

Rawan Alkurd

DATA SCIENTIST

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Summary

A data scientist, a researcher, and a programmer who loves to continuously learn, propose innovative ideas, and create new things. Passion and diligence are two traits that I believe most reflect me as an individual.

Professional Experience

Data Scientist, Larus Technologies

Ottawa, Canada

PROJECTS:

May 2020-Present

- Shipment/Price prediction and optimization (time series analysis).
- Predictive case identification to address the problem of early detection of asymptomatic/pre-symptomatic carriers of COVID-19.

Education

Ph.D Degree in Electrical and Computer Engineering

Ottawa, Canada

CARLETON UNIVERSITY, DEPARTMENT OF SYSTEMS & COMPUTER ENGINEERING.

2015-2020

- Thesis title: Big Data-Driven AI-based Wireless Networks Personalization.

Master's Degree in Electrical Engineering

Sharjah, UAE

KHALIFA UNIVERSITY, DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING.

2013-2015

- Thesis title: Relay-Assisted Optimum Combining Schemes for Relay-Based Cooperative Diversity Systems.

Bachelor's Degree in Communication Engineering.

Sharjah, UAE

KHALIFA UNIVERSITY, DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING.

2009 - 2013

- Overall GPA: 3.83-4.00 (95.75%).
- Classification: Distinction with First Class Honors.

Honors & Awards

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| 2016-2019 | Scholarship award , Recipient of the Vanier Graduate Scholarship, Canada's most prestigious graduate scholarship. | Canada |
| 2015 | Travel award , Recipient of IEEE Wireless Communications and Networking Conference (WCNC) Student Travel Grant, 2015. | USA |
| 2013 | 1st place , Best Poster Award, Undergraduate Research Conference (5th URC 2013) Zayed University, Dubai Campus. | UAE |
| 2013 | 1st place , The Prototype Project competition, Engineering Student Renewable Energy Competition (ESREC), UAEU, Project: Wireless Control of Self Sustained Solar Power Generation System. | UAE |
| 2013-2015 | Scholarship award , Khalifa University of Science, Technology and Research Graduate Scholarship. | UAE |
| 2009-2013 | Dean's Honor list , Collage of Engineering, Khalifa University of Science, Technology and Research. | UAE |

Projects

Big Data-Driven AI-based Wireless Networks Personalization

Carleton University

Ottawa, Canada

- **Objective:** Design, model, and build a big data-driven AI-based wireless network personalization framework. The personalized wireless network is designed to utilize big data analytics and machine learning to harness massive amounts of user data. The personalized network is supported with a patented user satisfaction behavior model called the Zone of Tolerance model (ZoT) that is used to model, acquire, and predict user satisfaction in wireless networks in a non-intrusive manner. The designed personalized network is able to dynamically adjust to changing user satisfaction behavior preferences and to the changes in the surrounding environment. The proposed personalized network is able to micro-manage and optimize resource allocation rewards and user satisfaction simultaneously using a multi-objective formulation.
- **Challenges:** The first challenge that is holding back innovation into new approaches for personalizing wireless networks is the lack of published data due to privacy and confidentiality reasons. Another challenge is modeling and predicting future user satisfaction information using context values available to the network. In addition, the network should be able to deal with new users who don't have sufficient data history in the network. Finally, the network should be able to optimize in real-time two contradicting objectives: both user satisfaction and the allocated resources. The objectives should be optimized in a multi-objective manner in order to achieve a win-win setting for users and service providers.
- **Tools/Software:** Python (Scikit-learn, Pandas, PySpark, TensorFlow, Keras, Platypus, Seaborn, Folium, Matplotlib, and Plotly), MATLAB, KNIME, Latex.
- **Achievements:**
 - A big data-driven AI-based wireless network personalization framework is proposed in order to integrate personalization into current wireless networks.
 - The ZoT model and a nonlinear satisfaction mapper are proposed to dynamically model user satisfaction behavior in wireless networks.
 - A synthetic dataset design methodology is proposed to generate labeled user context data.
 - In order to produce datasets with realistic user behavior patterns, an algorithm is proposed to incorporate real activity sensor measurements. In addition, to model the effect of insufficient user context data on the ML predictor, statistical errors are integrated into the proposed user satisfaction mapper.
 - Accommodating new users in personalized networks is done by associating them to one of the networks already existing user personas. Therefore, the concept of user persona as well as a persona prediction and association framework are proposed.
 - A user satisfaction prediction framework is proposed to collect, label, and predict personalized user satisfaction levels in wireless networks in an automated manner.
 - A two-phase deep neural network structure is proposed to implement user satisfaction prediction from context data in personalized wireless networks.

- A multi-objective formulation is proposed to simultaneously optimize user satisfaction and resources in personalized networks.
- A privacy-preserving framework based on Differential Privacy Technology is proposed to protect users' private information in personalized wireless networks.

Relay-Assisted Optimum Combining Schemes for Relay-Based Cooperative Diversity Systems

Khalifa University

Sharjah, UAE

- **Objective:** Develop a new optimum combining scheme for relay-based cooperative diversity systems which improves the relay decision information awareness at the destination receiver in order to improve the overall performance of the system.
- **Challenges:** For single-input multiple-output (SIMO) systems, Maximum Ratio Combining (MRC), employed at the receiver, achieves the best performance compared to other combining schemes in the literature, such as Selection Combining (SC) and Equal Gain Combining (EGC). This is due to the fact that MRC effectively uses the Channel State Information (CSI) at the receiver in the combining process. In contrast, for cooperative relay-based systems employing relay detection, the use of MRC degrades the performance due to the lack of relay decision information awareness at the destination.
- **Tools/Software:** Matlab, Latex.
- **Achievements:** In order to overcome the degradation resulting from lack of relay decision information at the destination receiver, a new optimum combining scheme is developed for relay-based cooperative diversity systems in which the performance gain is achieved through the use of relay decision information, along with CSI, in the combining process. The relay decision information is in the form of the number of errors per received packet over the source-relay link. Equivalently, and in simple terms, relay decision information takes the form of a single bit indicating whether the received packet over the source-relay link is error-free or contains errors. The developed optimum relay assisted combining scheme is demonstrated for both Decode-and-Forward (DF) and Hybrid-Decode-Amplify-Forward (HDAF) cooperative systems. The optimum combining scheme is developed in a generalized fashion, where MRC and other combining schemes are considered to be special cases. Extensive Monte Carlo simulations and numerical results demonstrate the significant performance gains of the developed optimum relay-assisted combining scheme. Moreover, the developed optimum combining scheme enhances system robustness due to the adaptivity of the destination combiner with the change in channel conditions and packet size.

Teaching Experience

SYSC 3600 Systems and Simulations.

SYSC 4700 Telecommunications Engineering.

SYSC 4607 Wireless Communications.

CMME 331 Modeling and Simulations of Communication Systems.

ENGR 111 Engineering Design.

PHYS 121 University Physics I.

ELCE 214 Electric Circuits.

Applied Research Interests

- Machine Learning.
- Real-time Big Data Analytics.
- Wireless Communications.

Software Tools

- OS** UNIX, MAC, Windows.
- Programming** Python, MATLAB, C++.
- Visualization** Python (Matplotlib, Seaborn, Plotly, Folium), Microsoft Power BI, Matlab.
- Data Mining** Python-Pandas, MATLAB, KNIME.
- ML** Python (Scikit-learn, TensorFlow, Keras, PySaprk-MLLIB).
- Big Data** Apache Spark.
- Optimization** Platypus, SciPy.

Publications

MACHINE LEARNING AND BIG DATA ANALYTICS

- 2020 **R. Alkurd**, I. Abualhaol, and H. Yanikomeroglu, "Personalized Resource Allocation in Wireless Networks: An AI-Enabled and Big Data-Driven Multi- Objective Optimization," *IEEE Access*, vol. 8, pp. 144592-144609, 2020. *Journal*
- 2020 **R. Alkurd**, I. Abualhaol, and H. Yanikomeroglu, "Big Data-Driven AI-based Framework to Enable Personalization in Wireless Networks," *IEEE Communications Magazine*, vol. 58, no. 3, pp. 18-24, March 2020. *Journal*
- 2020 **R. Alkurd**, I. Abualhaol, and H. Yanikomeroglu, "Preserving User Privacy in Personalized Networks,," submitted to *IEEE Transactions on Vehicular Technology*, September 2020 *Journal*
- 2020 **R. Alkurd**, I. Abualhaol, and H. Yanikomeroglu, "User Persona in Personalized Wireless Networks: A Data-Driven prediction framework," in *Proc. 2020 IEEE 92nd Vehicular Technology Conference (VTC-Fall)*, October 2020. *Conference*
- 2020 **R. Alkurd**, I. Abualhaol, and H. Yanikomeroglu, "Personalized Resource Allocation in Wireless Networks: An AI-Enabled and Big Data-Driven Multi-Objective Optimization", US provisional patent application no: 63/057,560, application date: 28 July 2020. *Patent*
- 2020 **R. Alkurd**, I. Abualhaol, and H. Yanikomeroglu, "Enabling wireless network personalization using Zone of Tolerance modeling and predictive analytics", W.O. Pat. Ser. No. PCT/CA2019/051197, application date: 29 August 2019, publication no: WO2020/041883 A1, publication date: 05 March 2020. *Patent*

- 2020 **R. Alkurd**, I. Abualhaol, and H. Yanikomeroglu, "User Satisfaction Prediction Framework for Personalized Wireless Networks: A DNN Approach," submitted to: *2020 IEEE International Conference on Communications (ICC)*, 2020. Conference
- 2019 **R. Alkurd**, I. Abualhaol, and H. Yanikomeroglu, "A Synthetic Dataset Modeling for Data-Driven AI-Based Personalized Wireless Networks," in *Proc. 2019 IEEE International Conference on Communications Workshops (ICC Workshops)*, Shanghai, China, May 2019. Conference
- 2019 **R. Alkurd**, I. Abualhaol, and H. Yanikomeroglu, "Dataset modeling for data-driven AI-based personalized wireless networks," in *Proc. 2019 IEEE International Conference on Communications (ICC)*, Shanghai, China, May 2019. Conference
- 2019 **R. Alkurd**, I. Abualhaol, and H. Yanikomeroglu, "A synthetic user behavior datasets for data-driven AI-based personalized wireless networks: Dataset," [Online]. Available: <https://github.com/rawanalkurd/Personalization-Framework-Datasets>, May 2019. Dataset

WIRELESS AND COOPERATIVE COMMUNICATIONS

- 2016 **R. Alkurd**, I. Abualhaol, Raed Shubair, and Muriel Medard, "Optimum HDAF Relay-Assisted Combining Scheme with Relay Decision Information," in *Proc. IEEE 84th Vehicular Technology Conference (VTC)*, Montréal, Canada, 18-21, September 2016. Conference
- 2015 **R. Alkurd**, Shubair, and I. Abualhaol, "Optimum Decode-and-Forward Relay-Assisted Combining Scheme with Relay Decision Information," in *Proc. IEEE International Conference on Communications (ICC)*, pp. 2331–2337, June 2015. Conference
- 2015 **R. Alkurd**, R. Shubair, and I. Abualhaol, "Modeling Conditional Error Probability for Hybrid Decode-Amplify-Forward Cooperative System," in *Proc. IEEE Wireless Communications and Networking Conference (WCNC)*, 7-12, March 2015. Conference
- 2014 **R. Alkurd**, I. Abualhaol, and Raed Shubair, "Survey on Device-to-Device Communications: Challenges and Design Issues," in *Proc. 2014 IEEE 12th International New Circuits and Systems Conference (NEWCAS)*, pp.361,364, 22-25 June 2014. Conference

STATISTICAL AND PERFORMANCE ANALYSIS

- 2014 **R. Alkurd**, I. Abualhaol, and S. Muhaidat, "Error Rate Performance Analysis of Cooperative SCR in VANETs over Generalized Fading Channels," in *Proc. IEEE Wireless Communications and Networking Conference (WCNC)*, pp. 3184–3189, 6-9 April 2014. Conference
- 2013 **R. Alkurd**, R. Shubair, I. Abualhaol, "Error rate performance analysis of cooperative MRC receivers over generalized fading channels," in *Proc. IEEE 20th International Conference on Electronics, Circuits, and Systems (ICECS)*, pp. 201–204, 8-11 December 2013. Conference
- 2013 **R. Alkurd**, R. Shubair, I. Abualhaol, "An efficient approximation of $Q(\sqrt{x})$ function and general BER performance analysis," in *Proc. GCC Conference and Exhibition (GCC)*, 2013 7th IEEE, pp.367,371, 17-20 November 2013. Conference