

Eric J. Earley

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SUMMARY

I am a postdoctoral researcher at the Chalmers University of Technology, working with Max Ortiz-Catalán at the Center for Bionics and Pain Research. I oversee and direct our research on sensory feedback to improve osseointegrated prosthetic limb use and control by stimulating peripheral nerves via implanted electrodes.

My research focuses on developing utilitarian solutions to prosthetic limitations which are impactful not only in a laboratory setting, but at home and during daily use. This requires a multidisciplinary and collaborative approach bringing together engineers, scientists, clinicians, therapists, and patients to develop novel technologies.

EDUCATION

Ph.D. Biomedical Engineering	2014 – 2020	Northwestern University
M.S. Biomedical Engineering	2012 – 2014	Northwestern University
B.S. Engineering: Mechanical Specialty	2008 – 2012	Colorado School of Mines

RESEARCH EXPERIENCE

Postdoctoral Research

2020 - present

Chalmers University of Technology ♦ Department of Electrical Engineering

Center for Bionics and Pain Research ♦ Bionic Arms

Mentor: Dr. Max Ortiz-Catalán

Developing sensory feedback via nerve stimulation for use with osseointegrated prosthetic limbs.

Investigating longitudinal behavioral and functional impacts of sensory feedback on prosthesis use at home, and quantifying perceptions and psychophysical metrics of varying stimulation parameters.

Doctoral Research

2014 – 2020

Northwestern University ♦ Shirley Ryan AbilityLab

Center for Bionic Medicine ♦ Neural Engineering for Prosthetics and Orthotics

Advisors: Dr. Levi Hargrove, Dr. Jon Sensinger

Used sensory feedback to improve motor adaptation by providing information not accurately available via vision, as determined by psychophysical analysis.

Master's Research

2012 – 2014

Northwestern University ♦ Rehabilitation Institute of Chicago

Center for Bionic Medicine ♦ Neural Engineering for Prosthetics and Orthotics

Advisor: Dr. Levi Hargrove

Improved control of partial-hand prostheses through optimization of EMG pattern-recognition parameters and dynamic window lengths while preserving wrist mobility.

Volunteer Internship

2012

University of Colorado ♦ Anschutz Medical Campus

BioMechatronics Development Laboratory

Advisor: Dr. Richard F. ffWeir

Designed thumb actuation mechanism and housing and created SolidWorks models of prototype 3-DOF prosthetic hand.

PUBLICATIONS

Peer-Reviewed Publications

- ♦ **E.J. Earley**, R.E. Johnson, J.W. Sensinger, L.J. Hargrove, “Joint Speed Feedback Improves Myoelectric Prosthesis Adaptation after Perturbed Reaches in Non Amputees,” *Scientific Reports*, vol. 11, no. 1, 2021. doi: 10.1038/s41598-021-84795-5
- ♦ **E.J. Earley**, R.E. Johnson, L.J. Hargrove, J.W. Sensinger, “Joint Speed Discrimination and Augmentation for Prosthesis Feedback,” *Scientific Reports*, vol. 8, no. 1, 2018. doi: 10.1038/s41598-018-36126-4
- ♦ **E.J. Earley**, L.J. Hargrove, T.A. Kuiken, "Dual Window Pattern Recognition Classifier for Improved Partial-Hand Prosthesis Control," *Frontiers in Neuroscience*, vol. 10, no. 58, 2016. doi:10.3389/fnins.2016.00058.

Conference Papers and Posters

- ♦ B.M. Musolf, **E.J. Earley**, M. Muñoz-Novoa, M. Ortiz-Catalán, “Analysis and Design of a Bypass Socket for Transradial Amputations,” *43rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, 2021.
- ♦ **E.J. Earley**, L.J. Hargrove, “Modeling Expected Reaching Error and Behaviors for Motor Adaptation,” *41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, pp. 1534-1538, 2019. doi: 10.1109/EMBC.2019.8857562.
- ♦ **E.J. Earley**, R.E. Johnson, L.J. Hargrove and J.W. Sensinger, “Visual Discrimination of Biomimetic Arm Speeds,” *2018 School and Symposium on Advanced Neurorehabilitation (SSNR)*, pp. 52, 2018.
- ♦ **E.J. Earley**, K.J. Kaveny, R.E. Johnson, L.J. Hargrove and J.W. Sensinger, "Joint-based velocity feedback improves myoelectric prosthesis performance," *2017 Myoelectric Controls and Upper Limb Prosthetics Symposium*, pp. 116, 2017.
- ♦ **E.J. Earley**, K.J. Kaveny, R.E. Johnson, L.J. Hargrove and J.W. Sensinger, "Joint-based velocity feedback to virtual limb dynamic perturbations," *2017 International Conference on Rehabilitation Robotics (ICORR)*, pp. 1313-1318, 2017. doi: 10.1109/ICORR.2017.8009430.
- ♦ **E.J. Earley** and L.J. Hargrove, "The Effect of Wrist Position and Hand-Grasp Pattern on Virtual Prosthesis Task Performance," *6th IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob)*, pp. 542-547, 2016. doi: 10.1109/BIOROB.2016.7523682.
- ♦ **E.J. Earley**, A.A. Adewuyi, and L.J. Hargrove, "Optimizing Pattern Recognition-Based Control for Partial-Hand Prosthesis Application," *36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, pp. 3574-3577, 2014. doi: 10.1109/EMBC.2014.6944395.

Publications In Preparation

- ♦ **E.J. Earley**, J. Zbinden, M. Muñoz-Novoa, E. Mastinu, A. Smiles, M. Ortiz-Catalán, “Gonna Fly Now: Competitive Motivation Increased Home Use and Improved Prosthesis Self-Perception after Cybathlon 2020 for x-OPRA Pilot,” *Journal of Neuroengineering and Rehabilitation*. Submitted.
- ♦ B. Ahkami, E. Mastinu, **E.J. Earley**, M. Ortiz-Catalán, “Extra-neural signals from severed nerves enable intrinsic hand movements in transhumeral amputations,” *Communications Biology*. Submitted.
- ♦ **E.J. Earley**, R.E. Johnson, J.W. Sensinger, L.J. Hargrove, “Wrist Speed Feedback Improves Elbow Compensation and Reaching Accuracy for Myoelectric Transradial Prosthesis Users in Hybrid Virtual Reaching Task.” In preparation (receiving edits from co-authors).
- ♦ J. Zbinden, P. Sassu, E. Mastinu, **E.J. Earley**, M. Muñoz-Novoa, R. Brånemark, M. Ortiz-Catalán, “Nerve transfer to native and free grafted muscles for the control of bionic limbs,” *Nature Biomedical Engineering*. In preparation (receiving approval from co-authors).
- ♦ A. Smiles, **E.J. Earley**, M. Ortiz-Catalán, N. Jiang, “Providing sensation of prosthetic grip stability to amputees through neural interface.” In preparation (receiving edits from co-authors).

Journal Referee

- ◆ ACM Transactions on Internet of Things
- ◆ Allied Academies Biomedical Research
- ◆ Annals of Physical and Rehabilitation Medicine
- ◆ Assistive Technology
- ◆ Biomedical Signal Processing and Control
- ◆ Computer Methods in Biomechanics and Biomedical Engineering
- ◆ IEEE EMBS Conference on Neural Engineering
- ◆ IEEE Engineering in Medicine and Biology Conference
- ◆ IEEE International Conference on Biomedical Robotics and Biomechatronics
- ◆ IEEE International Conference on Intelligent Robots and Systems
- ◆ IEEE International Conference on Rehabilitation Robotics
- ◆ IEEE Robotics and Automation Letters
- ◆ IEEE Transactions on Biomedical Engineering
- ◆ IEEE Transactions on Human-Machine Systems
- ◆ IEEE Transactions on Mechatronics
- ◆ IEEE Transactions on Medical Robotics and Bionics
- ◆ IEEE Transactions on Neural Systems & Rehabilitation Engineering
- ◆ Journal of NeuroEngineering and Rehabilitation
- ◆ Myoelectric Control Conference
- ◆ PLOS ONE
- ◆ Scientific Reports
- ◆ Wearable Technologies

ACADEMIC & TECHNICAL SKILLS

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- ◆ Prosthetic sensory feedback, sensory integration, psychophysics
 - ◆ Pattern recognition, classification, and machine learning algorithms
 - ◆ Human motor control, motor learning and adaptation, musculoskeletal anatomy
 - ◆ Statistical analysis, hypothesis testing, power analysis, linear and nonlinear mixed effects modeling
 - ◆ MATLAB, C, Simulink, LabVIEW
 - ◆ SolidWorks, FEA
 - ◆ HTML5, CSS
 - ◆ Adobe Illustrator, Photoshop, Premiere; Affinity Designer, Photo
 - ◆ Organization, scheduling, project management, Kanban, scrum
 - ◆ Native English; limited working proficiency Swedish; elementary proficiency German, French

TEACHING**Chalmers University of Technology – EEM076 – Electric Circuits and Fields***2020-present*

Lecturer, Examiner

Learning objectives: analyze linear circuits using DC and AC calculation methods, perform electromagnetic field calculations based on simple geometries, and use computer-based tools to analyze simpler electrical circuits.

Course development included refining electromagnetic field modules to better integrate with the circuits modules and adapting the course for digital instruction and examination during the COVID-19 pandemic.

Nettelhorst Elementary – Get-a-Grip Program*2017-2018*

Student Mentor

Through Northwestern's Science Club, mentored elementary school students in the fundamentals of engineering design, construction, and analysis, and guided them as they developed a prosthetic device made from household items.

Notre Dame University – PHIL 20632/STV 20233 – Robot Ethics*2016–2018*

Guest Lecturer

Along with Max Shepherd, gave guest lectures titled "ProstEthics" for Dr. Don Howard's Robot Ethics course focused on historical and current research of prosthetic limbs, and ethical considerations related to prosthetic design and transhumanism.

Northwestern University McCormick Graduate Leadership Council

2013 – 2017

Workshop Coordinator and Instructor

Coordinated workshops to teach introductory through advanced MATLAB and SolidWorks skills, and coordinated additional workshops on other transferable skills, for over 600 graduate students.

ADVISING & MENTORING

PhD Students

- ♦ **Jan Zbinden**, Electrical Engineering 2020 – present
3-Degree-of-Freedom Simultaneous and Proportional Control of Prosthetic Hands
- ♦ **Riccardo Collu**, Engineering & Architecture 2020 – present
Novel Waveform Shapes for Neurostimulation

MS Students

- ♦ **Anton Berneving**, Engineering Mathematics and Computational Science 2021
Neurostimulation Artifact Removal Algorithms for iEMG Prosthesis Control
- ♦ **Brett Musolf**, Biomedical Engineering 2020 – 2021
Design of a Bypass Socket for Transradial Prosthesis Use
- ♦ **Andrew Smiles**, Engineering 2020 – 2021
Slip Prediction and Stimulation System for Sensorized Prosthetic Hands

LEADERSHIP

Workforce for Inclusive Science

2021

Organizing Committee

Facilitating meetings and seminars aimed at promoting and fostering equity and inclusion in academia.

International Conference on Phantom Limb Pain

2021

Organizing Committee

Planned, oversaw, and executed social media plan before and during the event. Moderated discussion panel during final day of the conference.

National Communicating Science Conference

2017 – present

Leadership Team, Advisory Committee

Treasurer and advisory committee member, responsible for developing fiscal procedures and managing \$100,000 budget for flagship and local conferences. Program organizer for sixth annual national conference held summer 2018, responsible for selecting panelists and organizing non-panel workshops.

Chicago Communicating Science Conference

2015 – 2017

Treasurer, Lead Organizer

Organizer and treasurer for second conference held summer 2016. Lead organizer for third conference held summer 2017. Tracked budget and donated funds, secured conference location, and oversaw the conference.

Northwestern University Biomedical Engineering Graduate Students Group

2013 – 2017

Co-President

Oversaw periodic academic and social events, maintained communication with other officers, proposed and facilitated changes to annual BME research day including pop talks (short 3-minute overviews of research using jargon-free language), and rebuilt website.

Colorado School of Mines Robotics Club

2008 – 2011

Treasurer, Mentor

Developed and managed \$26,000 annual budget. Co-initiated project to design, build and program self-balancing wheelchair. Mentored high school students for FIRST Robotics Competition

PUBLIC OUTREACH & EDUCATION**SciShow YouTube Channel**

2018 – 2020

Freelance script writer for SciShow, a YouTube channel which make easy-to-understand science videos

- ♦ [Why Do Prosthetic Limbs Feel Way Heavier Than Biological Ones?](#)
- ♦ [Why Scientists are Giving Robots Human Muscles](#)
- ♦ [Why Do Batteries Taste Sour?](#)
- ♦ [Why Does Body-Temperature Air Feel Hot?](#)
- ♦ [Is Sitting up Straight Actually Good Posture?](#)
- ♦ [Does Medicine Actually Expire?](#)
- ♦ [Why Do Fetuses Kick So Much?](#)

Sci-Inspiration YouTube Channel

2017 – 2018

Channel explores scientific topics through popular media including movies, television, and video games.

- ♦ [Why can't we travel Faster than Light?](#): Explores the laws of physics that prevent traveling faster than the speed of light
- ♦ [How can we travel Faster than Light?](#): Walks through various sci-fi and theoretical technology that could allow faster than light travel

Other Science Videos

2016 – 2017

- ♦ “STEM Connect Careers: Eric Earley.” *Discovery Education*, 2017.
- ♦ [Prosthetic Limbs and Motor Adaptation](#): A short 3-minute video explaining the purpose of my research using clear and concise language

Science Writing

2017

- ♦ [The Cybathlon: The Olympics of Restoring Daily Tasks](#), HELIX Magazine.

Public Talks & Demos

2014 – present

- ♦ Center for Bionics and Pain Research Inaugural Symposium, 2021.
- ♦ “Sensory Substitution in the Presence of Vision: Providing Joint Speed Feedback to Improve Myoelectric Prosthesis Control and Adaptation,” Thesis defense, 2019.
- ♦ “Wunderbar Together Science Slam,” Daley Plaza, Chicago, IL, 2019.
- ♦ “Neural Engineering: Designing Bionic Limbs Controlled by the Brain,” College of DuPage STEMinar Series, 2018.
- ♦ Chicago Science Festival, Illinois Science Council, 2016 – 2019.
- ♦ Museum of Science and Industry Robotics Week, 2016 – 2019.
- ♦ “How Do I Talk to my Robo-Limb?”, RSG Science Communicating Workshop, 2016.
- ♦ IEEE Engineer’s Week, 2016.
- ♦ “Adler After Dark”, Adler Planetarium, 2015 – 2018.
- ♦ Camp Neuro Chicago, 2015.