Ibrahim AbuAlhaol

Ph.D. | P.Eng. | SMIEEE

Larus Technologies
Carleton University
Ottawa, ON, Canada
✆ ***(613) 216-9474***
✉ *ibrahimee@ieee.org*
🖥 *alhaol.com*
Permanent resident in Canada

Summary

Research Scientist at Larus Technologies and **Adjunct Research Professor** at Carleton University in Ottawa, Canada. Holds a BSc, an M.Sc, and a PhD in Electrical and Computer Engineering. Holds M.Eng in Technology Innovation Management. Senior member of IEEE and a Professional Engineer (P.Eng.) in Ontario, Canada. His research interests include real-time big-data analytics and its application in the Internet-of-Things, cybersecurity, and wireless communication networks. He has an excellent knowledge and hands-on experience in machine learning modeling and real-time Big Data analytics: **(i)** *Python programming* (Data analysis and mining with pandas, visualization with matplotlib and seaborn, machine learning with Scikit-learn/Spark-MLlib/TensorFlow, and natural language processing with NLTK/Gensim), **(ii)** *Databases* (MySQL, MongoDB, and Cassandra), **(iii)** *Real-time Big Data analytics* (Spark streaming and Kafka).

Education

2005–2008 **PhD in Electrical and Computer Engineering**, *University of Mississippi*, United States.
"Performance Evaluation and Optimization of Cooperative Communication Systems over Fading Channels"

2014–2015 **M.Eng. in Technology Innovation Management**, *Carleton University*, Canada.
"Towards Security and Privacy Differentiation in End-to-End Encryption Services"

2002–2004 **M.Sc. in Electrical Engineering**, *Jordan University of Science & Technology*, Jordan.
"Application of Fast Frequency Hopping CDMA in Multi-rate Short Range Wireless Networks"

1995–2000 **B.Sc. in Electrical Engineering**, *Jordan University of Science & Technology*, Jordan.

Employment

2017-Present **Research Scientist**, *Larus Technologies*, Ottawa, Canada.
Maritime Internet-of-Things | Actionable Intelligence | Real-time Big Data Analytics.

2017-Present **Adjunct Research Professor**, *Carleton University* , Ottawa, Canada.
Machine Learning | Big Data Analytics | 5G Wireless Networks Personalization | User Satisfaction .

2015-2017 **Research Scientist**, *VENUS Cybersecurity Corporation*, Ottawa, Canada.
Collective Intelligence | Machine Learning | Big Data Analytics | BGP Hijacking | DDOS Attacks | Visualization.

2014-2015 **Researcher**, *Carleton University*, Ottawa, Canada.
Device-to-Device Wireless Security | RSA Key Exchange | AES Encryption.

2009-2014 **Assistant Professor**, *Khalifa University of Science & Technology*, United Arab Emirates.
Probability and Statistics | Wireless Communications | Modulation and Coding | Digital Communications.

2008-2009 **Wireless System Engineer**, *Broadcom Corporation*, San Diego, USA.
3G/4G System Design | RF Compliance | 3GPP Standard | Bluetooth | WLAN.

2008-2008 **System Engineer Intern**, *Qualcomm Incorporation*, San Diego, USA.
4G Wireless Network Analysis and Simulation | HSPA | WiMAX | LTE.

2005-2008 **Ph.D. Student/ Research Assistant**, *University of Mississippi*, Oxford, United States.
Cooperative (UAV) Networks | MIMO/OFDM Systems | MATLAB/C++ Simulations.

Research Statistics

Statistics: **4** Book chapters | **5** Journals | **36** Conferences | **239** Google Scholar citations.

Experience

JAN 2017 −Present **Research Scientist**, Larus Technologies, Ottawa, Canada.

Objective: Exploiting massive amount of sensor data (Big Data) emitted by many maritime actors in order to improve both internal and collaborative processes for maritime Internet-of-Things related organizations.

Challenge: Generation of Actionable Intelligence (AI) for Decision Support (DS) using real-time Big Data analytics. The AI includes anomalies, alerts, threats, potential response generation, process refinement and other types of knowledge that improve the efficiency of maritime-related organizations.

Tools/Software: MOEA Framework-Java (Multi-objective Optimization), DEAP-Python (Evolutionary Algorithms), Big Data (PySpark and MLLIB), Databases (Cassandra, PostgreSQL, and MongoDB), Automatic Identification System (AIS) Data Mining (Python-Pandas), Data visualization (Python-Seaborn).

Responsibilities: [1] Prepare literature reviews on supply chain management and optimization and identify maritime related problems (pain points) to be solved (optimized) by real-time Big Data analytics. [2] Exploring Meta-heuristic Multi-objective Optimization (MOO) techniques and prepare a detailed document of the available state-of-the-art open source frameworks and tools. [3] Design, develop, and evaluate data mining processes to extract global speed statistics and outliers for all sea vessels categories at specific period of interest (POI) and time of interest (TOI) (tools: PySpark, Cassandra, Pandas, and Seaborn) [4] Collaborate with the software team to improve the utilization of real-time analytics and machine learning models to improve the accuracy of decision support system. [5] Harness publicly available maritime ports meta-data and establish efficient automated processes to collect, analyze and provide compiled data to be utilized by other DS systems optimizers. [6] Co-authoring publications in the area of meta-heuristics multi-objective optimization enabled by BD analytics and ML.

JAN 2017 −Present **Adjunct Research Professor**, Carleton University, Ottawa, Canada.

Objective: Modeling user satisfaction and zone of tolerance with Machine Learning (ML) and Big Data analytics and proactively direct the scheduler to micro manage resource allocations in 5G Networks.

Challenge: Harnessing massive amount of contextual and performance data and model the features that are correlated to the user satisfaction and zone of tolerance in spatial, temporal, and social contexts.

Tools/Software: MATLAB, KNIME, Python (Scikit-learn, Pandas, PySpark, and Matplotlib).

Responsibilities: [1] Co-supervising Ph.D. students to apply Machine Learning and Big Data (BD) analytics on wireless communication problems. [2] Direct the students on designing, developing, and evaluating machine learning models and techniques and apply them to personalize the distribution of resources in 5G networks. [3] Direct the effort to synthesize and model user data and tune the models to generate both usage and contextual data. [4] Co-authoring conferences and journals papers. [5] Direct the work-flow of generating processes, models, and data in an effort to provide open source tools and data that can be utilized by other members in the research community. [6] Acting as a reader and grader on Technology Innovation Management (TIM) Master of Engineering (M.Eng.) projects (e.g., **Machine Learning:** "Significance of Passenger Data for Better Forecasting of Maximum Permissible Takeoff Weight", **Natural Language Processing:** "Analysis of Customer Perspective of Identity and Access Management solutions using Topic Modeling Approach").

OCT 2015 **Research Scientist**, VENUS Cybersecurity Corporation, Ottawa, Canada.
– DEC 2016 **Objective:** Data Mining (DM) and Exploratory Analysis (EA) of live and historical Border Gateway Protocol (BGP) data in order to enable Cybersecurity operational monitoring, post-event analysis, and real-time anomaly detections.

Challenge: Real-time Big Data mining with unsupervised Machine Learning (ML) capabilities to tune supervised ML predictors. This includes feature engineering, cleaning, averaging, filtering, and time-series aggregation.

Tools/Software: KNIME, MATLAB, Python (Skit-learn, Pandas, and PySpark), Databases (MongoDB), Real-time streaming platform (Apache Kafka), Javascript visualization (D3, Crossfilter, DC).

Responsibilities: **[1]** Prepare literature review on Exploratory Data Analysis (EDA), Border Gateway Protocol (BGP) anomaly detection, and real-time Big Data analytics frameworks and software architecture. **[2]** Design, prototype, and evaluate BGP anomaly indicators and build machine learning models (supervised and unsupervised) to predict BGP IP prefix hijacking and Distributed Denial of Service (DDOS) attacks. **[3]** Build a visual interactive dashboard on the data being ingested from BGP stream. This includes displaying recent alerts and providing interactive visualizations of the context of a given alert using timelines, histograms, and moving averages of several types of the indicators that are being monitored. **[4]** Collaborate with the team to integrate the prototype as a real-time analytic engine that ingests BGPstream real-time stream, and push it to Apache Kafka, and store the processed indicators in a MongoDB Database and utilize Apache Spark MLLIB to predict the anomalies. The generated intelligence is pushed to a web-based Dashboard that enables the analyst to drill down and explore the incident. **[5]** Documentation and publish original research in peer-reviewed conferences and journals. **[6]** Testing and validating the developed processes in a large-scale and real-life IP prefix hijacking and DDOS incidents.

FEB 2014 **Researcher**, Carleton University, Ottawa, Canada.
– SEP 2015 **Objective:** Investigating the security and privacy differentiation in end-to-end encryption services.

Challenge: Improving the value proposition through usability in end-to-end encryption services.

Tools/Software: MATLAB and open source Javascript libraries (AES-JS: AES-256 encryption/decryption, JSENCRYPT: RSA key-exchange).

Responsibilities: **[1]** Prepare literature review on solutions that achieves communication security and privacy. **[2]** Identify limitations of the currently used communication encryption/decryption standards. **[3]** Conduct literature review to identify communication security standards to overcome the identified limitations. **[4]** Provide recommendations on the chosen standards and how to customize/improve them. **[5]** Conduct MATLAB system level simulations to prove the applicability the of chosen algorithms/standards. **[6]** The applicable algorithms/standards are recommended to the development team for integration and testing.

OCT 2009 **Assistant Professor**, Khalifa University of Science & Technology, United Arab Emirates.
– JAN 2014 <u>Objective:</u> Teaching and conducting research in wireless communications.

<u>Challenge:</u> Teaching, supervising graduate students, and attract research fund.

<u>Tools/Software:</u> MATLAB and Latex.

<u>Responsibilities:</u> **[1]** Teaching undergraduate courses: Introduction to Professional Engineering (ENGR 110), Probability and Statistics (MATH 215), Wireless Communications (CMME 400), Communication Networks (CMME 320), Modulation and Coding Techniques (CMME 404), Digital Communications I (CMME 302), Communication Engineering Project Laboratory (CMME 395) and Digital Communication Laboratory (CMME 300). **[2]** Advise students on academic matters and career decisions. **[3]** Supervised the following undergraduate projects: Mobile Bluetooth-Based Parking System, Multi-Sources Patient Localization System for Emergency Response, Wireless Control of Self-Sustained Solar Power Generation System, Evaluation of Spectrum Sensing Techniques in Cognitive Radio Networks, Solar Thermal Power Generation System, Performance Evaluation of MIMO-OFDM System over Fading Channels, Simulation of Interference Mitigation for OFDM Multi-hop LTE Networks, Single Carrier Frequency Division Multiple Access Air Interface for LTE, Wireless Device to Alert Drivers to Keep a Safe Distance, Downlink Power Control Techniques in CDMA Systems, Universal Mobile Telecommunications System (UMTS) Physical Layer, Orthogonal Frequency Division Multiplexing (OFDM) Synchronization Techniques. **[4]** Electrical and Computer Engineering (ECE) Committee Member: Responsible for establishing a Master of Science in Electrical and Computer Engineering (M.Sc. in ECE) program. **[5]** Resources Committee Member: Assessed current and future material requirements for the academic programs and propose new equipment and resources. **[6]** External Relations Committee Member: Identified best practices for interaction with all important external constituencies and defined means that facilitated strong relationships with the University.

SEP 2008 **Wireless System Engineer**, Broadcom Corporation, San Diego, USA.
– OCT 2009 <u>Responsibilities:</u> **[1]** Performed system level test plan, execution, troubleshooting, optimization and problem resolution on 2G/3G mobile devices. **[2]** Worked with a multi-discipline team to test and commercialize UMTS (Single SIM/Dual SIM) solutions. **[3]** Actively involved in producing requirements for tools and system simulators and work closely with development teams and test equipment vendors to come up with the appropriate test setups and associated automation. **[4]** Ensured close interaction with the modem stack, multi-media, RF, drivers, 3GPP standard representatives and System Design Engineers to ensure proper test coverage of the features.

MAY 2008 **System Engineer Intern**, Qualcomm Incorporation, San Diego, USA.
–AUG 2008 <u>Responsibilities:</u> **[1]** Analyzed and simulated fourth-generation (4G) wireless network core components. **[2]** Characterized and improved the performance of RF/RX front in WiMax and LTE wireless systems. **[3]** Identified RF/RX front functionality for which minimum standard system performance requirements should exist (Digital filtering (down-sampling & jammer rejection), DC offset removal (inner loop and outer loop), automatic gain control (AGC), digitally controlled variable gain amplifier (DVGA), and IQ-imbalance.) **[4]** Generated and consolidated performance requirements data and conducted analysis and evaluation of critical performance metrics for 4G using MATLAB and C++. **[5]** Compared system level performance findings with other wireless standards (i.e., GSM, WCDMA, Bluetooth, WLAN).

Software/Tools

OS	Linux, MAC, Windows.
Programming	Python, Java, C++, MATLAB.
Databases	MySQL, PostgreSQL, MongoDB, Cassandra.
Optimization	Java (MOEA-Framework), Python (DEAP).
Visualization	Python (Matplotlib, Seaborn, Bokeh, Folium) , JavaScript (D3.js, DC.js, Crossfilter.js).
Data Mining	Python-Pandas, Python-Orange, MATLAB, KNIME.
ML	Python (Scikit-learn, TensorFlow, PySaprk-MLLIB).
NLP	Python (NLTK, Gensim).
Big Data	Apache Spark.
Real-time	Apache Kafka.

Teaching Experience

SEP 2009 – JAN 2014

Probability and Statistics (MATH 215)
Textbook: Introduction to Probability and Statistics for Engineers and Scientists, S. M. Ross, 3rd edition, Elsevier, 2004.

- **Wireless Communications (CMME 400)**
  Textbook: Wireless Communications, Second Edition, Andreas F. Molisch, Wiley, 2011, ISBN: 0470741864.

- **Communication Networks (CMME 320)**
  Textbook: Data Communications and Networking, Behrouz Forouzan- 4th Edition, McGraw Hill, 2006, ISBN: 9780073250328.

- **Modulation and Coding Techniques (CMME 404)**
  Textbook: Bernard Sklar, Digital Communications Fundamentals and Applications, 2nd edition, Prentice Hall, 2001, ISBN: 9780130847881.

- **Digital Communications I (CMME 302)**
  Textbook: Modern Digital and Analog Communication Systems, B. P. Lathi and Zhi Ding, 4th edition, Oxford University Press, 2009.

- **Introduction to Professional Engineering (ENGR 110)**
  Textbook: John D. Kemper and Billy R. Sanders. Engineers and Their Profession, Oxford University Press, 5th edition, 2000, ISBN: 978 0195120578.

- **Communication Engineering Project Laboratory (CMME 395)**

Research Grants

2013 **Cross-Layer Design for Secure Land Transport Systems** (Grant=200,000 AED).
Abstract: The long-term goal of this research project is to develop both fundamental theories and practical designs of efficient, secure and safe vehicular networks, key components of ITS, and their seamless integration with other existing networks. To achieve the goal, the existing technologies are examined in various layers (i.e., all major layers of the Open System Interface (OSI)). Then, we proposed solutions to how available resources could be sensed, the information shared, and better utilized if these layers cooperate.

2012 **Vehicular ad-hoc networks (VANETs) for Intelligent Transportation Systems (ITSs): Enhancing the safety and the traffic management in United Arab Emirates** (Grant=190,000 AED).

Abstract: This research addresses physical layer techniques to meet the unique challenges in VANETs operating in mobile wireless environments. Considering the unique requirements of VANETs, the work involves analysis and design of cooperative transmission schemes which are optimized for inter-vehicular communication scenarios. The research consists of three sub-projects that involve the design of efficient cooperative schemes, the development of channel estimation/tracking algorithms, and the design of a cooperative OFDM scheme.

Interests

- Technology Innovation Management
- Real-time Big Data Analytics
- Maritime Internet-of-Things
- 5G Network Personalization
- Machine Leraning
- Wireless Security

Publications (Under Review / Preparation)

2018 **I. Abualhaol**, F. Cheraghchib, R. Falcona,R. Abielmona, B. Raahemi, and E. Petriu, "Maritime port boundary and vulnerability indicators with AIS Big Data Analytics", to be submitted to IEEE 2018 World Congress on Computational Intelligence (IEEE WCCI), Rio de Janeiro, Brazil (Planned: 15 Jan 2018).

2017 **I. Abualhaol**, "Continuous authentication with adaptive legitimacy patterns for secure wireless communications", to be submitted to International Journal of Information Security, Springer (Planned: 15 Dec 2017).

2017 R. Alkurd, **I. Abualhaol**, and H. Yanikomeroglu, "Enabling network personalization in 5G and beyond by machine learning and big data anlaytics", under review in IEEE Communications Magazine (submission: 05 October 2017).

2017 F. Cheraghchib, **I. Abualhaol** R. Falcona, R. Abielmona, B. Raahemi, and E. Petriu, "Modeling the Speed-based Vessel Schedule Recovery Problem using Evolutionary Multiobjective Optimization", under review in Elsevier Information Science journal(submission: 01 October 2017).

Publications (Published / Accepted)

2017 F. Cheraghchib, **I. Abualhaol**, R. Falcona,b, R. Abielmona, B. Raahemi, and E. Petriu, "Big-Data-Enabled Modelling and Optimization of Granular Speed-based Vessel Schedule Recovery Problem", accepted for publication in 2017 IEEE International Conference on Big Data, Boston, MA, USA, Dec 11-14, 2017.

2017 I. Al Ridhawi , N. Mostafa, Y. Kotb ,M. Aloqaily and **I. Abualhaol**, "Data Caching and Selection in 5G Networks Using F2F Communication", accepted for publication in 2017 IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC 2017), Montreal, QC, Canada.

2017 M. Gad and **I. Abualhaol**, "Securing Smart Cities Systems and Services: A Risk-Based Analytics-Driven Approach," accepted for publication as a chapter for the book entitled "Transportation and Power Grid in Smart Cities: Communication Networks and Services", John Wiley, UK.

2017 A. Shah, **I. Abualhaol** , M. Gad, and M. Weiss, "Combining Exploratory Analysis and Automated Analysis for Anomaly Detection in Real-Time Data Streams", Technology Innovation Management Review, 7(4): 25-31, 2017.

2016 Michael Weiss, **I. Abualhaol** and Mohamed Amin, "A Leader-Driven Open Collaboration Platform for Exploring New Domains," OpenSym conference, Berlin, Germany, August 17-19, 2016.

2016 Rawan Alkurd, **I. Abualhaol**, Raed Shubair, and Muriel Medard, " Optimum HDAF Relay-Assisted Combining Scheme with Relay Decision Information," IEEE 84th Vehicular Technology Conference, Montréal, Canada, September 18-21, 2016.

2016 **I. Abualhaol** and S. Muegge "Securing D2D Wireless Links by Continuous Authenticity with Legitimacy Patterns," 49th Hawaii International Conference on System Sciences (HICSS), pp. 5763-5771, Jan 2016

2015 R. Alkurd, R. Shubair, and **I. Abualhaol**, "Optimum Decode-and-Forward Relay-Assisted Combining Scheme with Relay Decision Information," IEEE International Conference on Communications (ICC), pp. 2331–2337, June 2015.

2015 R. Alkurd, R. Shubair, and **I. Abualhaol**, "Modeling Conditional Error Probability for Hybrid Decode-Amplify-Forward Cooperative System," IEEE Wireless Communications and Networking Conference (WCNC), 7-12, March 2015.

2014 R. Alkurd, R. Shubair, and **I. Abualhaol**, "Survey on device-to-device communications: challenges and design issues," 12th IEEE International New Circuits and Systems Conference (NEWCAS), pp. 361–364, 22-25 June, 2014.

2014 R. Alkurd, **I. Abualhaol**, and S. Muhaidat, "Error Rate Performance Analysis of Cooperative SCR in VANETs over Generalized Fading Channels," IEEE Wireless Communications and Networking Conference (WCNC), pp. 3184–3189, 6-9 April, 2014.

2014 C. Han, S. Muhaidat, **I. Abualhaol**, M. Dianati, and R. Tafazolli, "Intrusion Detection in Vehicular Ad-Hoc Networks on Lower Layers," Security, Privacy, Trust, and Resource Management in Mobile and Wireless Communications, pp. 148–173, IGI Global, PA, USA, 2014.

2013 Y. Abu Haeyeh, **I. Abualhaol**, Y. Iraqi, and S. Muhaidat, "Intrusion Detection in Vehicular Ad-Hoc Networks: A Physical Layer Approach," Communication Systems: New Research, pp. 133–152, Nova publishers, 2013.

2013 R. Alkurd, R. Shubair, **I. Abualhaol**, "Error rate performance analysis of cooperative MRC receivers over generalized fading channels," IEEE 20th International Conference on Electronics, Circuits, and Systems (ICECS), pp. 201–204, 8-11 Dec, 2013.

2013 S. Al Maeeni, S. Muhaidat, and **I. Abualhaol**, "Non-coherent detection for cooperative OFDM-based system over time-varying fading channels," 20th IEEE International Conference on Electronics, Circuits, and Systems (ICECS), pp. 197–200, 8-11 Dec, 2013.

2013 R. Alkurd, **I. Abualhaol**, and S. Muhaidat, "An efficient approximation of $Q(\sqrt{x})$ function and general BER performance analysis," IEEE 7th GCC Conference and Exhibition, pp. 367–371, 17-20 Nov, 2013.

2013 E. Salahat and **I. Abualhaol**, "Generalized average BER expression for SC and MRC receiver over Nakagami-m fading channels," IEEE 24th International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC), pp. 3360–3365, 8-11 Sep., 2013.

2013 E. Salahat and **I. Abualhaol**, "General BER analysis over Nakagami-m fading channels," the 6th Wireless and Mobile Networking Conference (WMNC), pp. 1–4, 23-25 April, 2013.

2013 H. Eghbali, **I. Abualhaol**, S. Muhaidat, and Y. Iraqi, "Random-based Fair Allocation Algorithm with Fuzzy Comprehensive Evaluation for Single Carrier Multi-Relay Cooperative Networks," 19th European Wireless Conference (EW), pp. 1–5, 16-18 April, 2013.

2012 M. Ahmed, S. Jimaa, and **I. Abualhaol**, "Performance Enhancements of MIMO-OFDM system using Various Adaptive Receiver Structures," International Journal of Computer and Information Technology (IJCIT), pp. 99–106, vol. 1, 2012.

2012 M.A Ahmed, S.A Jimaa, and **I. Abualhaol**, "Enhanced channel estimation technique in MIMO-OFDM system,", IEEE 8th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob), pp. 545–549, 8-10 Oct. 2012.

2012 M. Ahmed, S. Jimaa, and **I. Abualhaol**, "BER Enhancement of MIMO-OFDM Using an Optimized NLMS Receiver", 2012 6th Asia Modeling Symposium (AMS), pp. 211–214, 29-31 May, 2012.

2012 H. Eghbali, **I. Abualhaol**, S. Muhaidat, and Y. Iraqi, "Cluster-Based Fair Allocation Algorithm for Multi-Relay Single Carrier Distributed Networks," IEEE 75th Vehicular Technology Conference (VTC Spring), pp. 1–5, 6-9 May, 2012.

2012 H. Eghbali, S. Muhaidat, and **I. Abualhaol**, "Enhanced ZP-OFDM receiver in multi-relay cooperative networks," 25th IEEE Canadian Conference on Electrical & Computer Engineering (CCECE), pp. 1–6, 29 April-2 May, 2012.

2012 Y. Iraqi, **I. Abualhaol**, and S. Muhaidat, "Lifetime Evaluation of Cooperative OFDM WSNs," IEEE Wireless Communications and Networking Conference (WCNC), pp. 2054–2058, 1-4 April, 2012.

2011 **I. Abualhaol** and M. Matalgah "Performance analysis of cooperative multi-carrier relay-based UAV networks over generalized fading channels," International Journal of Communication Systems (IJCS), Jan 2011.

2011 **I. Abualhaol**, "Symbol Error Rate Analysis of Relay-based Wireless Systems", IEEE 22nd International Symposium on Personal Indoor and Mobile Radio Communications, pp. 1894–898, 11-14 Sep, 2011.

2011 H. Eghbali, S. Muhaidat, and **I. Abualhaol**, "Distributed single carrier frequency-domain equalization for multi-relay cooperative networks over frequency selective Rician channels," 45th Asilomar Conference on Signals, Systems and Computers(ASILOMAR), pp. 1115–1120, 6-9 Nov, 2011.

2011 **I. Abualhaol** and M. Bawa'aneh "Capacity analysis of cooperative relay-based communication system," IEEE GCC Conference and Exhibition, pp. 21–24, 19-22 Feb, 2011.

2011 H. Eghbali, **I. Abualhaol**, and S. Muhaidat, " Enhanced Iterative-based ZP-OFDM Receiver in Multi-Relay Cooperative Networks," Journal of Selected Areas in Telecommunications (JSAT), September Edition, 2011.

2011 **I. Abualhaol** and M. Matalgah "Unified Analysis of Optimized Relay-based Wireless Systems," Journal of Selected Areas in Telecommunications (JSAT), July Edition, 2011.

2010 **I. Abualhaol** and M. Matalgah "Resource Allocation for a Cooperative Broadband MIMO-OFDM System," Cooperative Communications for Improved Wireless Network Transmission: Frameworks for Virtual Antenna Array Applications, pp. 382–398, IGI Global, PA, USA, 2010.

2010 **I. Abualhaol** and M. Matalgah "Performance analysis of multi-carrier relay-based UAV network over fading channels", IEEE GLOBECOM Workshops, pp.1811–1815, 6-10 Dec, 2010.

2010 **I. Abualhaol** and Y. Iraqi, "Random-based fair allocation in Multi-Relay cooperative OFDM system," IEEE 6th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob), pp. 596–599, 11-13 Oct, 2010.

2010 **I. Abualhaol**, M. Matalgah, and A. Abu-Abed "Enhanced cooperative coding for relay-based MIMO-OFDM systems," IEEE 21st International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC), pp. 2299–2303, 26-30 Sep, 2010.

2009 **I. Abualhaol** and M. Matalgah, "Throughput Optimization of Cooperative Teleoperated UGV Network," International Journal of Mobile Computing and Multimedia Communications (IJMCMC), pp. 32–46, 2009.

2008 **I. Abualhaol** and M. Matalgah "Subchannel-Division Adaptive Resource Allocation Technique for Cooperative Relay-Based MIMO-OFDM Wireless Systems," IEEE Wireless Communications and Networking Conference (WCNC), pp. 1002–1007, March 31- April 3, 2008.

2008 **I. Abualhaol** and M. Matalgah "Capacity Analysis of MIMO System Over Nakagami-m Fading Channels Using Finite Mixture with Expectation Maximization Algorithm," IEEE International Conference on Computer Systems and Applications (AICCSA), pp. 309–316, March 31- April 4, 2008.

2007 **I. Abualhaol** and M. Matalgah "End-to-End Performance Analysis of Cooperative Relay-Based Wireless System Over Generalized Gaussian-Finite-Mixture Fading Channels," The 50th Annual IEEE Global Communications Conference (GLOBECOM), pp. 3942–3947, 26-30 Nov, 2007.

2007 **I. Abualhaol** and M. Matalgah "Capacity Analysis of MIMO System Over Identically Independent Distributed Weibull Fading Channels," IEEE International Conference on Communications (ICC), pp. 5003-5008, 24-28 June, 2007.

2006 **I. Abualhaol** and M. Matalgah "Outage Probability Analysis in a Cooperative UAVs Network Over Nakagami-m Fading Channels," IEEE 64th Semiannual Vehicular Technology Conference (VTC), pp. 1–4, 25-28 Sep, 2006.

2006 **I. Abualhaol** and M. Matalgah "Throughput Optimization of Cooperative UAVs Using Adaptive Channel Assignment," IEEE Wireless Communications and Networking Conference (WCNC), vol. 4, pp. 2279–2284, 3 -6 April, 2006.