Erica Waters

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Personal Profile

I am a PhD student in mechanical engineering and applied mechanics at the University of Pennsylvania. I am passionate about developing meaningful, robot-based haptic interactions that make stroke rehabilitation more affordable and accessible. My research interests include haptics, controls, human modelling, human-robot interaction, and rehabilitation robotics.

Education

University of Pennsylvania *Philadelphia, PA*

PhD in Mechanical Engineering and Applied Mechanics *Aug 2021 - Current*

- **GEMS, Instructor:** led a STEM activity for middle school students in the Philadelphia area as part of an engineering outreach camp
- **Courses:** Introduction to Robotics, Advanced Robotics, Advanced Robotics, Control and Optimization with Applications in Robot, Machine Learning, Design of Mechatronic Systems, Brain-Computer Interfaces, Advanced Dynamics, Principles and Techniques of Applied Math I & II

University of Tennessee *Knoxville, TN*

BS in Mechanical Engineering *Aug 2017 - Dec 2020*

- **Life Without Limits, Vice President:** co-founded a student organization to design and distribute 3D-printed assistive devices
- **Society of Women Engineers, Member and SWEeties Mentor:** mentored first year students and helped plan outreach events
- **FUTURE, Peer Mentor:** volunteered as a peer mentor to post-secondary students with intellectual and developmental disabilities
- **Chancellor's Honors Program, Member:** completed honors course work and attended enrichment seminars
- **Cook Grand Challenge Honors Program, Member:** completed experiences and coursework relevant to the NAE Grand Challenges

Research Experience

University of Pennsylvania *Philadelphia, PA*

Graduate Research Assistant *June 2021 - Current*

- Performed a systematic literature review of robot-based haptic dyads for motor learning and submitted paper to IEEE Transactions on Haptics
- Implemented a dyadic PD controller on the TheraDyad, a robotic system consisting of two 1-DOF affordable rehabilitation robots
- Completed a case study of robot-based motor learning with 6 older adults and 2 stroke survivors using the TheraDyad
- Designed dynamic, adaptive, assistive and resistive controllers for the next generation of the TheraDrive 1-DOF affordable rehabilitation robot
- Mentored students through the Army Educational Outreach Program (AEOP) and Louis Stokes Alliances for Minority Participation (LSAMP)
- Presented research updates at lab meetings and journal article reviews at journal club

University of Tennessee *Knoxville, TN*

Undergraduate Research Assistant *Feb 2018 - Jan 2020*

- Designed a human subjects study relating upper extremity reaching kinematics and confidence
- Utilized a 3D motion capture system to obtain kinematic data of human reaching to different targets and assessed self-reported confidence
- Trained a k-nearest neighbors algorithm to classify confidence of a reach based on kinematic features

Teaching Experience

University of Pennsylvania *Philadelphia, PA*

Graduate Teaching Assistant *Aug 2022 - May 2023*

- Led robot lab sessions for small groups and held office hours as head TA for the Introduction to Robotics Course
- Wrote and updated lab assignments to teach fundamentals of robotics using the 7-DOF Franka Emika Panda Robot
- Led weekly TA meetings, directed course logistics, graded assignments, facilitated final competition, and managed class discussion board

OpenLiteracy *Remote*

Tutor *Jan 2021 - June 2021*

- Tutored rising ninth grade students in geometry and developed supplementary tutoring materials

Kids 4 Coding *Remote*

Instructor *Sep 2020 - Dec 2020*

- Led weekly Python and Scratch coding lessons for elementary and middle school aged children

Tennessee Tutoring Corps *Maryville, TN*

Tutor *June 2020 - Aug 2020*

- Led English language arts and math small groups for rising third-grade students at the Boys and Girls Club

University Projects

Algorithm to Predict Finger Flexion from ECoG Recordings *Philadelphia, PA*

University of Pennsylvania, Brain Computer Interfaces *March 2023 - May 2023*

- Worked with a 3-person team to design an algorithm to predict the flexion of individual fingers from electrocorticography (ECoG) signals
- Pre-processed the data by removing flat channels, bandpass filtering, subtracting the mean, and applying a sliding window
- Calculated a feature matrix and applied a gradient boosting regression with least-squares loss to predict finger flexion angle

Model Predictive Controller (MPC) for Robot-Based Stroke Therapy *Philadelphia, PA*

University of Pennsylvania, Control And Optimization With Applications In Robotics *Nov 2022 - Dec 2022*

- Worked with a partner to design and evaluate a MPC to assist in trajectory tracking with a simulated 1-DOF rehabilitation robot
- Modelled humans as feedback controllers by using least-squares method to fit the feedback controller to real human trajectory tracking data
- Wrote a report and presented a poster comparing the MPC performance with the simulated humans to a traditional assistive PD controller

Grand Theft Autonomous (Semi-Autonomous Vehicle Design Challenge) *Philadelphia, PA*

University of Pennsylvania, Design of Mechatronic Systems *Oct 2022 - Dec 2022*

- Worked with a 3-person team to develop a semi-autonomous vehicle to navigate a course and placed 3rd in the competition
- Programmed a feedback controller using ultrasonic sensors to follow a wall and autonomously adjust distance and orientation
- Designed an op-amp circuit to amplify IR phototransistor signal and differentiate between 2 different signal frequencies

Functional, Affordable, and Adaptable Transradial Prosthesis *Knoxville, TN*

University of Tennessee, Interdisciplinary Senior Design *Aug 2019 - May 2020*

- Worked with an 7-person interdisciplinary team of engineers to develop a 3D printed transradial prosthesis with myoelectric sensing
- Designed and prototyped the hand to house electronics and function for grasping
- Conducted background research, documented technical progress, performed acceptability testing, and presented at multiple design reviews

Skills

Engineering	Controls, Machine Learning, Microcontrollers (Teensy, Arduino, ItsyBitsy, ESP32), CAD (SolidWorks, OnShape), Sensors and Signal Processing, Prototyping (Laser Cutting, 3D Printing), Troubleshooting
Research	Human Subjects (IRB Protocol Writing, Recruitment, Consenting), Clinical Assessment (Box and Blocks, Grooved Pegboard, Color Trails), Experimental Design, Literature Review
Programming	Python (NumPy, SciPy, Matplotlib, PyTorch, Scikit-learn, Drake, etc.), C/C++, MATLAB
Miscellaneous	LaTeX (Overleaf), Git, REDCap, SPSS
Soft Skills	Technical Writing, Time Management, Teamwork, Mentorship, Communication, Logistics, Presentation Skills

Honors and Awards

2021 **Graduate Research Fellowship**, National Science Foundation
2020 **Grand Challenge Scholar**, National Academy of Engineers
2020 **Honors and Scholars Summer Enrichment Grant**, University of Tennessee
2017 **Hope Scholarship with Merit**, University of Tennessee
2017 **Volunteer Scholarship**, University of Tennessee
2017 **Dr. and Mrs. Joe Beals Scholarship**, University of Tennessee

Publications

Conference Proceedings

Classification of Task-Specific Confidence from Kinematic Features
Erica Waters, Eric Wade
2021 10th International IEEE/EMBS Conference on Neural Engineering (NER), 2021

Self-Efficacy and Kinematics: Establishing a Relationship between Kinematics and Task Challenge of a Goal Directed Reaching Task in Unimpaired Adults
Erica Waters, Eric Wade
2019 IEEE Symposium Series on Computational Intelligence (SSCI), 2019