Elissa Danielle Ledoux
Ph.D., E.I.T.

4718 Richards Ct
Antioch, TN 37013
elissa.ledoux@gmail.com
(225) 287-6966
www.linkedin.com/in/elissa-ledoux

Summary:

A Mechanical Engineering Ph.D. and E.I.T. with experience in industrial and rehabilitation robotics as well as undergraduate education. Eager to apply mathematical modeling and simulation techniques and industrial best practices to engineering design, fabrication, and analysis, and a passion to share that knowledge with future engineers in a university teaching position. Boundless enthusiasm for math with a purpose, efficient and organized multitasker, strong work ethic.

Education:

Doctor of Philosophy in Mechanical Engineering, GPA 3.9/4.0 **May 2024**
School of Engineering, Vanderbilt University (VU) Nashville, TN
Dissertation title: *Design and Evaluation of Soft Robotic Powered Hand Orthoses to Assist the Neurologically Impaired*
Studied under Dr. Eric Barth, Professor of Mechanical Engineering

Master of Science in Mechanical Engineering, GPA 3.9/4.0 **August 2016**
School of Engineering, Vanderbilt University (VU) Nashville, TN
Thesis title: *Control and Evaluation of Stair Ascent with a Powered Transfemoral Prosthesis*
Studied under Dr. Michael Goldfarb, H. Fort Flowers Professor of Mechanical Engineering

Bachelor of Science in Mechanical Engineering, Mathematics Minor, GPA 3.9/4.0 **May 2013**
Summa Cum Laude
College of Engineering, Louisiana State University (LSU) Baton Rouge, LA

Teaching Experience:

Full-time Lecturer, *MTSU Engineering Department, Murfreesboro, TN* **2018-present**

- Instruct undergraduate students in dynamics, kinematics, robotics, senior design capstone, and FE exam prep engineering courses
- Developed new material for the above courses to meet ABET engineering criteria
- Guided 60 teams of capstone students in developing and documenting prototypes for automation and robotic applications
- Assisted substantially with documentation for the 2023 Mechatronics Engineering ABET audit (continuing development, capstone, and student performance analyses)
- Created recommended path chart for the Mechatronics Engineering major based on course catalog

Teaching Assistant, *VU Mechanical Engineering Department., Nashville, TN* **2014-2017**

- Guided 40 teams of capstone students in developing prototypes for robotic, medical, industrial, automotive, and artistic applications
- Instructed and supervised students to ensure safe laser cutting, machining, and power tool use
- Helped instructor develop assignments, grading rubrics, and a best practices manual
- Instructed and assisted system dynamics and instrumentation students during laboratory activities involving hardware-software interactions with MATLAB and LabView
- Graded homeworks, tests, and lab reports

Technical Experience:

Engineering Consultant, f*reelance* **2018-present**

- Drafted concept and design drawings for building layout and construction, assisted with spreadsheet calculations for quote estimation *(Ag Building Solutions)*
- Assisted with construction work, including telehandler operation and steel erection *(Nationwide Builders)*
- Advised robot cell design and modeling *(Universal Logic)*

Research Assistant, *VU Mechanical Engineering Department, Nashville, TN* **2020-2023**

- Developed two powered soft robotic hand orthoses/exoskeletons to facilitate stroke survivor recovery (doctoral work)
- Tested the orthosis prototypes on neurologically impaired patients under IRB Study # 221208
- Participated in entrepreneurship programs to earn grants, including *NSF I-Corps* ($50,000, second place) and Vanderbilt Wondry's *Ideator* program ($2300, first place)

Mechanical Designer, *Universal Logic, Nashville, TN* **2017-2018**

- Designed, prototyped, and tested end effectors for industrial pick-and-place robotic arms
- Designed cell layouts for robot workspaces, calculated and simulated robot reach analyses
- Developed training documentation for gripper design and robot reach analysis
- Automated the CAD design process for various types of grippers based on mathematical formulas
- Edited robot programs for efficiency and precision (ABB, Yaskawa, Fanuc)

Research Assistant, *VU Mechanical Engineering Department, Nashville, TN* **2013-2017**

- Developed a controller for a powered knee and ankle prosthesis to enable reciprocal stair ascent
- Assessed the biomechanical and metabolic benefits of the stair ascent controller on transfemoral amputee subjects
- Developed a gait event detection algorithm for healthy and transfemoral amputee level walking
- Assisted in the metabolic assessment of a bicycling controller for a powered transfemoral prosthesis

Engineering Intern, *Albemarle Corporation, Pasadena, TX* **summer 2013**

- Designed, built, and populated databases for ranking corrosion susceptibility of plant equipment
- Assessed the corrosion susceptibility of plant piping and equipment
- Worked on two safety projects involving communication, portable tank unloading, and ladders

Grants:

[G1] $28,000 (applied April 2024): *Tennessee Board of Regents OER Grant*: "Development of OER for Engineering Capstone to Enhance Quality and Accessibility of Materials", PI: Elissa Ledoux, collaborators at East Tennessee State University, under review

[G2] $50,000 (2021): *National Science Foundation I-Corps Grant*: for powered hand orthosis project, 2nd place finish, PI: Eric Barth, # TI-2120154. Awarded to student-led teams completing an immersive, entrepreneurial training program that facilitates the transformation of invention to impact.

[G3] $2300 (2020): *Vanderbilt Wond'ry Ideator Program Pitch Competition* for hand orthosis project, PI: Deanna Meador. Awarded to the 1st place competitor in a pitch competition at the end of the *Ideator* program, which helps aspiring university-affiliated innovators evaluate and develop their ideas through an evidence-based approach focusing on product-market fit.

[G4] $450 (2019): *Travel grant* to FoMRE (Field of Mechatronics and Robotics Engineering) workshop at 2019 ASEE Conference and Exposition

[G5] $28,000 annually (2014-2016): *National Science Foundation Graduate Research Fellowship Program* (NSF GRFP): awarded to select outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based master's and doctoral degrees at accredited United States institutions, renewable annually for up to three years

[G6] $2000 (2013): *Vanderbilt University IBM PhD Fellowship*: awarded to exceptional PhD students addressing focused areas of interest in technology

Publications:

Book Chapters

[B1] Ledoux, E.D. (2024). "From Preschool Dropout to College Professor: An Unlikely but Positive Path," book chapter submitted to *Educator Reflections: The Power of Our Stories,* MT Open Press, under review.

Journal Articles

[J1] Ledoux, E. D., N. S. Kumar, and E. J. Barth. (ready for submission, waiting for PI to sign off), "Design, Modeling and Preliminary Evaluation of a Simple Wrist-Hand Stretching Orthosis for Neurologically Impaired Patients," *will be submitted to Wearable Technologies upon PI approval*.

[J2] Ledoux, E. D. and E. J. Barth. (Submitted March 2024), "Design, Modeling and Preliminary Evaluation of a 3D-Printed Wrist-Hand Grasping Orthosis for Stroke Survivors," *submitted to Wearable Technologies, under review*.

[J3] Ledoux, E. D. (2018). "Inertial Sensing for Gait Event Detection and Transfemoral Prosthesis Control Strategy," *IEEE Transactions on Biomedical Engineering*.

[J4] Lawson, B. E., Ledoux, E. D., & Goldfarb, M. (2017). "A robotic lower limb prosthesis for efficient bicycling," *IEEE Transactions on Robotics*, 33(2), 432-445.

[J5] Ledoux, E. D., & Goldfarb, M. (2017). "Control and evaluation of a powered transfemoral prosthesis for stair ascent," *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 25(7), 917-24.

Conference Papers

[C1] Ledoux, E. D., Lawson, B. E., Shultz, A. H., Bartlett, H. L., & Goldfarb, M. (2015, August). Metabolics of stair ascent with a powered transfemoral prosthesis. In *Engineering in Medicine and Biology Society (EMBC), 2015 37th Annual International Conference of the IEEE* (pp. 5307-5310).

[C2] Lawson, B. E., Shultz, A., Ledoux, E., & Goldfarb, M. (2014, August). Estimation of crank angle for cycling with a powered prosthesis. In *Engineering in Medicine and Biology Society (EMBC), 2014 36th Annual International Conference of the IEEE* (pp. 6207-6210).

Presentations:

[P1] "OrthoHands: Soft Robotic Hand Orthoses for Stroke Recovery," *Biomedical Engineering and Instrumentation Conference, Boston, MA (2023).*

[P2] *"*Inertial Sensing for Transfemoral Amputee Gait Detection.*" Biomedical Engineering and Instrumentation Summit, virtual,* (2021).

[P3] "Metabolics of Stair Ascent with a Powered Transfemoral Prosthesis." *Engineering in Medicine and Biology Conference, Milan, Italy,* (2015).

Awards and Honors:

- **Make a Difference Recognition** (2020-2023), MTSU: nomination by graduating seniors of a faculty member who significantly contributed to their success while at the university
- **Poster Model**, MTSU Engineering Department:
    - Selected to represent the department in advertisements due to areas of teaching and expertise as well as enthusiasm and crowd appeal
    - 2019-2023: featured on billboards, posters, and flyers advertising MTSU engineering
    - 2023: co-featured with the department head in an infomercial on True Blue TV highlighting the Mechatronics Engineering capstone program and new Applied Engineering Building, https://mtsunews.com/out-of-the-blue-applied-engineering/
- **Faculty Fellow Designation** (2019), MTSU: awarded to faculty who complete the Faculty Fellows year-long teaching and professional development program through the Learning, Teaching, and Innovative Technologies Center on campus.
- **Outstanding Teaching Assistant** Award (2015), Vanderbilt University Mechanical Engineering Dept: an award voted on by department faculty for the best teaching assistant for that academic year. The award can only be received once.

Professional Development:

- **World of Concrete** (2024): attended a convention showcasing concrete and construction equipment as well as robotics and automation emerging in that industry. Developed a highlights video for student education to present upon return
- **Robotics Summit and Expo** (2023): attended a convention showcasing mechatronic technology and robots for automation applications, hosting talks focusing on emerging healthcare and industrial robotics. Developed a highlights video for student education to present upon return
- **International Production and Processing Expo** (2023): attended a convention showcasing equipment and automation related to the meat production and processing industry. Developed a highlights video for student education to present upon return
- **CBAS Teaching Trios Program** (2020-21): A teaching development program at MTSU in the college of basic and applied sciences, involving composing a performance rubric for teaching engineering courses as well as completing several teaching observation and feedback sessions
- **FoMRE Capstone Design Workshop** (2019): participated in the Field of Mechatronics and Robotics Engineering Capstone Design Workshop at the American Society in Engineering Education (ASEE) Conference 2019, awarded a $440 travel grant to attend
- **Faculty Fellows Program** (2018-19): A teaching and professional development program at MTSU involving workshops, mentorship, reflections, and developing a teaching philosophy statement and faculty development plan
- **Faculty Learning Community**, "Signature Thinking: A Framework for Enhancing Creativity," (2018-19): a multidisciplinary study group of faculty members at MTSU that explores ways to encourage creative thinking and enhance student experience through course design

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Course Development

- ENGR 2120 Dynamics: developed course materials from scratch to meet ABET General Engineering student outcome #1, developed supplementary YouTube channel
- ENGR 3590 Kinematics: significantly revised existing course to focus more on industry applications and incorporate more training in MATLAB software, meet ABET General Engineering student outcomes #1 and 2, developed supplementary YouTube channel
- ENGR 4500 FE Exam Prep: significantly revised existing course twice
    - once for conversion to online in order to simulate the computer-based exam format NCEES introduced in 2014
    - once to update content based on revised NCEES exam requirements of 2021
- ENGR 4501 Robotics: developed course materials from scratch to meet ABET General Engineering student outcomes #1-5 and 7, developed supplementary YouTube channel

- ET 4860 Robotics: developed course materials from scratch to meet ABET Engineering Technology student outcomes #1-3 and 5, developed supplementary YouTube channel
- ENGR 4580 Capstone Design 1 and ENGR 4590 Capstone Design 2: developed course materials largely from scratch to meet all seven ABET General Engineering student outcomes, implemented and documented the continuous improvement process prior to the 2023 ABET audit, introduced prototyping to the 4580 course (was previously absent)

Contributions to Student Development:

- Undergraduate **Honors Thesis Advisor** for Jennifer Wade, *RC You Later: Development of a Remote-Controlled Hovercraft with First-Person View Capabilities* (2023-2024)
- **Mentored First Place Team at the 2024 National Robotics Challenge** Manufacturing Workcell Competition, Post-Secondary category. The team placed first in their category, winning both the Gold Award and the Honda Innovation Award (2024)
- **Mentored 60 teams of capstone students** in developing and documenting prototypes for automation and robotic applications (2018-2024). Several of these projects have been spotlighted by MTSU's Out of the Blue media group:
  - **2024:** "Exploring the Depths with Student-Built Submersible Vehicles"
  - **2024**: "Mechatronic Innovations That Are Transforming Industries"
  - **2023:** "MTSU Mech-Tech shows off seniors' creative talents"
  - **2022:** "From 3D printing to 'Mr. CatDog', MTSU Mech-Tech Expo 2022 features robotics-driven projects"
  - **2021:** "MTSU graduating seniors' projects seize spotlight at Mech-Tech expo"
  - **2020:** "True Blue Makers: Mechatronics seniors demonstrate capstone projects"
  - **2019**: "MTSU engineering technology students showcase ingenuity, gadgets at Mech-Tech expo"

Student Evaluations of Teaching:

Average rating (out of 5.00) on student evaluations of teaching over most recent 3-year period.

- ENGR 2120 Dynamics: rating 4.34/5, 6 terms
- ENGR 3590 Kinematics: rating 4.64/5, 9 terms
- ENGR 4500 FE Exam Prep: rating 4.68/5, 6 terms
- ENGR 4501 Robotics: rating 4.75/5, 3 terms
- ENGR 4580 Capstone Design 1: rating 4.79/5, 6 terms
- ENGR 4590 Capstone Design 2: rating 4.74/5, 6 terms
- ET 4860 Robotics: rating 4.3/5, 2 terms

Service Activities:

- Documentation Assistant for **ABET Accreditation Renewal Audit**, MTSU Mechatronics Engineering (2023): Developed the continuous improvement and capstone program sections of the report, as well as analyses of student performance on several courses
- **Invited Panelist**, MTSU CUSTOMS, (2023): Served on a faculty panel for incoming student orientation, as well as gave the department welcome address to engineering students
- **Faculty advisor**, MTSU Women's club volleyball (2022)
- **Faculty advisor**, E-Nable MT prosthetic hand club (2021)