Curriculum Vitae

Name: Bassam A. Khuwaileh
Academic Rank: PhD.
Institution of Affiliation: University of Sharjah, Department of Mechanical & Nuclear Engineering.

Correspondence address

Work:

Bassam A. Khuwaileh, PhD
University of Sharjah, Building M6
Sharjah, United Arab Emirates
Office Number: M6-109

Educational Background

(August 2012 – December 2015)

PhD of Nuclear Engineering - North Carolina State University, USA
Main Subjects: Reactor Design Calculations, Design Optimization, Uncertainty Quantification, Sensitivity Analysis, Inverse Problem, Reduced Order Modeling, Subspace Methods, Targeted Accuracy Assessment.

Dissertation Title: (Scalable Methods for Uncertainty Quantification, Data Assimilation and Target Accuracy Assessment in Multi-Physics Advanced Simulation of Light Water Reactors).

Note*: This research is supported by the Consortium for Advanced Simulation of Light Water Reactors (http://www.casl.gov), an Energy Innovation Hub (http://www.energy.gov/hubs) for Modeling and Simulation of Nuclear Reactors under U.S. Department of Energy Contract No. DE-AC05-00OR22725*.
(2007 – 2012)

Bachelor's Degree in Nuclear Engineering - Jordan University of Science and Technology, Jordan
Main Subjects: Nuclear Engineering Physics, Light Water Reactors Design, Mathematics: Calculus, Probability Theory, Statistics, Uncertainty Quantification, Differential Equations, Matrix Analysis, Programming, Digital and Analogical Electronics.

Note: Graduated with honor as the top student in the class.

Research

Funded Research Projects

1. **"Neutronics and Thermal-Hydraulics Models Validation via Uncertainty Propagation and Parameter Space Analysis "** (PI)

2. **"Developing a Toolkit for Uncertainty, Sensitivity, Model Calibration and Validation for Nuclear Engineering Applications"** (PI)

3. **Optimizing the Design of Nuclear Fuel Assembly Mixing Vanes using CFD Analysis** – (PI)

Publications

Technical reports (milestone reports peer reviewed and published within the US Department of Energy innovations hub *No. DE-AC05-00OR22725*):

1. **Khuwaileh, B. A**., Hooper, R., Turinsky, P. J., and Mousseau, V. A. (**2015**). Uncertainty Quantification Analysis Using VERA-CS for a PWR Fuel Assembly with Depletion. CASL-I-2015-0328-000.
2. **Khuwaileh, B. A**., and Turinsky, P. J. (**2016**). Data Assimilation and Uncertainty Quantification Using VERA-CS for a Core Wide LWR Problem with Depletion. CASL-U-2016-1054-000.
3. **Khuwaileh, B**., Turinsky, P., & Williams, B. J. (**2016**). *ROMUSE 2.0 User Manual* (No. LA-UR-16-27623). Los Alamos National Laboratory (LANL).
4. Adams, Brian M. ; Coleman, Kayla ; Hooper, Russell W. **; Khuwaileh, B. A.** ; Lewis, Allison ; Smith, Ralph C. ; Swiler, Laura P. ; Turinsky, Paul J. ; Williams, Brian J. (**2016**). *User guidelines and best practices for CASL VUQ analysis using Dakota* (LA-UR--16-27626). Los Alamos National Laboratory, Los Alamos, NM (United States).
5. **Khuwaileh, B**., Turinsky, P (**2019**). Plant Data Based Cross-Sections Bayesian Calibration: Watts Bar Unit I Cycle I. CASL-U-2019-1747-000

Published Peer Reviewed Journal Articles:

1. **Khuwaileh BA**, Al-Shabi M, Assad ME. Artificial Neural Network based Particle Swarm Optimization solution approach for the inverse depletion of used nuclear fuel. Annals of Nuclear Energy. 2021 Jul 1;157:108256.
2. Alhammadi SY, Alktebi AA, Eldemiery AE, Gillette V, Assad ME, AlShabi M, **Khuwaileh BA**. An Extended Thermosyphon Cooling System for APR-1400 Reactor Design. Case Studies in Thermal Engineering. 2021 Jun 1;25:100894.

3. Assad ME, Khosravi A, AlShabi M, **Khuwaileh B**, Hamid AK. Energy and cost analysis of processing flat plate solar collectors. Energy Engineering: Journal of the Association of Energy Engineering. 2021;118(3):447-58.
4. **A. Khuwaileh B**, Said Z. Differential parameters uncertainty estimation via a PCA-based monte carlo sampling approach: IRT-4M fuel type as a case study. Journal of Nuclear Science and Technology. 2021 Mar 17:1-8.
5. **Khuwaileh BA**, Al-Hamadi FI, Hartanto D, Said Z, Ali M. On the performance of nanofluids in APR 1400 PLUS7 assembly: Neutronics. Annals of Nuclear Energy. 2020 Sep 1;144:107508.
6. **Khuwaileh BA**, Metwally WA. Gaussian process approach for dose mapping in radiation fields. Nuclear Engineering and Technology. 2020 Aug 1;52(8):1807-16.
7. Al-Hamadi FI, **Khuwaileh BA**, Liem PH, Hartanto D. Analysis of OECD/NEA medium 1000 MWth sodium-cooled fast reactor using the Monte Carlo serpent code and ENDF/B-VIII. 0 nuclear data library. Nuclear Science and Techniques. 2020 Dec;31(12):1-1.
8. **Khuwaileh, Bassam**, and Ahmed Ishag. "On the potential of water desalination as a proxy for energy storage systems in nuclear power plants." *International Journal of Nuclear Energy Science and Technology* 13.2 (**2019**): 138-162.
9. **Khuwaileh, Bassam**, and Paul Turinsky "Non-Linear, Time Dependent Target Accuracy Assessment Algorithm for Multi-Physics, High Dimensional Nuclear Reactor Calculations.", Progress in Nuclear Energy, Progress in Nuclear Energy 114, 227-233.**(2019)**.

10. **Khuwaileh, Bassam**, Brian Williams, Paul Turinsky, and Donny Hartanto. "Verification of Reduced Order Modeling Based Uncertainty/Sensitivity Estimator (ROMUSE)." Nuclear Engineering and Technology 51, 968-976 (**2019**).

11. Coleman, Kayla D., Allison Lewis, Ralph C. Smith, Brian Williams, Max Morris, and **Bassam Khuwaileh**. "Gradient-Free Construction of Active Subspaces for Dimension Reduction in Complex Models with Applications to Neutronics." SIAM/ASA Journal on Uncertainty Quantification 7, no. 1 (**2019**): 117-142.

12. Walid A. Metwally, Abdulrahman S. Alawad, **Bassam A. Khuwaileh**, On the over-conservatism of the 5% depletion uncertainty rule in spent fuel criticality analyses, Annals of Nuclear Energy, Volume 125, **2019**, Pages 1-11, ISSN 0306-4549

13. **Khuwaileh, Bassam A**., and Paul J. Turinsky. "Surrogate based model calibration for pressurized water reactor physics calculations." *Nuclear Engineering and Technology* 49.6 (**2017**): 1219-1225.

14. Williams, Brian J.; Adams, Brian M.; Coleman, Kayla; Gilkey, Lindsay N.; Gordon, Natalie; Hooper, Russell; **Khuwaileh, Bassam A**.; Lewis, Allison; Maupin, Kathryn; Smith, Ralph C.; Swiler, Laura P.; Turinsky, Paul J. *User Guidelines and Best Practices for CASL VUQ Analysis Using Dakota*. No. LA-UR-17-29083. Los Alamos National Lab.(LANL), Los Alamos, NM (United States), (2017).

15. G. Arbanas, M. L. Williams, L. C. Leal, M. E. Dunn, **B. A. Khuwaileh,** C. Wang, & H.S. Abdel-Khalik. Advancing Inverse Sensitivity/Uncertainty Methods for Nuclear Fuel Cycle Applications. *Nuclear Data Sheets*, *123*, 51-56.(2015)

16. **B. A. Khuwaileh** & H. S. Abdel-Khalik. Subspace-based Inverse Uncertainty Quantification for Nuclear Data Assessment. *Nuclear Data Sheets*, *123*, 57-61. (2015)

17. **B. A. Khuwaileh**, M. A. Al-Nimr and M. Alata "A Novel Hybrid Solving Approach Based on Combining Similarity Solutions with Laplace Transformation Technique to Solve Different Engineering Problems" Research Journal of Applied Sciences, Engineering and Technology 7(8), 2014.

18. S. R. Malkawi, **B. A. Khuwaileh**, M. N Al-Momani, "Prediction of neutron energy spectrum in a typical MTR type research reactor using Monte Carlo simulations", Annals of Nuclear Energy, Volume 56, Pages 17–22. (2013).

19. **B. A. Khuwaileh** and M. A. Al-Nimr. "An Ultra Compact High Efficiency Thermo-Photovoltaic System for Electricity Generation." International Journal of Renewable Energy Research (IJRER) 4.2: 261-266.(2014).

20. M. A. Al-Nimr, **B. A. Khuwaileh**, M. Alata, "A Novel Integrated Direct Absorption Self-Storage Solar Collector", International Journal of Green Energy, 8:6, 618-630.(2011).

<u>Conference Proceedings and Summaries (peer reviewed)</u>

1. **Khuwaileh BA**, Ishag A, Al-Shabi M, Assad ME. Desalination as an energy storage alternative for nuclear power plants: Barakah power plant as a case study. InEnergy Harvesting and Storage: Materials, Devices, and Applications X 2020 Apr 23 (Vol. 11387, p. 1138714). International Society for Optics and Photonics.
2. Assad ME, AlShabi M, Sahlolbei A, Hmida A, **Khuwaileh B**. Geothermal energy use in seawater desalination. InEnergy Harvesting and Storage: Materials, Devices, and Applications X 2020 Apr 23 (Vol. 11387, p. 1138716). International Society for Optics and Photonics.
3. Assad ME, AlShabi M, Sahlolbei A, **Khuwaileh B**. Analysis of hybrid geo-solar power plant. InEnergy Harvesting and Storage: Materials, Devices, and Applications X 2020 Apr 23 (Vol. 11387, p. 1138715). International Society for Optics and Photonics.
4. **Bassam A. Khuwaileh**, Paul J. Turinsky. "*Plant Data Based Cross-Sections Bayesian Calibration: Watts Bar Unit I Cycle I*. M&C 2019 (August 25-29), Bridging Theory and Applications, Portland, Oregon USA.
5. Alhamadi FI, Sadek R, Abdalla A, Ababneh A, Said Z, **Khuwaileh BA**. Performance of Nano-Fluids as Coolants/Moderator in APR1400–Neutronics Case Study. Transactions. 2019 Jun 1;120(1):524-7.

6. **Bassam A. Khuwaileh**. Model Verification via Principal Component Analysis. Transactions of American Nuclear Society Annual Meeting **2018**.
7. **Bassam A. Khuwaileh** and Moh'd Al-Nimr. Forward Sensitivity Analysis and Uncertainty Contribution Estimation via Parameter Space Analysis. Transactions of American Nuclear Society Winter Meeting-2017.
8. **Bassam A. Khuwaileh**, Brian J. Williams and Paul J. Turinsky. ROMUSE: Reduced Order Modeling Based Uncertainty/Sensitivity Estimator for Reactor Core Simulators. Transactions of American Nuclear Society Winter Meeting-2017.
9. **B. A. Khuwaileh** and P.J. Turinsky. Surrogate Based Data Assimilation for Pressurized Water Reactors. International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering 2017.

10. **B. A. Khuwaileh** and P.J. Turinsky. Scalable Algorithms for Uncertainty Quantification of Multi-Physics Light Water Reactor Problems with Feedback Effect. Proceedings of PHYSOR2016: *Unifying Theory and Experiments in the 21st Century.* (2016).

11. **B. A. Khuwaileh**, J. M. Hite, and H. S. Abdel-Khalik, "Subspace Methods for Multi-Physics Reduced Order Modeling in Nuclear Engineering Applications" Proceedings of PHYSOR 2014, Kyoto-Japan.(2014)

12. **B.A. Khuwaileh**, C. Wang, Y. Bang and H.S. Abdel-khalik, "Employing Non-Converged Iterates for Reduced Order Modeling Basis Construction", Transactions of American Nuclear Society,(2014)

13. **B.A. Khuwaileh** and H.S. Abdel-khalik,, "A New Importance Measure for Reduced Order Modeling", Transactions of American Nuclear Society,(2014)

14. **B. A. Khuwaileh** and H.S. Abdel-khalik, "Further Developments of Inverse Sensitivity/Uncertainty Quantification for High Dimensional Constrained Problems", Transactions of American Nuclear Society, winter meeting (2014).

15. **B. A. Khuwaileh** and H. S. Abdel-khalik, "An Improved Method for Inverse Uncertainty Quantification for Nuclear Data Assessment", Proceedings of PHYSOR 2014, Kyoto-Japan.(2014)

16. **B. A. Khuwaileh** and H. S. Abdel-khalik, "Efficient Subspace Construction for Reduced Order Modeling in Reactor Analysis", Proceedings of PHYSOR 2014, Kyoto-Japan.(2014)

17. **B. A. Khuwaileh**, M. A. Al-Nimr, M. Alata, "A Novel Hybrid Solving Approach Based on Combining Similarity Solutions with Laplace Transformation Technique to Solve Different Engineering Problems", Proceedings of the 3rd (2011) CUTSE International Conference Miri, Sarawak, Malaysia, 8-9 Nov. , (2011).

18. **B.A. Khuwaileh** and H.S. Abdel-khalik, "Exploratory Development of Multi-Physics Reduced Order Modeling", Transactions of American Nuclear Society, 108, (2013)

19. **B.A. Khuwaileh**, G. Arbanas, M. Williams, L.C. Leal, M.E. Dunn, H.S. Abdel-khalik, "The Effect of Implicit Self-Shielding on the Inverse Sensitivity/Uncertainty Method for Thermal Reactors", Transactions of American Nuclear Society, 109, 804, (2013).

20. G. Arbanas, **B.A. Khuwaileh**, M. Williams, L.C. Leal, M.E. Dunn, H.S. Abdel-khalik, "Integral Benchmark Experiments in the Inverse Sensitivity/Uncertainty Quantification for Thermal Reactors", Transactions of American Nuclear Society,109, 808, (2013)

21. **B.A. Khuwaileh** and H.S. Abdel-khalik, "Exploratory Development of Multi-Physics Reduced Order Modeling II", Transactions of American Nuclear Society, 109, 757, (2013).

22. **B.A. Khuwaileh** and H.S. Abdel-khalik", Subspace Methods for Multi-physics Reduced Order Modeling in Nuclear Engineering Applications", Transactions of American Nuclear Society, summer meeting (2013).

23. C. Wang, **B.A. Khuwaileh**, G. Arbanas and H.S. Abdel-khalik, "Alternative Approach for Importance Ranking of Nuclear Data", Transactions of American Nuclear Society,(2014)

24. C. Wang, **B. A. Khuwaileh**, H. S. Abdel-Khalik, Goran Arbanas, Mark Williams, Michael E. Dunn, "Insure: An Inverse Sensitivity Uncertainty Quantification Toolkit", Transactions of American Nuclear Society, winter meeting (2014).

25. J. M. Hite, C. Wang, **B. A. Khuwaileh** and H.S. Abdel-Khalik, "Flexible Uncertainty Analysis of Computer Models with Alchemy", Transactions of American Nuclear Society, winter meeting (2014).

Invited Talks/Presentations:

1. Closing Plenary Speaker: "Global Nuclear Materials Stewardship Challenges", 59th INMM annual meeting, July 22-26th, 2018, Baltimore, Maryland USA.

2. **B.A. Khuwaileh,"**Structure in Randomness: There are Plenty of opportunities for Forward and Inverse Reactor Problems", NC state University, February, 2nd 2017.
   Link: https://www.ne.ncsu.edu/event/structure-randomness-plenty-opportunities-forward-inverse-reactor-problems/

3. **B.A. Khuwaileh, "***Improving Fuel Reliability via Physics-Based Modeling and Simulation*". Barakah NPP Fuel Reliability Workshop, Jebel Dhanna Resort, Ruwais, UAE, 10-11 October, 2017

4. **B.A. Khuwaileh** and P.J. Turinsky, "Subspace Methods for Multi-Physics Large Scale Uncertainty Quantification", 13th US National Congress on Computational Mechanics (July-2015).

5. **B. A. Khuwaileh** and P.J. Turinsky. Scalable Methods for Data Assimilation, Uncertainty Quantification and Target Accuracy Assessment for Multi-Physics Advanced Simulation of LWRs. Presented at the Nuclear Energy knowledge and Validation Center (NEKVaC-2015).

ss

Contributed Talks/Presentations:

1. **B.A. Khuwaileh,** C. Wang, Y. Bang and H.S. Abdel-khalik, "Employing Non-Converged Iterates for Reduced Order Modeling", SIAM annual meeting, (2014).

2. H.S. Abdel-khalik and **B.A. Khuwaileh**, "Filtering Algorithm For Pod-Based Reduced Order Modeling Techniques", SIAM annual meeting, (2014).

3. M.E. Dunn, G. Arbanas, **B.A. Khuwaileh**, M.L. Williams, L.C. Leal, C. Wang, H.S. Abdel-khalik," Integral Benchmark Experiments in the Inverse Sensitivity/Uncertainty Computations", International Workshop of Nuclear Data Covariances. (2014).

4. **B.A. Khuwaileh** and H.S. Abdel-Khalik, "Efficient Subspace Based Algorithm for Targeted Accuracy Nuclear Data Assessment using Inverse Uncertainty Quantification", International Workshop of Nuclear Data Covariances, (2014).

5. **B. A. Khuwaileh**, M. A. Al-Nimr and M. AL-Ataa, "Novel Technique for Utilizing the Underground Thermal Reservoir for Heating and Cooling Purposes by using Fins", Think Green Conference, Amman, Jordan. (2012).

Teaching and Training

Courses

During my post at the University of Sharjah, I have been teaching the following courses:

1. Nuclear Power Reactors, 407401 (5)
2. Nuclear Reactor Thermal-Hydraulics, 407302 (6)
3. Nuclear Fuel Cycle, 407459 (4)
4. Introduction to Nuclear Engineering and Radiological Sciences, 407200 (1)
4. Senior Design Projects Coordinator.

In addition as a graduate student, I served as a teaching assistant for the following courses:

1. Fundamentals of Nuclear Engineering, NE 301.
2. Nuclear Fuel Cycles. NE 512.