

Curriculum Vitae

Exceptionally innovative and educated Ph.D. graduate possessing +10 years of experience in both experimental and simulation environments. Fluent instructor, capable of preparing and delivering highly engaging and effective lessons to undergraduate students in courses including, but not limited to, Mechanical Engineering Technology. Strong collaborator who is adept at engaging with departments leaders to participate in course development and program assessment while maintaining a professional and optimistic demeanor. Well-versed in computational fluid dynamics (CFD), composite materials, 3D CAD modeling, Additive manufacturing, applied computational methods, finite element analysis (FEA), coding, and experimental characterization, as well as in commercial codes including ANSYS / ICEM, Fluent, & CFX, Abaqus, SolidWorks. Hands-on expertise in water tunnel testing, Particle Image Velocimetry (PIV), composite manufacturing. Proficient with statistical Design of Experiments (DOE) procedures, ANOVA, and artificial neural networks (ANN).

Selected Recent Achievements

- Developed a comprehensive CFD blockage model for evaluating the performance of confined hydrokinetic turbines.
- Currently developing optimized hydrokinetic turbine blades with nontraditional 3D-printed cores using Blade Element Momentum (BEM), ANN, and Genetic Algorithm (GA) Techniques, and additive and composite manufacturing processes.
- Currently studying the effect of water channel shape on blockage behavior and hydrokinetic turbines performance
- Currently developing and fabricating a cost-effective silicone mold for injection molding.
- Partook in developing empirical models to compare energy consumption and eco-impact of the additive fused deposition modeling and consolidation plastic injection molding.
- Investigated the effects of blending lignin extracted from tobacco with polyethylene.

Education and Credentials

Doctor of Philosophy, Mechanical Engineering, GPA: 3.8/4.0

Dissertation: Development of Horizontal Axis Hydrokinetic Turbine using Experimental and Numerical Approaches

Missouri University of Science and Technology (Missouri S&T), Rolla, MO, May 2020

Master of Science, Mechanical Engineering, GPA: 3.7/4.0

Missouri University of Science and Technology (Missouri S&T), Rolla, MO, December 2014

Bachelor of Science, Mechanical Engineering

College of Engineering Technology, Hoon, Libya, (formerly Higher Institute of Engineering)

Technical Proficiency

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|---------------------------------------|--|
| Software: | CAE – ANSYS (ICEM, TurboGird, Fluent, CFX, Workbench), Abaqus (FEA), JMP and Minitab (statistics), LabVIEW & Simulink (control and data acquisition), DirectSOFT & PLCLogix (PLC), CAD – Solidworks, Solid Edge, Languages – MATLAB & Simulink, Fortran |
| Experimental Characterization: | Water Tunnel Testing – Turbine power measurement, Flow visualization (PIV) Material Characterization – Mechanical testing (Instron) |
| Composites Manufacturing: | Out-of-autoclave (OOA) prepreg, Vacuum-assisted resin transfer molding (VARTM) |
| Additive Manufacturing | Fused Deposition Modeling (FDM), Powder Bed Fusion (PBF) |

Teaching Experience

Missouri S&T/ Missouri State University Cooperative Program, Springfield, MO
Assistant Professor

August 2022–Present

Prepare and deliver lectures and laboratory sessions for the course ME 4480, Mechanical Engineering Control Systems Lab. Prepare and deliver lectures for the course ME 4479, Automatic Control of Dynamic Systems.

University of Minnesota, Duluth, MN
Assistant Professor

January 2022–May 2022

Prepare and deliver lectures and laboratory sessions for the course IE 3122, Materials Engineering Laboratory. Prepare and deliver lectures for the course ME 2105, Introduction to Materials Science for Engineers.

University of Minnesota, Duluth, MN
Postdoctoral Associate

January 2020– January 2022

Prepare and deliver lectures and laboratory sessions for the course IE 3122, Materials Engineering Laboratory. Develop and present five two-hour graduate lectures for Composite Materials over the course of AMS 5101, Materials Analysis and Design I, and four two-hour graduate-level lectures for Additive Manufacturing through AMS 5102, Materials Analysis and Design II.

Missouri S&T, Rolla, MO
Graduate Teaching Assistant

January 2014 – December 2019

Instructed a section of 16 senior-level undergraduate students as a teaching assistant in the Mechanical Engineering Control Systems Lab (ME 4480 lab). Introduced students to the use of computers as an instrument for measurement, data, processing, and system control. Other duties included providing students with experiments in developing and documenting computer programs for measurement and control applications. Aided in the computer lab and graded homework assignments/projects for three graduate-level courses, which were Introduction to Finite Element Analysis, Advanced Finite Element Analysis, and Introduction to Composite Materials.

- Awarded the *College of Engineering and Computing Graduate Educator Award* In 2019 and the *Outstanding Graduate Teaching Assistant Award* in 2015 and 2018.

College of Engineering Technology, Hoon, Libya (formerly College of Engineering Technology)
Graduate Teaching Assistant

March 2008– May 2010

Supported and provided assistance for laboratory experiments related to fluid mechanics, heat transfer, and mechanical engineering drawing labs.

Research Experience

Research at the University of Minnesota, Duluth, MN
Assistant Professor

January 2022 – May 2022

Conduct research in hydrokinetic energy, injection molding, and 3D printing.

- Currently developing optimized hydrokinetic turbine blades with nontraditional 3D-printed cores using BEM, ANN, GA Techniques, and additive and composite manufacturing processes.
- Currently studying the effect of water channel shape on blockage behavior and hydrokinetic turbines performance
- Currently studying the effect of different injection tools on the injection molding process.
- Starting a research on developing a self-regulated duct diffuser to control the flow around the rotors.

Research at the University of Minnesota, Duluth, MN
Postdoctoral Associate

January 2020 – January 2022

Collaborate and offer insights into developing and fabricating a cost-effective silicone mold for injection molding. Partake in the development of empirical models to compare energy consumption and eco-impact of the additive fused deposition modeling and consolidation plastic injection molding. Develop a comprehensive blockage model for evaluating the performance of confined hydrokinetic turbines. Investigated the effects of blending lignin extracted from tobacco with polyethylene. Fabricating

and evaluating high-quality fiber-reinforced polymer composite using an out-of-autoclave process. Involved in the innovative development and design of a smart pillbox.

Peaslee Steel Manufacturing Research Center (PSMRC) Industry Project, Missouri S&T
Graduate Research Assistant

March 2019 – December 2019

Modeled the kinetics of static recovery recrystallization to determine the fraction of static recrystallization and strain recovery during multi-pass hot rolling. Devised and implemented a MATLAB program to analyze the data from steel double hit tests to investigate static softening behavior. Developed a model of the kinetics of static softening based on the experimental results. The model is then implemented into a finite element model. Created a three-dimensional finite element model to study the multi-stage hot rolling of a square steel bar.

Sandwich Composites with Additively Manufactured Cores, Missouri S&T
Graduate Research Assistant

October 2019 – December 2019

Participated in fabricating sandwich panels using carbon-epoxy face sheets and three different nontraditional additively manufactured metallic triply periodic minimal surface cellular structures as cores. Studied the influence of core geometry on the edgewise compressive, flexural, and impact properties of sandwich structures.

Composites Manufacturing Lab, Missouri S&T
Graduate Research Assistant

February 2013 – March 2018

Design, Fabrication, and Analysis of Hydrokinetic Composite Turbine Blades (January 2016 – March 2018):

Designed and manufactured lab-scale composite turbine blades from a carbon/epoxy prepreg utilizing Fused Deposition Modeling (FDM) for tooling and out-of-autoclave (OOA) technique for fabricating the blades. Studied the effect of induced delamination between the carbon fiber layers of turbine blades after different periods of underwater operation using thermographic testing. Developed blade geometry with multiple thin lay-ups for finite element analysis (FEA) using MATLAB and SOLIDWORKS. Simulated a composite failure based on Hashin's failure criterion to predict the composite blade failure using Abaqus. Modeled a one-way fluid-structure interaction (FSI) to analyze stresses induced in an operating composite blade. BEM and Fluent were both used to calculate the hydrodynamic loads. Partook in the mechanical testing of the manufactured blade Instron machine.

Manufacturing and Evaluation of Polyurethane Composite Insulation Housing Panels using VARTM Process (February 2015 – December 2015):

Manufactured composite structural insulation panels (CSIP) with glass-fiber/Polyurethane using VARTM process to meet the North American Building Codes requirement. Participated in mechanical testing and performance evaluation of manufactured CSIP panels adhering to ASTM standards. Performed thermal simulation to analyze the thermal resistance of the designed panel.

Manufacturing of Composite Bridge Deck Panels (February 2013 – June 2013):

Manufactured polyurethane sandwich composites with various foam types using VARTM.

Water Tunnel Lab, Missouri, S&T
Graduate Research Assistant

May 2012 – December 2019

Design and Performance Evaluation of a Hydrokinetic Turbine System for Energy Harvesting (initially funded by Office of Naval Research).

Computational Fluid Dynamics (CFD) Modeling and Performance Optimization of Hydrokinetic Turbines (December 2017 – December 2020):

Developed an experiment setup equipped with a high capacity torque sensor, high-resolution rotational speed sensors (the rotational speed sensor was developed in the lab), and load sensor. Fabricated set of composite bladed with different sizes for both parametric study and future development of the blockage model. Modeled and simulated the performance of a single turbine system at different levels of solidities utilizing commercial software of ANSYS 18.2 / ICEM and Fluent. Modeled and simulated the performance of a multi-turbine system with optimum solidity rotors. Validated the system's predicted performance and its flow characteristics experimentally utilizing a water turbine power measurement setup and a particle image velocimetry system.

Performance Enhancement of Blade Element Momentum Theory for Hydrokinetic Turbine (May 2016 – August 2018):

Integrated artificial neural networks (ANNs) into a blade element momentum (BEM) model to overcome the convergence issues that usually occur during the BEM model iteration to predict water turbine performance and blade loading. Integrated BEM-ANNs model into a modified BEM model to account for blockage effects. Adapted XFOIL- MATLAB interface to generate hydrofoils hydrodynamic characteristics at a wide range of operational conditions for performance predicting and optimization. Verified the developed models by comparing simulation results with our experimental findings and other existing classical and modified BEM models (these models were coded in the lab using MATLAB). Improved the BEM-ANNs model accuracy by using additional ANNs that were employed as a multivariate interpolation tool to calculate the lift and drag coefficients over an operational range of local Reynolds numbers.

Development of Multi-Turbine System for River and Limited Operational Space Application (May 2013 – December 2014):

Experimentally evaluated and enhanced the performance of the horizontal axis multi-turbine systems through the investigation of several important hydrodynamic and design parameters. Designed and integrated a duct reducer into the multi-turbine system and investigated its effect on the system performance. Utilized particle image velocimetry to examine the effects of several design parameters on the wake structure and thus on the turbine systems performance.

Design and Performance Evaluation of a Hydrokinetic Composite Turbine (May 2012 – August 2013):

Developed an experiment setup equipped with torque and rotational speed sensors. Designed and manufactured lab-scale composite blades. Developed in-house code utilizing blade element momentum (BEM) algorithm to predict the designed turbine performance. Numerically modeled and simulated stationary blade to investigate the stall mechanism and wake development. Validated the predicted results utilizing the experimental setup and particle image velocimetry.

Professional Experience

Chemistry & Technology Company and CASON Engineering Plc, Libya
Assistant Engineer

September 2007 – February 2008

Collaborated directly with an Assistant Mechanical Engineer for the water supply pilot program in Libya. The project was led by the Chemistry & Technology Company and CASON Engineering Pic.

Alnafitha and Chemistry & Technology companies, Libya
Technical Engineer

March 2004 – November 2006

Maintained and renewed five subsidiary sewage stations and the main sewage station in Sabha, Libya. The project was led by Alnafitha, as well as Chemistry & Technology companies. Duties also included supervising the renewing of the water supply network in Sabha, Libya, which was led by the Alnafitha company.

Journal Publications

1. Dasari, S.K., Ganguly, S., Abutunis, A., Chandrashekhara, K., Buchely, F., Lekakh, S., and O'Malley, R., "Implementation of Experimental Static Recrystallization of High Strength Steel into Computational Simulation of Multi-pass Slab Hot Rolling," *Metals and Materials International*, vol. 24, no. 2, pp. 1-16, 2023. <https://doi.org/10.1007/s12540-023-01442-6>
2. Abutunis, A. and Menta, V. G., "Comprehensive Parametric Study of Blockage Effect on the Performance of Horizontal Axis Hydrokinetic Turbines," *Energies*, vol. 15, no. 7, p. 2585, 2022.
[Online]. Available: <https://www.mdpi.com/1996-1073/15/7/2585>.
3. Tahir, I., Rapinac, J., Abutunis, A., Menta, V., "Investigating the Effects of Tobacco Lignin on Polypropylene," *Journal of Polymer*, vol. 14, no. 4, pp. 1-11, 2022. <https://doi.org/10.3390/polym14040706>
4. Menta, V., Abutunis, A., and Chandrashekhara, K., "Manufacturing and Evaluation of High-Quality Composites using Out-of-Autoclave Prepregs," *Academic Journal of Polymer Science*, Volume 5, Issue 4, pp. 1-9, 2022. <https://juniperpublishers.com/ajop/pdf/AJOP.MS.ID.555669.pdf>
5. Menta, V. G. K., Abutunis, A., Zuales, T., Dowling, D., Imtiaz, N., and Khan, A., "Mechanical System Design and Development of Smart Pillbox for a Therapeutic Robot-Based Ecosystem," *Journal of Innovation Sciences and Sustainable Technologies*, 2022, Volume 2, Issue 4, pp. 181-196, 2022. <https://doie.org/10.0213/JISST.2023410369>.
6. Abutunis, A., Fal, M., Fashanu, O., Duan, L., and Chandrashekhara, K., "Coaxial Horizontal Axis Hydrokinetic Turbine System: Numerical Modeling and Performance Optimization," *Journal of Renewable and Sustainable Energy*, vol. 13, no. 2, pp. 024502 (1-22), 2021.

7. Fashanu, O., Rangapuram, M., Abutunis, A., Newkirk, J., Chandrashekhara, K., Misak, H., and Klenosky, D., "Mechanical Performance of Sandwich Composites with Additively Manufactured Triply Periodic Minimal Surface Cellular Structured Core," *Journal of Sandwich Structures & Materials*, pp. 1-19, 2021, <https://doi.org/10.1177/10996362211037>
8. Enemuoh, E. U., Menta, V. G., Abutunis, A., O'Brien, S., Kaya, L. I., and Rapinac, J. "Energy and Eco-Impact Evaluation of Fused Deposition Modeling and Injection Molding of Polylactic Acid," *Sustainability*, vol. 13, no. 4, pp. 1875 (1-15), 2021.
9. Fal, M., Hussein, R., Chandrashekhara, K., Abutunis, A., Menta, V., "Experimental and Numerical Failure Analysis of Horizontal Axis Water Turbine Carbon Fiber-Reinforced Composite Blade," *Journal of Renewable and Sustainable Energy*, vol. 13, no. 1, pp. 014501 (1-14), 2021.
10. Sather, R., Abutunis, A., Dowling, D., Zuales, T., Menta, V., Khan, A., "Evolution of Smart Pillbox: History and Reasons for a Need to Design a Smart Pillbox," *International Research Journal of Advanced Engineering and Science*, Volume 1, Issue 1, pp. 1-9, 2021.
11. Abutunis, A., Taylor, G., Fal, M., and Chandrashekhara, K., "Experimental Evaluation of Coaxial Horizontal Axis Hydrokinetic Composite Turbine System," *Renewable Energy*, vol. 157, pp. 232- 245, 2020.
12. Fal, M., Abutunis, A., Chandrashekhara, K., and Dhaliwal, G.S., "Investigation of Laminar Debonding in Horizontal Axis Water Turbine Composite Blades," *Journal of Renewable and Sustainable Energy*, vol. 12, no. 4, pp. 044501 (1-12), 2020.
13. Abutunis, A., Hussein, R., and Chandrashekhara, K., "A Neural Network Approach to Enhance Blade Element Momentum Theory Performance for Horizontal Axis Hydrokinetic Turbine Application," *Renewable Energy*, vol. 136, pp. 1281-1293, 2019.
14. Mohamed, M., Hussein, R., Abutunis, A., Huo, Z., Chandrashekhara, K., and Sneed, L., "Manufacturing and Evaluation of Polyurethane Composite Structural Insulated Panels," *Journal of Sandwich Structures & Materials*, vol. 18, pp. 769-789, 2016.
15. Menta, V., Tahir, I., Abutunis, A., "Effects of Blending Tobacco Lignin with HDPE on Thermal and Mechanical Properties," *Materials*, vol. 15, no. 13, p. 4437, 2022.
16. Tahir, I., Rapinac, J., Abutunis, A., Menta, V., "Design and Development of Low-Cost Elastomeric Molds for Injection Molding Process". (Submitted to *Polymers*).
17. Abutunis, A., Chandrashekhara, K., and Menta, V., "Investigating the effect of water channel shape on blockage behavior and hydrokinetic turbines performance," 2022, (In progress).
18. Abutunis, A., Menta, V., and Chandrashekhara, K., "Design and Optimization of Hydrokinetic Turbine Blades Utilizing Coupled Neural Network, Bladed Element Momentum Theory, and Genetic Algorithm," 2022. (In progress).
19. Abutunis, A., Menta, V., and Chandrashekhara, K., "Development of optimized hydrokinetic turbine blades with nontraditional 3D-printed cores using bladed element momentum theory, computational intelligence techniques, and additive and composite manufacturing processes.," 2022, (In progress).

Conference Proceedings

1. Abutunis, A., Fal, M., Fashanu, O., Duan, L., and Chandrashekhara, K., "Coaxial Horizontal Axis Hydrokinetic Turbine System: Numerical Modeling and Performance Optimization," *Journal of Renewable and Sustainable Energy*, vol. 13, no. 2, pp. 024502 (1-22), 2021.
2. Hussein, R., Fal, M., Abutunis, A., Anandan, S., and Chandrashekhara, K., "Modeling and Characterization of Stress-Assisted Thermo-Oxidation of Bismaleimide Composites," Proceedings Composites and Advanced Materials Expo. (CAMX), Dallas, TX, October 15-18, 2018
3. Fal, M., Abutunis, A., Hussein, R., Dhaliwal, G.S., and Chandrashekhara, K., "Horizontal Axis Water Turbine Composite Blades: Damage Evaluation and Numerical Simulation," Proceedings of Composites and Advanced Materials Expo (CAMX), Orlando, FL, December 12-14, 2017
4. Abutunis, A., Taylor, G., Fal, M., Nicholas, J., and Chandrashekhara, K., "Performance Evaluation of Coaxial Horizontal Axis Hydrokinetic Composite Turbine System," Proceedings of Composites and Advanced Materials Expo (CAMX), Dallas, TX, October 26-29, 2015
5. Li, H., Taylor, G., Abutunis, A., Chandrashekhara, K., Kashyap, A. and Kimball, J., "Design and Performance Evaluation of a Horizontal Axis Hydrokinetic Turbine System," Proceedings of Society for the Advancement of Material and Process Engineering (SAMPE), pp. 1-14, Long Beach, CA, 2013.

School Accomplishments & Activities

Reviewed three papers for the journal of "Renewable & Sustainable Energy"
Missouri S&T, 2016-2018

Reviewed a paper for the journal of "Polymers and Polymer Composites"
University of Minnesota Duluth, 2021

Reviewed a paper for the journal of “Surface Review and Letters”

University of Minnesota Duluth, 2021

Reviewed a paper for the journal “Renewable Energy”

University of Minnesota Duluth, 2022

Partook in “Conversation Partner Program” at Missouri S&T Intensive English Program Center

Missouri S&T, 2012

Volunteering

Missouri S&T, Rolla Volunteer

2012 – 2015

Volunteered at Missouri S&T “Office of International and Cultural Affairs” for New International Student Orientation, Celebration of Nations, and International Day events.

Professional Affiliations

- Professional Member, The Society for the Advancement of Materials and Process Engineering (SAMPE), 2013-2021
- Professional Member, American Society of Mechanical Engineers (ASME), 2021-2022
- Member, Honor Society Organization, 2021

Outstanding Teaching Awards

- College of Engineering and Computing Graduate Educator Award, 2019, Missouri S&T
- Outstanding Graduate Teaching Assistant Award 2018, Missouri S&T
- Outstanding Graduate Teaching Assistant Award 2015, Missouri S&T

Major Conferences & Workshops Attended

1. The Composites and Advanced Materials Expo (CAMX), Dallas, TX, October 15-18, 2018
2. The Composites and Advanced Materials Expo (CAMX), Orlando, FL, December 12-14, 2017
3. The Composites and Advanced Materials Expo (CAMX), Dallas, TX, October 29-29, 2017
4. Americas 2014 composites show & conferences (JEC), Atlanta, GA, May 13-15, 2014
5. Society for the Advancement of Material and Process Engineering (SAMPE), Long Beach, CA, May 6-9, 2013
6. Ansys Workshop: ANSYS Mechanical, Topology Optimization, and Additive Manufacturing, ANSYS Fluent, Tulsa, OK, January 8-10, 2020
7. Instron Interactive Workshop: Optimize Your Testing, St. Louis, Mo, August 11, 2016
8. COMSOL Multiphysics & Application Builder Workshop, Rolla, MO, June 23, 2016
9. LabVIEW Associate Developer (CLAD) Workshop, Rolla, MO, September 25-December 5, 2013