Areej AlBahar

Ph.D. Student in Industrial and Systems Engineering at Virginia Tech

Blacksburg, VA, U.S.A.

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Research Statement

I am a Ph.D. student in the Grado Department of Industrial and Systems Engineering at Virginia Tech. I work in the Machine Learning for Advanced Manufacturing Laboratory headed by Dr. Xiaowei Yue. My research interests include statistical quality control and machine learning, nonparametric regression and Gaussian processes, Bayesian modeling, and sequential design.

Education

Virginia Polytechnic Institute and State University (Virginia Tech) — *Blacksburg, VA, USA*
Ph.D. in Industrial and Systems Engineering — *Aug. 2016 - present*

University of Florida — *Gainesville, FL, USA*
M.S. in Industrial and Systems Engineering — *Jan. 2015 – May. 2016*

Kuwait University — *Khaldiya, Kuwait*
B.S. in Industrial and Management Systems Engineering — *Sep. 2008 – Jan. 2013*

Publications

Journal Articles

A Robust Asymmetric Kernel Function for Bayesian Optimization, With Application to Image Defect Detection in Manufacturing Systems
Areej AlBahar, Inyoung Kim, Xiaowei Yue
IEEE Transactions on Automation Science and Engineering (2021) pp. 1–12. 2021

Physics-Constrained Bayesian Optimization
Areej AlBahar, Inyoung Kim, Xing Wang, Xiaowei Yue
IEEE Transactions on Automation Science and Engineering (under revision) (2021). 2021

Nested Bayesian Optimization for Computer Experiments
Yan Wang, Meng Wang, Areej AlBahar, Xiaowei Yue
IEEE Transactions on Mechatronics (under revision) (2021). 2021

Stress-Aware Optimal Placement of Actuators for High Precision Quality Control of Composite Structures Assembly
Areej AlBahar, Inyoung Kim, Tim Lutz, Xiaowei Yue
IEEE Robotics and Automation Letters (under review) (2022). 2022

Honors & Awards

NAMRC 49 / MSEC 2021 NSF Student Support Award — *Blacksurg, VA, USA*
Virginia Tech — *April 2021*

22nd Annual Outstanding International Student Award — *Gainesville, FL, USA*
University of Florida — *Nov. 2016*

21st Annual Outstanding International Student Award — *Gainesville, FL, USA*
University of Florida — *Nov. 2015*

Full scholarship to pursue M.S. and Ph.D. degrees in the USA — *Khaldiya, Kuwait*
Kuwait University Scholarship Program — *Dec. 2014*

Dean's Honor list and Outstanding Students list — *Khaldiya, Kuwait*
College of Engineering and Petroleum, Kuwait University — *2009 - 2013*

Second Place Winner — *Kuwait*
Kuwait Regional Mathematical Olympiad — *2007*

Work Experience

Graduate Research Assistant — *Blacksburg, VA, USA*
Virginia Tech — *Feb. 2022 - present*

Graduate Research Assistant — *Blacksburg, VA, USA*
Virginia Tech — *Oct. 2021 - Nov. 2021*

Facility Management Engineer — *Khaldiya, Kuwait*
Kuwait University — *Dec. 2013 - Dec. 2014*
Certifications: ISO 9001:2008 Foundation Training, Fundamentals of Occupational Health and Safety Systems, Problem Solving For Managers, and ISO 9001 for Quality Management Systems.

Research Experience

Sep. 2021 - present — **Stress-Aware Optimal Placement of Actuators in Composite Fuselages**
In this work, we incorporate physical constraints (e.g., stress) into the Bayesian optimization framework. We propose a safe sequential sampling strategy to minimize exploration of hazardous regions while optimizing the response surface function in a minimum number of function evaluations.

Jan. 2021 - Sep. 2021 — **Physics-Constrained Bayesian Optimization**
In this work, we address the challenges of optimizing constrained non-stationary and expensive-to-evaluate engineering response surface functions with constrained Bayesian optimization. Most existing non-stationary approaches are still ineffective in accurately modeling complex nonstationary functions. We propose a multi-layer deep Gaussian process mean function which improves the applicability of constrained Bayesian optimization to complex non-linear and non-stationary processes.

Jan. 2020 - Dec. 2020 — **Image Defect Detection in Manufacturing Systems**
In this work, we address the challenges of approximating complex, nonlinear, and expensive-to-evaluate engineering response surface functions with Bayesian optimization. Most existing kernel functions are vulnerable and susceptible to outliers; the existence of outliers causes the Gaussian process model to be sporadic. We propose an asymmetric kernel function to create a Bayesian optimization model that is robust to outliers. We use the proposed framework in hyperparameter tuning of deep learning models.

Jan. 2018 - Oct. 2019 — **Predictive Modelling for Online Quality Process Monitoring**
I focus heavily on deep learning models; more specifically, predictive neural networks and their performance. By employing quality control and data analytics concepts, I model series of images as inputs to recurrent and convolutional neural networks in order to predict future instances, I then use the predicted instances for quality classification. Bayesian optimization and unsupervised learning schemes are the methods I am currently exploring to improve those neural networks performances.

Teaching Experience

Teaching Assistant - Operations Research II *Khaldiya, Kuwait*

Department of Industrial and Management Systems Engineering, Kuwait University *Fall 2013*

- Office hours and grading

Teaching Assistant - Reliability and Maintainability Engineering *Khaldiya, Kuwait*

Department of Industrial and Management Systems Engineering, Kuwait University *Fall 2013*

- Office hours and grading

Professional Service

Reviewer Journal of Intelligent Manufacturing ('20)

References

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Inyoung Kim (Academic co-advisor)
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