Mishek Jair Musa

479-445-9156 | mishekmusa3a@gmail.com | Fayetteville, AR
linkedin.com/in/mishekmusa/ | mjmusa.github.io

Education

Ph.D. in Mechanical Engineering — Fayetteville, AR
University of Arkansas — *Jan 2022 – Dec 2024*
Dissertation Advisor: Dr. Uche Wejinya

M.Sc. in Mechanical Engineering — Fayetteville, AR
University of Arkansas — *Aug 2019 – Dec 2021*
Thesis Advisor: Dr. Yue Chen *(now at Georgia Tech)*
Thesis Title: Respiratory Compensated Robot for Liver Cancer Treatment

B.Sc. in Mechanical Engineering — Fayetteville, AR
University of Arkansas — *Aug 2016 – May 2019*
Minor Degree in Mathematics

Skills

Software: Windows (OS), Linux (OS), Matlab & Simulink, Robot Operating System (ROS), Gazebo, RViz, LabView, Git, Microsoft Office Suite, Blender, GIMP

Programming: Python, C++, LaTeX, HTML5, Arduino, Raspberry Pi, NVIDIA Jetson Nano

Frameworks: Pytorch, Tensorflow, Scikit-Learn, OpenCV, MoveIt!

CAD Software: Solidworks, Autodesk Fusion 360, Autodesk Inventor, OnShape, EAGLE

Manufacturing: Additive Manufacturing (FDM, SLA, and SLS 3D printing), Milling (CNC and Manual), Lathe (Manual), Hand Tools, Power Tools, Soft Robot Fabrication, Laser Cutting, PCB design

Language: English (fluent), Belizean Creole (fluent), Spanish (conversational)

Research & Work Experience

Doctoral Research Assistant — Fayetteville, AR
Micro-Nano Systems Engineering and Robotics Laboratory — *Jan 2022 – Present, Full-time*

- Developing a modular two-wheeled balancing mobile robotic platform to test novel control system strategies such as hierarchical sliding mode control, adaptive control, and reinforcement learning based control.
- Designing and fabricating piezoelectric based micro-actuators with optimized closed-loop control schemes for implementation in micromanipulation systems.
- Managing the mechatronics laboratory in the mechanical engineering department and instructing the laboratory segment of the Intro to Mechatronics course.

Master's Research Assistant — Fayetteville, AR
Medical Robotics Lab, University of Arkansas — *May 2019 – Dec 2021, Full-time*

- Design, analysis, fabrication, and characterization of several robotic devices for percutaneous needle insertion procedures under intraoperative image-guidance.
- Design and fabrication of soft robots for experimental validation of theoretical research, and design and fabrication of soft sensors for head motion detection in the MRI environment.

- Developed the laboratory segment of a fundamental mechanical engineering course on the functioning and design of mechatronic systems and their integration with Arduino microcontrollers.
- Authored several journal and conference papers and assisted in the writing of several grants and proposals.
- Supervised 6 undergraduate students conducting senior design projects and undergraduate honors research.

Lead Mechanical Engineer Fayetteville, AR
University of Arkansas Razorbots *Aug 2018 – May 2019*

- Lead mechanical engineer for the excavation subsystem team for the NASA Robotics Mining Competition Team.
- Supervised a team of 10 fellow undergraduate mechanical engineers.
- Designed and fabricated a functioning robot to perform excavation tasks in a simulated Martian environment.

Assistant Engineering Technician Belize City, Belize
Guerra's Engineering Ltd. *June 2015 – Aug 2015*

- Assisted a technician in the installation, maintenance and servicing of air-conditioning units, refrigeration appliances and various electrical appliances.
- Assisted in the construction and installation of air-duct systems.

Teaching Experience

Course Development
University of Arkansas Department of Mechanical Engineering

MEEG 3223 - Introduction to Mechatronics

- This course offers a comprehensive introduction to the principles governing the design and control of mechatronic systems, necessitating the harmonization of mechanical and electrical expertise within a cohesive framework. Key subject areas encompass foundational electronics, diode and transistor functionalities, power amplification, digital logic, operational amplifier utilization, motor design, encoder implementation, and Arduino programming.
- Assisted in the development of the laboratory section of the course by designing Arduino based lab activities, converted hand-written notes to LaTeX-based lecture presentations, and validated sample problems to be used in homework, quizzes, and examinations.

Graduate Teaching Assistant Fayetteville, AR
University of Arkansas *Aug 2019 – Present*

Responsibilities include instructing lab modules, managing assistant TA's, giving substitute and guest lectures, grading reports, assignments, and exams.

- **Spring Semester 2024**
  Lead Teaching Assistant for MEEG 3223 Introduction to Mechatronics – 75 students
- **Fall Semester 2023**
  Lead Teaching Assistant for MEEG 3223 Introduction to Mechatronics – 17 students
  Teaching Assistant for MEEG 4213 Control of Mechanical Systems – 7 students
- **Spring Semester 2023**
  Lead Teaching Assistant for MEEG 3223 Introduction to Mechatronics – 52 students
- **Fall Semester 2022**
  Lead Teaching Assistant for MEEG 3223 Introduction to Mechatronics – 14 students
  Teaching Assistant for MEEG 3113 Fundamental of Vibrations – 73 students

- **Spring Semester 2022**
  Lead Teaching Assistant for MEEG 3223 Introduction to Mechatronics – 46 students
- **Fall Semester 2021**
  Teaching Assistant for MEEG 3223 Introduction to Mechatronics – 24 students
- **Spring Semester 2021**
  Lead Teaching Assistant for MEEG 3223 Introduction to Mechatronics – 90 students
- **Fall Semester 2020**
  Teaching Assistant for MEEG 591V Introduction to Mechatronics – 15 students
- **Spring Semester 2020**
  Teaching Assistant for MEEG 591V Introduction to Mechatronics – 15 students
  Teaching Assistant for MEEG 4213 Control of Mechanical Systems – 20 students
- **Fall Semester 2019**
  Teaching Assistant for MEEG 591V Introduction to Mechatronics – 15 students

Publications

Journal Publications

[J1] Q. Xiao, **M. J. Musa**, I. S. Godage, H. Su, and Y. Chen, "Kinematics and Stiffness Modeling of Soft Robot with a Concentric Backbone", in ASME Journal of Mechanisms and Robotics. doi: 10.1115/1.4055860 (2023)

[J2] A. L. Gunderman, **M. J. Musa**, B. O. Gunderman, F. Benovac, K. Cleary, X. Yang, Y. Chen, "Autonomous Respiratory Motion Compensated Robot for CT-Guided Abdominal Radiofrequency Ablations," in IEEE Transactions on Medical Robotics and Bionics, doi: 10.1109/TMRB.2023.3265718 (2023)

[J3] **M. J. Musa**, S. Sengupta, and Y. Chen, "Design of a 6 DoF Parallel Robotic Platform for MRI Applications," in Journal of Medical Robotics Research, doi: 10.1142/S2424905X22410057 (2022)

[J4] **M. J. Musa***, A. B. Carpenter*, C. Kellner, D. Sigounas, I. Godage, S. Sengupta, C. Oluigbo, K. Cleary, and Y. Chen, "Minimally Invasive Intracerebral Hemorrhage Evacuation: A Review", in Annals of Biomedical Engineering, doi: 10.1007/s10439-022-02934-z (* indicates co-first author) (2022)

[J5] **M. J. Musa**, S. Sengupta, and Y. Chen, "MRI-Compatible Soft Robotic Sensing Pad for Head Motion Detection," in IEEE Robotics and Automation Letters, doi: 10.1109/LRA.2022.3147892 (2022)

[J6] **M. J. Musa**, K. Sharma, K. Cleary, and Y. Chen, "Respiratory Compensated Robot for Liver Cancer Treatment: Design, Fabrication, and Benchtop Characterization," in IEEE/ASME Transactions on Mechatronics, doi: 10.1109/TMECH.2021.3062984 (2021)

[J7] Q. Xiao, R. Monfaredi, **M. J. Musa**, K. Cleary, and Y. Chen, "MR-Conditional Actuations: A Review," in Annals of Biomedical Engineering doi: 10.1007/s10439-020-02597-8 (2020)

Conference Publications

[C1] **M. J. Musa**, U. Wejinya, "Optimized PID Control for a Piezoelectric Bending Microactuator", in International Conference on Manipulation Automation and Robotics at Small Scales (MARSS 2023)

[C2] **M. J. Musa**, S. Sengupta, and Y. Chen, "A 6DOF MR Compatible Robotic Platform for Development of Motion Correction Technology," in International Society for Magnetic Resonance in Medicine (ISMRM) Workshop on Motion Detection Correction (2022)

[C3] S. Sengupta, **M. J. Musa**, and Y. Chen, "MoCoPad: A new soft sensor system for fast head motion detection and tracking in MRI," in 31st International Society for Magnetic Resonance in Medicine (ISMRM) Annual Meeting (2022)

[C4] **M. J. Musa**, S. Sengupta, and Y. Chen, "Design of a 6 DoF Parallel Robot for MRI-guided Interventions," 2021 International Symposium on Medical Robotics (ISMR), doi: 10.1109/ISMR48346.2021.9661513. (2021)

[C5] **M. J. Musa**, K. Sharma, K. Cleary, and Y. Chen, "Design and Workspace Analysis of a Patient Mounted Liver Ablation Robot," in 11th National Image-Guided Therapy Workshop. (2021)

Papers in Preparation

[PP1] K. Yamazaki, T. Hanyu, X. Li, K. Vo, **M. J. Musa**, C. Rainwater, R. Singh, B. Raj, N. Le, "Real-Time Open-Set Queryable 3D Mapping"

[PP2] **M. J. Musa**, U. Wejinya, "Optimized PID Control for a Piezoelectric Bending Microactuator", invitation for extended journal publication in Journal of Micro and Bio Robotics (JMBR) (under review)

[PP3] **M. J. Musa**, U. Wejinya, "An Investigative Study of the Navigation of a Self-Balancing Robot in a Dynamic Environment"

[PP4] J. A. Moritz, **M. J. Musa**, U. Wejinya, "Control Strategies for Two-Wheeled Balancing Robots: A Comparative Study of Hierarchical Sliding Mode Control and PID"

Patents

[P1] Saikat Tarun Sengupta, Yue Chen, **Mishek Musa**, "Head Motion Correction in MRI Using a Soft Pressure Sensing Pad", US Provisional Patent Application No. 63/306,067

[P2] Yue Chen, **Mishek Musa**, Xiaofeng Yang, Nima Kokabi, "Image-Guided Robotic System and Method with Step-Wise Needle Insertion", US Provisional Patent Application No. 63/299,304

[P3] Yue Chen, **Mishek Musa**, "Respiratory Compensated Robot for Liver Cancer Treatment", US Patent Application No. 17/525,461

Presentations

International Conference on Robotics and Automation (ICRA) May 23-27, 2022
Philadelphia, PA, USA

- Presented on my research on the development of a novel MRI-compatible soft robotic sensing pad for head motion detection.

International Symposium on Medical Robotics (ISMR) Nov 17-19, 2021
Atlanta, GA, USA

- Presented on my research on the design of a 6 DoF parallel robot for MRI-guided interventions.

11th National Image-Guided Therapy Workshop Apr 16-17, 2020
Rockville, MA, USA

- Presented on my research on the design and analysis of a patient mounted, respiratory compensated robot for liver cancer treatment.

Awards & Ceritifications

- Reginald R. "Barney" & Jameson A. Baxter Graduate Fellowship (2023 – 2024)
- 21st Century Leadership Chair in Engineering II – Mechanical Engineering Fellowship (2022 – 2023)
- W.R. Thomas Endowed Graduate Fellowship (2022 – 2023)
- University of Arkansas Doctoral Travel Grant Award (2021)
- Treasurer of Pi Tau Sigma – International Mechanical Engineering Honor Society (2018 – 2019)
- University of Arkansas Caribbean Tuition Advantage Scholarship (2016 – 2019)
- Certified SolidWorks Associate – License: C-NUA8W3Y8QZ (does not expire)

Professional Development & Activities

Technical Reviews

Provided technical reviews of publications submitted to:

- International Journal of Robotics Research (IJRR) (2024)
- IEEE International Symposium on System Integration (SII) (2024)
- IEEE Transactions on Image Processing (TIP) (2023)
- IEEE International Conference on Robotics and Biomimetics (ROBIO) (2023)
- IEEE Robotics and Automation Letters (RA-L) (2023)
- International Symposium on Medical Robotics (ISMR) (2022)
- IEEE Robotics and Automation Letters Special Issue: Autonomous Systems in Robotic Surgery (2021)

Memberships

- IEEE Student Member
- IEEE Robotics and Automation Society Member
- Pi Tau Sigma – International Mechanical Engineering Honor Society

University of Arkansas School of Law Patent Bootcamp September 2022

Fayetteville, AR

- A one-day patent bootcamp that offers participants training on the basis of intellectual property law, patent law, and the patent application process. The goals of the patent bootcamp are: (i) to identify and discuss the challenges women/minorities/indigenous communities face with regards to protecting their inventions and innovation; and (ii) to provide intense training about the U.S. patent system and the patenting process.

Arkansas Summer Research Institute (ASRI) June 2022

Fayetteville, AR

- A two-week intensive professional development event hosted by Arkansas NSF EPSCoR in collaboration with the Arkansas School for Mathematics, Sciences, the Arts (ASMSA). The event is attended by students from Arkansas and the surrounding region. During the event, students learn a blend of technical skills and professional skills with particular focus on data science and machine learning.

Student Program for Innovation in Science and Technology (SPISE) July 2014

University of the West Indies, Barbados

- An intensive four-week residential enrichment summer program for gifted Caribbean post-secondary students, modeled after the MITES program at MIT and is spearheaded by Dr. Cardinal Warde of the Electrical Engineering Department at MIT. Course work included physics, calculus, robotics, and electronics.

Service

- Assistant to the Director for the University of Arkansas REU Site: Summer Internships in Nanomaterials, Nanomechanics, and Leadership Training in Engineering (Summer 2022, Summer 2023).
- Graduate Student Panelist discussing experiences in graduate school and how to choose to attend graduate school to current REU participants at the University of Arkansas.
- Mechanical Engineering Ambassador: Promote and inspire freshmen to join the Mechanical Engineering Department at the University of Arkansas through talks and presentations.

Selected Coursework

Control Systems, Control of Mechanical Systems, Advanced Control Systems, Intro to Robotics, Numerical Analysis, Tissue Mechanics, Numerical Linear Algebra, Partial Differential Equations, Machine Learning, Artificial Intelligence, Intro to Deep Learning, Computer Vision, Advanced Numerical Methods, Composite Materials

References

References available upon request.