

ALA'ALDIN ALAFAGHANI

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PROFILE

Additive manufacturing researcher with experimental experience in metallography characterization techniques and finite element analysis methods coupled with design of experiment and data science methods

EDUCATION

University of California, Merced *August 2015 - Present*
Doctor of Philosophy, Mechanical Engineering GPA: 3.92

Dissertation : Investigating and Modeling the Process Parameters of Additive Manufacturing

Select Courses: Continuum Mechanics, Mechanical Behavior of Materials, Electron Microscopy, Kinetics and Thermodynamics, Multi-Physics Modeling

University of California, Merced *August 2015 - April 2019*
Master of Science, Mechanical Engineering GPA: 3.91

University of Jordan *August 2009 - June 2014*
Bachelor of Science, Mechanical Engineering GPA: 3.44

TECHNICAL STRENGTHS

Experimental

- Additive Manufacturing, using Powder Bed Fusion and Fused Deposition Modeling
- Scanning Electron and Optical Microscopy to characterize microstructures and fractured surfaces
- Mechanical testing including fatigue, tensile, and hardness testing
- 3D digital image correlation to optically measure displacements, strains, and velocity
- Sample prep techniques, cutting, polishing, and chemical etching

Data Analysis

- Machine learning, Neural Networks, Multiple Linear Regression, Nonlinear Regression, K-Nearest Neighbors, Support Vector Machine
- Multi-objective optimization, Particle Swarm Optimization, Genetic Algorithm, Weighted Sum Optimization

Software & Tools

- 3D modeling software, SolidWorks, Creo Parametric, Ansys Finite Element Analysis, Simulia Abaqus, OpenFOAM
- Coding and programming, Matlab, Octave, Python
- Design of experiments and statistics, Minitab, JMP Pro, MS Excel

PROFESSIONAL EXPERIENCE

University of California, Merced

Aug 2015 - Present

Graduate Student Researcher

- Develop research projects, plan and execute experiments.
- Write publications, address peer review comments, and write rebuttals.
- Grant and proposal writing, contributed to federally funded proposals.
- Develop finite element models and verify their accuracy experimentally.
- Develop predictive data-driven models using design of experiments and machine learning regression algorithms.
- Lead a team of junior graduate students and undergraduate student in different projects.

University of California, Merced

Aug 2015 - Dec 2021

Teaching Assistant

- Teaching assistant for the following courses Component Design, Computer Aided Engineering, Fluid Dynamics, and Statics and Dynamics at UC Merced, responsible for grading and lab and discussion sessions.
- Received good reviews for ability to explain and communicate the material.

University of California, Merced

May 2019 - Aug 2019

Graduate Student Mentor

- Mentored more than 20 undergraduate students during their scholarship in UROC (Undergraduate Research Opportunity Center), who were doing research in different labs
- Prepared and presented various workshops to prepare for graduate school applications, such as preparing for the GRE, preparing their personal statements and resumes.

Triangle Marine Services, Dubai, UAE

Feb 2015 - Aug 2015

Project Supervisor Trainee

- Led on small projects such as steel replacement, pipelines pressure tests and testing fuel injectors
- Participated in engines and generators overhauls in addition to air conditioning systems installation

Arab Ship Management, Aqaba, Jordan

Summer 2013

Marine Engineer Cadet

- Performed routine maintenance of pumps and fuel purifiers, Fuel and oil logs keeping.
- Aided in a main engine major overhaul and a generator top overhaul

RESEARCH PROJECTS

Modeling and predicting the mechanical properties of additively manufactured parts

Role: Main Investigator

Prediction of mechanical properties of additively manufactured parts fabricated using different processing parameters using physics and data-driven hybrid approaches. Bayesian and artificial neural network are used to optimize the predictive models.

Fatigue life of heat treated additively manufactured steel and nickle based super alloy

Role: Main Investigator

Developed customized heat treatments for nickel based alloy Inconel 718 and precipitation hardening steel 15-5PH to improve their static and fatigue performance and reliability in addition to reducing the anisotropy resulting from additively manufacturing the parts using direct metal laser sintering. Metallurgy techniques such as scanning electron microscopy and digital image correlation were employed to improve the heat treatments

Mechanical properties of additively manufactured steel and nickel based super alloy in elevated environmental temperatures

Role: Main Investigator

Investigated the microstructure and mechanical properties of Inconel 718 and 15-5PH steel under elevated environmental temperatures.

Investigating the Influence of Origami-Based Sheet Metal Forming Processing Parameters on the Bending Force and Fracture Failure

Role: Collaborator

Investigated the influence of the scale and shape of the material discontinuities on the bending force and fatigue failure. A finite element model was developed and verified experimentally using digital image correlation to compare the strain fields from the experiment with the model.

Effect of processing parameters on the mechanical properties of Fused Deposition Modeling parts

Role: Main Investigator

Experimentally investigated the influence of processing parameters on the mechanical properties and dimensional accuracy of Fused Deposition Modeling parts using different design of experiment techniques.

AWARDS

Southern California Edison Fellowship	2021
ME Graduate Travel Fellowship Award	2017
ME Bobcat Award at University of California, Merced	2016

AD-HOC REVIEWER

Journal of Manufacturing Processes	4 publications
Journal of Industrial Textiles: Composite textiles	3 publications

PUBLICATIONS

- [1] A. Alafaghani, A. Qattawi, M.A. Ablat, J.Q. Sun, Modified Solution Annealing Heat Treatments of Powder Bed Fused Inconel 718. **(Submitted)**
- [2] A. Alafaghani, A. Qattawi, J. Truong, M.S. Jaman, J.Q. Sun, Optimizing Fused Deposition Modeling Processing Parameters Using Response Surface Method for Strong Parts, in: Vol. 1 Addit. Manuf. Adv. Mater. Manuf. Biomanufacturing; Life Cycle Eng. Manuf. Equip. Autom., American Society of Mechanical Engineers, Cincinnati, OH, USA: Submitted, 2020. <https://doi.org/10.1115/MSEC2020-8528>.
- [3] M.A. Ablat, A. Qattawi, M.S. Jaman, A. Alafaghani, C. Yau, M. Soshi, J.-Q. Sun, An experimental and analytical model for force prediction in sheet metal forming process using perforated sheet and origami principles, *Procedia Manuf.* 48 (2020) 407–418. <https://doi.org/10.1016/j.promfg.2020.05.063>.
- [4] A. Alafaghani, A. Qattawi, M.S. Jaman, M.A. Ablat, Microstructure and mechanical properties of direct metal laser-sintered 15-5PH steel with different solution annealing heat treatments, *Int. J. Adv. Manuf. Technol.* 105 (2019) 3499–3520. <https://doi.org/10.1007/s00170-019-04404-8>.
- [5] A. Qattawi, D. Ulutan, A. Alafaghani, Prediction of Mechanical Properties of Direct Metal Laser Sintered 15-5PH Steel Parts Using Bayesian Inference: A Preliminary Study, in: Vol. 2 Process. Mater., American Society of Mechanical Engineers, 2019. <https://doi.org/10.1115/MSEC2019-3052>.

- [6] A. Qattawi, A. Alafaghani, M.A. Ablat, M.S. Jaman, A multidisciplinary engineering capstone design course: A case study for design-based approach, *Int. J. Mech. Eng. Educ.* (2019) 030641901988262. <https://doi.org/10.1177/0306419019882622>.
- [7] A. Alafaghani, A. Qattawi, M.A.G. Castañón, Effect of manufacturing parameters on the microstructure and mechanical properties of metal laser sintering parts of precipitate hardenable metals, *Int. J. Adv. Manuf. Technol.* 99 (2018) 2491–2507. <https://doi.org/10.1007/s00170-018-2586-5>.
- [8] A. Alafaghani, A. Qattawi, Investigating the effect of fused deposition modeling processing parameters using Taguchi design of experiment method, *J. Manuf. Process.* 36 (2018) 164–174. <https://doi.org/10.1016/j.jmapro.2018.09.025>.
- [9] A. Alafaghani, A. Qattawi, M.A. Ablat, Design Consideration for Additive Manufacturing: Fused Deposition Modelling, *Open J. Appl. Sci.* 07 (2017) 291–318. <https://doi.org/10.4236/ojapps.2017.76024>.
- [10] A. Alafaghani, A. Qattawi, B. Alrawi, A. Guzman, Experimental Optimization of Fused Deposition Modelling Processing Parameters: A Design-for-Manufacturing Approach, *Procedia Manuf.* 10 (2017) 791–803. <https://doi.org/10.1016/j.promfg.2017.07.079>.

PRESENTATIONS/TALKS

- [1] Prediction of Mechanical Properties of Direct Metal Laser Sintered 15-5PH Steel Parts Using Bayesian Inference: A Preliminary Study. Technical presentation in MSEC 2019 International Manufacturing Science and Engineering Conference, June 2019. Erie, PA, USA.
- [2] Modified Heat Treatments of DMLS Of Precipitate Hardenable Steel. Poster presentation in MSEC 2019/NAMRC 45/ICMP11, June 2019. Erie, PA, USA.
- [3] Investigating the Effect of Fused Deposition Modeling Processing Parameters Using Taguchi Design of Experiment Method. Poster presentation in MSEC 2018/NAMRC 45/ICMP11 June 2019. Los Angeles, USA
- [4] Fused Deposition Modelling Parts at Elevated Temperatures. Technical presentation in ASME 2017 International Mechanical Engineering Congress & Exposition (IMECE 2017), November 2017. Tampa, Fl, USA.
- [5] Influence of High Temperature on Fused Deposition Modelling Parts. Poster presentation in MSEC 2017/NAMRC 45/ICMP11 June 2017. Los Angeles, USA
- [6] Effect of Processing Parameters on Fused Deposition Modeling parts. Technical presentation in ASME 2016 International Mechanical Engineering Congress & Exposition (IMECE 2016), November 2016. Phoenix, Az
- [7] Influence of High Temperature on Fused Deposition Modelling Parts. Poster presentation in MSEC 2017/NAMRC 45/ICMP11 June 2017. Los Angeles, USA
- [8] Introduction to additive manufacturing. Guest Lecture, University of Toledo, Fall 2020.
- [9] Introduction to design of experiments. Workshop, University of California: Merced, Summer 2020.