list-style-type: none"> > Ehsan Raei. <ul style="list-style-type: none"> > Adaptive Radar Waveform Design. > Started at October 2018 (SnT). > Gabriel TEDGUE BELTRAO. <ul style="list-style-type: none"> > MIMO Distributed Radar for Indoor Applications (MIDIA). > Started at October 2019 (SnT). > Mohammad Mahdi Feraidooni. <ul style="list-style-type: none"> > Enhancing Detection of Moving Targets in MIMO Radar Systems. > Shahid Beheshti University, G. C., Tehran, Iran. > Himani Joshi (Visiting Student). <ul style="list-style-type: none"> > DoA estimation of wideband signals > IIT-Delhi, India.

 SELECTED PUBLICATIONS

- 2019
- > **M. Alae-Kerahroodi**, Aubry, A., Naghsh, M. M., De Maio, A., and Modarres-Hashemi, M. (2020) (Book Chapter). "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.-). IET : IET Scitech Series on Radar.
 - > **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**, 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.
- 2018
- > **M. Alae-Kerahroodi**, M. Modarres-Hashemi, M.M. Naghsh, B. Shankar and B. Ottersten, "Binary Sequences Set with Small ISL for MIMO Radar Systems," 26th European Signal Processing Conference (EUSIPCO), 2018.
- 2017
- > **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.

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>
November 2017 January 2008	Active/Passive Sensing Implementation on FPGA, TEHRAN, Iran <ul style="list-style-type: none">> Passive/Secondary Radar System<ul style="list-style-type: none">> 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.> Radar Target Emulator<ul style="list-style-type: none">> 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<ul style="list-style-type: none">> Contribution in development of a transceiver for WiMAX using Xilinx ZC706 SDR module. <p>USRP/SDR FPGA MATLAB VHDL</p>

+ LANGUAGES

Persian ●●●●●
English ●●●●○
French ●●○○○

</> PROGRAMMING LANGUAGES

Matlab ●●●●●
LabView ●●●●○
VHDL ●●●○○
C++ ●●○○○

“ REFERENCES

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