

Khalil Al Handawi

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PROFILE

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| Research | Design for changing requirements. Multidisciplinary design optimization. Instrumentation and state estimation. |
| Technical | |
| ENGINEERING SYSTEMS | - Design for flexibility and robustness - Reliability and uncertainty quantification (Monte-Carlo with importance sampling) |
| MODELING AND SIMULATION | - Finite element methods (thermomechanical, structural, electromagnetic) - System dynamics models |
| OPTIMIZATION: | - Blackbox and derivative-free optimization (Mesh-adaptive direct search) - Stochastic optimization |
| MACHINE LEARNING: | - Deep learning (Recurrent neural networks) - Hyperparameter optimization |
| STATE ESTIMATION: | - Extended Kalman filter - Mahony complementary filter (attitude estimation) |
| Software | MATLAB and Simulink, Python (PyTorch, matplotlib), C++ (CUDA, OpenMP, Qt) FEA (Abaqus, ANSYS), CAD (SOLIDWORKS, NX Siemens), DAQ (NI LabVIEW) |

EDUCATION

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| JAN 2017 – DEC 2020 | Doctor of Philosophy Mechanical Engineering , CGPA: 4.00 CONCENTRATION Engineering design and optimization DISSERTATION <i>Optimization driven set-based design under uncertain requirements</i> | <i>McGill University</i> |
| AUG 2013 – DEC 2015 | Master of Science Mechanical Engineering , CGPA: 4.00 CONCENTRATION Instrumentation and photonics DISSERTATION <i>Internal corrosion detection of oil and gas pipelines using fiber optics</i> | <i>Khalifa University</i> |
| AUG 2009 – JUNE 2013 | Bachelor of Science Mechanical Engineering , FIRST CLASS HONOURS, CGPA: 3.97 CAPSTONE PROJECT <i>Development of a human operated mobile hexapod platform</i> | <i>Khalifa University</i> |

EXPERIENCE

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| JAN 2021 – PRESENT | Systems Optimization Lab, McGill University <i>Postdoctoral Researcher</i> | MONTRÉAL, CANADA |
| | <ul style="list-style-type: none">Developed a deep learning forecasting model for COVID-19 trajectories based on sample viral load measurements from the general population: https://covid-forecaster-lebanon.herokuapp.com/.Built a stochastic COVID model for predicting the spread of the disease in a population using agent-based approaches and used reinforcement learning algorithms to optimize public health policies.Applied stochastic optimization to hyperparameter optimization problems in machine learning.Lectured the engineering systems optimization class and developed MATLAB training modules and projects related to multidisciplinary optimization with applications to aircraft design. | |
| JAN 2017 – JAN 2021 | McGill University <i>Research assistant</i> | MONTRÉAL, CANADA |
| | <ul style="list-style-type: none">Won a Fonds de Recherche du Québec Nature et Technologie (FRQNT) grant (56,000 CAD). | |

- Developed mathematical frameworks for quantifying design flexibility and robustness and managing uncertain requirements in aircraft system and subsystem design.
- Developed a thermomechanical simulation model for modeling additive manufacturing repair and life extension processes.
- Co-developed a novel lifecycle cost model based on system dynamics to model the effect of life extension on lifecycle costs.
- Used machine learning models to substitute expensive thermomechanical simulations in design studies and developed a variant of kernel smoothing for estimating the sensitivity of design solutions to different requirements (Jacobian formulation).

JUNE 2017 – JAN 2020

GKN Aerospace Engine Systems

TROLHÄTTAN, SWEDEN

Visiting researcher

- Participated in a technology transfer to translate my research on optimization into industrial practice by provided training modules and workshops to GKN engineers (MATLAB and Python).
- Surveyed GKN engineers about their experience designing aeroengine components for engine system manufacturers to create a timeline of expected design updates and changes. This data formed the basis of a case study for my research on design for flexibility and robustness.
- Set up advanced design automation and exploration tools to be used as part of GKN's workflow (engineering workbench) by integrated parametric design software (NX Siemens) with simulation software (Abaqus and ANSYS) to evaluate hundreds of concepts for a turbine rear frame.

JAN 2019,2020

Center for Autonomous Robotic Systems, Khalifa University

ABU DHABI, UAE

Visiting researcher

- Performed sensor fusion research with applications to unmanned aerial vehicle (UAV) control and maneuvering.
- Fused UAV internal measurement unit (IMU) data with high latency positioning measurements from an Optitrack motion capture system to obtain smooth high frequency attitude estimates suitable for control applications.
- Used the principles of quaternion transformation to translate observed attitude in the IMU reference frame to an internal reference frame.
- Repurposed a DJI Wind 4 UAV for firefighting by redesigning the drone platform to carry an extinguishant payload.
- Co-authored a paper based on the repurposed UAV to be published in a special issue of the Journal of Field Robotics.

AUG 2013 – DEC 2016

Asset Integrity Management Systems Lab, Khalifa University

ABU DHABI, UAE

Research Assistant

- Developed fiber optic sensors for monitoring mechanical and electrochemical phenomena such as strain, temperature, and corrosion.
- Used optical time-domain reflectometry for distributed fiber optic sensing of large structures such as oil pipelines.
- Worked with fiber Bragg grating sensors for localized measurements of strain and temperature and their subsequent translation into corrosion rate.
- Established a correlation between photoelastic properties of various waveguides (distributed and localized sensors) and the corrosion rate in oil and gas structures.
- Simulated photonic corrosion sensors in MATLAB and Abaqus for sensor design and calibration.
- Developed a novel accelerated corrosion testing setup based on electrochemical cells for validating and verifying the proposed corrosion sensors and establishing the calibration curve.

MAY 2014 – MAY 2015

Khalifa University

ABU DHABI, UAE

Khalifa university Baja SAE team leader

- Led the first UAE national team to compete in the Baja SAE competition (Maryland, 2015).

- Guided the assembly team on integrating vehicle subsystems (chassis, suspension, and power train).
- Performed structural optimization on vehicle chassis using MATLAB and ANSYS.
- Provided workshops on finite element analysis and computer aided design to team members.
- Prepared assembly and part drawings for the manufacturing team.

JAN 2018 – DEC 2019 **McGill University** MONTRÉAL, CANADA
Teaching assistant

- Mechanical lab course – Prepared lab manuals, conducted labs, graded student reports, and incorporated MATLAB programming exercises into the syllabus.
- Engineering Professional Practice course – Conducted town halls, hosted guest lecturers, provided feedback to students, and gave several talks about entrepreneurship.

AUG 2013 – DEC 2015 **Khalifa University** ABU DHABI, UAE
Teaching Assistant

- System dynamics and controls course – Conducted lab sessions and held office hours.
- Computer aided design – Conducted computer lab sessions.
- Mentored undergraduate students participating in the Abu Dhabi Solar Challenge (building and designing a solar-powered vehicle).
- Co-mentored an undergraduate capstone project.

AUG 2012 – MAY 2012 **Yokogawa** ABU DHABI, UAE
Engineering intern

- Wrote programs for industrial plant operation and control using distributed control systems.
- Visited the main headquarters in Japan to represent the Abu Dhabi National Oil Company.

AWARDS AND RECOGNITION

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| MAY 2019 – DEC 2021 | Doctoral Research award (B2X) <i>Fonds de Recherche du Québec - Nature et Technologies</i> | 56,000 CAD |
| JAN 2017 – DEC 2019 | McGill Engineering Doctoral Award (MEDA) <i>McGill University</i> | 96,000 CAD |
| AUG 2013 – DEC 2015 | ADNOC Graduate fellowship <i>Abu Dhabi National Oil Company</i> | 90,000 USD |
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| Team leader of the first team to successfully qualify and complete the Baja SAE competition | KHALIFA UNIVERSITY, ABU DHABI, UAE | |
| Awarded 2nd place in the Abu Dhabi Solar Challenge (10,000 AED) | KHALIFA UNIVERSITY, ABU DHABI, UAE | |
| Recognition for voluntary commitment to the Graduate School's and the Graduate Student Affair's events | KHALIFA UNIVERSITY, ABU DHABI, UAE | |
| Graduated Honors with distinction (2,000 AED) | KHALIFA UNIVERSITY, ABU DHABI, UAE | |
| Made it to the Provost's list 3 times | KHALIFA UNIVERSITY, ABU DHABI, UAE | |

PUBLICATIONS

Submitted preprints

K. Al Handawi and M. Kokkolaras (2021). Optimization of infectious disease prevention and control policies using agent-based modeling. *IEEE Transactions on Emerging Topics in Computational Intelligence*, <https://www.gerad.ca/en/papers/G-2021-07>, (Under Review)
funded by an NSERC discovery grant

Refereed Journal Articles

K. Al Handawi, M. Panarotto, P. Andersson, O. Isaksson and M. Kokkolaras (2021). Optimization of design margins allocation when making use of additive remanufacturing. *Journal of Mechanical Design*, (In Press)
funded partially by NSERC, FRQNT, CARIC and EU Horizon 2020 research and innovation programme

M. Chehadeh, M. Wahbah, M. Awad, O. AbdulHay, **K. Al Handawi**, L. Seneviratne, I. Greatbatch and Y. Zweiri (2021). Novel aerial firefighting system for suppression of incipient cladding fires. *Journal of Field Robotics*, (In Press)
funded by Emaar Properties PJSC

K. Al Handawi, P. Andersson, M. Panarotto, O. Isaksson and M. Kokkolaras (2020). Scalable set-based design optimization and remanufacturing for meeting changing requirements. *Journal of Mechanical Design*, 143(2): pp 021702. doi: [10.1115/1.4047908](https://doi.org/10.1115/1.4047908)

funded partially by NSERC, FRQNT, CARIC and EU Horizon 2020 research and innovation programme

K. Al Handawi, N. Vahdati, O. Shiryayev and L. Lawand (2017). Analytical modeling tool for design of hydrocarbon sensitive optical fibers. *Sensors*, 17(10): pp 2227. doi: [10.3390/s17102227](https://doi.org/10.3390/s17102227)

funded by Abu Dhabi National Oil Company

L. Lawand, O. Shiryayev, **K. Al Handawi**, N. Vahdati and P. Rostron (2017). Corrosivity sensor for exposed pipelines based on wireless energy transfer. *Sensors*, 17(6): pp 1238. doi: [10.3390/s17061238](https://doi.org/10.3390/s17061238)

funded by Abu Dhabi National Oil Company

K. Al Handawi, N. Vahdati, P. Rostron, L. Lawand and O. Shiryayev (2016). Strain-based FBG sensor for real-time corrosion rate monitoring in pre-stressed structures. *Sensors and Actuators B: Chemical*, 236: pp 276 – 285. doi: [10.1016/j.snb.2016.05.167](https://doi.org/10.1016/j.snb.2016.05.167)

funded by Abu Dhabi National Oil Company

Conference Papers

K. Al Handawi, P. Andersson, M. Panarotto, O. Isaksson and M. Kokkolaras (2020). Scalable set-based design optimization and remanufacturing for meeting changing requirements. in *Proceedings of the International Design Engineering Technical Conferences & Computers and Information in Engineering Conference*, Virtual conference, IDETC2020.

L. Lawand, **K. Al Handawi**, M. Panarotto, P. Andersson, O. Isaksson and M. Kokkolaras (2019). A lifecycle cost-driven system dynamics approach for considering additive re-manufacturing or repair in aero-engine component design. in *Proceedings of the Design Society: International Conference on Engineering Design*, Delft, Netherlands, ICED19: pp 1343 – 1352. doi: [10.1017/dsi.2019.140](https://doi.org/10.1017/dsi.2019.140)

K. Al Handawi, N. Vahdati, O. Shiryayev, and L. Lawand (2016). Corrosion monitoring along infrastructures using distributed fiber optic sensing. in *Proceedings of SPIE Smart Structures/NDE, International Society for Optics and Photonics, Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems*, Las Vegas, USA, SPIE2016. doi: [10.1117/12.2218820](https://doi.org/10.1117/12.2218820)

L. Lawand, O. Shiryayev, **K. Al Handawi**, N. Vahdati and P. Rostron (2016). Corrosivity monitoring system using RFID-based sensors. in *Proceedings of SPIE Smart Structures/NDE, International Society for Optics and Photonics, Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems*, Las Vegas, USA, SPIE2016. doi: [10.1117/12.2218813](https://doi.org/10.1117/12.2218813)

COURSE WORK

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| • Advanced mechanics of materials | • Material engineering and corrosion |
| • Engineering systems optimization | • Measurements and instrumentation |
| • Continuum mechanics | • Advanced vibrations |
| • Applied numerical methods | • Fracture mechanics |
| • Applied finite element analysis | • Viscous and compressible fluid flows |

PERSONAL INTERESTS

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| • Gymnastics and calisthenics training | • 3d printing hobbyist |
| • Powerlifting | • Car modding (muscle cars) and drag racing |
| • Competitive gaming | • Tinkering and taking apart any machine and putting it back together! |