Elissa Danielle Ledoux

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Summary:

Mechanical/robotics engineer eager to apply math and industrial best practices in engineering design, fabrication, and modeling, and a passion to share that knowledge in a university teaching position. Experience in both industrial and rehabilitation robotics, as well as undergraduate education. 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 **graduating May 2024**
School of Engineering, Vanderbilt University (VU) Nashville, TN
Dissertation title: *Design and Evaluation of Soft Robotic Powered Hand Orthosis 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 **graduated 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, *Summa Cum Laude*, GPA 3.9/4.0 **graduated May 2013**
College of Engineering, Louisiana State University (LSU) Baton Rouge, LA

Teaching Experience:

Full-time Lecturer, *MTSU Engr. Dept., Murfreesboro, TN* 2018-present
- Instruct undergraduate students in dynamics, kinematics, robotics, senior design capstone, and FE exam prep engineering courses
- Guided 60 teams of students in developing and documenting prototypes for automation and robotic applications
- Developed lectures, assignments, grading rubrics, and exams for seven courses to meet ABET engineering criteria
- Created the recommended path flowchart for the Mechatronics Engineering major based on the course catalog

Senior Design Teaching Assistant, *VU Mech. Engr. Dept., Nashville, TN* 2014-2017
- Guided 40 teams of 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

System Dynamics and Instrumentation Teaching Assistant, *VU Mech. Engr. Dept., Nashville, TN* 2013-2014
- Instructed and assisted students during laboratory activities involving hardware-software interactions with MATLAB and LabView
- Graded homeworks, tests, and lab reports

Technical Experience:

Research Assistant, *VU Mechanical Engineering Department, Nashville, TN* 2020-2023
- Developed 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
- Edited robot programs for efficiency and precision (ABB, Yaskawa, Fanuc)

Research Assistant, *VU Mechanical Engineering Department, Nashville, TN* 2013-2017
- Developed a stair ascent 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 three transfemoral amputee subjects
- Developed a gait event detection algorithm for healthy subject and transfemoral amputee level walking
- Assisted in the development and 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 piping and equipment
- Assessed the corrosion susceptibility of plant piping and equipment
- Worked on two safety projects involving communication, portable tank unloading, and ladder rung covers.

Related Skills/Coursework:

dynamics, controls, robotics, mechatronics, Onshape CAD, drafting, MATLAB, Simulink, machining, laser cutting, Microsoft Office, technical report writing/documentation, problem solving, course design, EIT certification, college teaching certification

Awards and Honors:

- Make a Difference Recognition, MTSU, 2020-2023
- Poster model for MTSU Engineering Dept., 2019-2023
- Outstanding Teaching Assistant award, VU, 2015
- NSF Graduate Research Fellowship, 2014

Activities and Interests:

- Faculty advisor, MTSU Women's club volleyball, 2022
- Faculty advisor, E-Nable MT prosthetic hand club, 2021
- Volunteer, *Room in the Inn* mission program for homeless
- Airbnb entrepreneur www.airbnb.com/h/starwarsnashville

Publications:

Journal Articles

[J1] 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), 917-924.

[J2] 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.

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

[J4] Ledoux, E. D. and E. J. Barth. (Submitted Oct. 2023), "OrthoHand Flex: Design, Modeling and Evaluation of a 3D-Printed Wrist-Hand Grasping Orthosis for Stroke Survivors," *submitted to IEEE TNSRE, under review*.

[J5] Ledoux, E. D., N. S. Kumar, and E. J. Barth. (Submitted Dec. 2023), "OrthoHand Extend: Design, Modeling and Evaluation of a Simple Wrist-Hand Stretching Orthosis for Neurologically Impaired Patients," *submitted to IEEE TNSRE, under review*.

Conference Papers

[C1] 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).

[C2] 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).

Grants:

[G1] $2300: Vanderbilt Wond'ry Ideator Program (2020) for powered hand orthosis project, PI: Deanna Meador

[G2] $50,000: National Science Foundation I-Corps Program (2021) for powered hand orthosis project, PI: Eric Barth, # TI-2120154

Presentations:

[P1] "Metabolics of Stair Ascent with a Powered Transfemoral Prosthesis." *Engineering in Medicine and Biology Conference, Milan, Italy,* (2015).

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

[P3] "OrthoHands: Soft Robotic Hand Orthoses for Stroke Recovery," *Biomedical Engineering and Instrumentation, Boston, MA (2023).*

Faculty Development Programs:

- 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
- CBAS Teaching Trios Program (2020-21): A teaching development program at MTSU involving composing a performance rubric for teaching engineering courses as well as completing several teaching observation and feedback sessions

Student Evaluations of Teaching:

Average rating (out of 5.00) on student evaluations of teaching over 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