Edgar Peña, PhD

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EDUCATION

Dec 2017: **PhD**, Biomedical Engineering, University of Minnesota, Twin Cities (UMN)
Dissertation Title: "Optimization Algorithms for Spatially Targeted Deep Brain Stimulation"
Advisor: Matthew D. Johnson

Jun 2013: **BS**, *Cum Laude*, Electrical Engineering & Biomedical Engineering, University of California, Irvine

RESEARCH EXPERIENCE

May 2018 – Present: **Postdoctoral Associate**, Biomedical Engineering, Duke University
Advisor: Warren M. Grill
Performed acute *in vivo* rat experiments to optimize high frequency nerve block methods. Developed computational models in MATLAB, COMSOL, and NEURON to model peripheral nerve stimulation and recording.

- Published two peer-reviewed first author papers.
- Presented peripheral nerve modeling work at two international conferences.

Jan 2018 – Apr 2018: **Postdoctoral Associate**, Biomedical Engineering, UMN

Nov 2013 – Dec 2017: **Graduate Research Assistant**, Biomedical Engineering, UMN
Advisor: Matthew D. Johnson
Developed mathematical optimization solutions for deep brain stimulation in computational models. Implemented finite element models in COMSOL. Implemented biophysical models on NEURON and Python in a Linux high-performance computing system. Analyzed magnetoencephalography data in MATLAB from humans with Parkinson's disease.

- Published four peer-reviewed first/co-first author papers on mathematical optimization.
- Published a peer-reviewed first author paper on magnetoencephalography.

Jun 2012 – Aug 2012: **Undergrad Research Assistant**, Biomedical Engineering, University of California, Davis
Advisor: Katherine Ferrara
Analyzed PET scans of mice using ImageJ and MATLAB to evaluate methods for precise localization of metastatic brain tumors.

- Developed web interface for the lab through PHP and Python on an Apache server.
- Presented work at two national conferences for poster and technical paper competitions.
- Ranked among the top three presenters by peers in final oral presentation of program.

Aug 2010 – Jun 2013: **Undergrad Research Assistant**, Biomedical Engineering, University of California, Irvine
Advisor: Frithjof Kruggel
Used C++ and a proprietary MRI analysis library in a Linux environment to implement algorithms for reconstructing white matter pathways from diffusion-weighted MRI.

- Presented work at a national conference.

PUBLICATIONS

Peer Reviewed Articles

Mar 2021: "Individual Magnetoencephalography Response Profiles to Short-Duration L-Dopa in Parkinson's Disease," *Frontiers in Human Neuroscience*, vol. 15, p. 640591
E. Peña, T.M. Mohammad, F. Almohammed, T. AlOtaibi, S. Nahrir, S. Khan, V. Poghosyan, M.D. Johnson, J.A. Bajwa

Mar 2021: "Non-monotonic kilohertz frequency neural block thresholds arise from amplitude- and frequency-dependent charge imbalance," *Scientific Reports*, vol. 11, no. 1, p. 5077
E. Peña, N.A. Pelot, W.M. Grill

Sept 2020: "Quantitative comparisons of block thresholds and onset responses for charge-balanced kilohertz frequency waveforms," *Journal of Neural Engineering*, vol. 17, no. 4, p. 046048.
E. Peña, N.A. Pelot, W.M. Grill

Dec 2018: "Multi-Objective Particle Swarm Optimization for Postoperative Deep Brain Stimulation Targeting of Subthalamic Nucleus Pathways," *Journal of Neural Engineering*, vol. 15, no. 6, p. 066020.
E. Peña, S. Zhang, R. Patriat, N. Harel, M.D. Johnson

Oct 2018: "Clinical deep brain stimulation strategies for orientation-selective pathway activation," *Journal of Neural Engineering*, vol. 15, no. 5, p. 056029.
J.P. Slopsema, **E. Peña**, R. Patriat, L. J. Lehto, O. Gröhn, S. Mangia, N. Harel, S. Michaeli, M.D. Johnson

May 2017: "Determining Electrode Placement for Transcranial Direct Current Stimulation: A Comparison of EEG- Versus TMS-Guided Methods," *Clinical EEG and Neuroscience*, p. 1550059417709177.
T.L. Rich, J. S. Menk, K.D. Rudser, M. Chen, G.D. Meekins, **E. Peña**, T. Feyma, K. Bawroski, C. Bush, B.T. Gillick

Feb 2017: "Particle swarm optimization for programming deep brain stimulation arrays," *Journal of Neural Engineering*, vol. 14, no. 1, p. 016014.
E. Peña*, S. Zhang*, S. Deyo, Y. Xiao, and M. D. Johnson [*co-first authors]

Feb 2016: "Theoretical Optimization of Stimulation Strategies for a Directionally Segmented Deep Brain Stimulation Electrode Array," *IEEE Transactions in Biomedical Engineering*, vol. 63, no. 2, pp. 359–371.
Y. Xiao*, **E. Peña***, and M.D. Johnson [*co-first authors]

Manuscripts in Preparation

"In Silico and In Vivo Optimization of Kilohertz Frequency Nerve Block Waveform for Energy-Efficient Nerve Block"
E. Peña, N.A. Pelot, W.M. Grill

"Computational Models of Compound Nerve Action Potential Recordings from Rat Vagus Nerve"
E. Peña, N.A. Pelot, W.M. Grill

PRESENTATIONS

Invited Talks

Sept 2020: "Effects of conventional waveform shapes on kilohertz-frequency nerve block properties"
Near Peer Neural Engineering Seminar Series, UMN, Minneapolis, MN

Jan 2018: "Optimization for DBS Programming: Theory, Practice, and Potential"
Medtronic Neuromodulation, Fridley, MN

Oct 2017: "Optimization Algorithms for Spatially Targeted Deep Brain Stimulation"
Promoting Emerging Engineering Research Scholars, Auburn University, Auburn, AL

Nov 2014: "Spatial and Temporal Modeling of Electrical Brain Stimulation"
Society of Hispanic Professional Engineers (SHPE) National Conference, Detroit, MI

Selected Poster Sessions

Jun 2021: "Computational Models of Compound Nerve Action Potential Recordings from Rat Vagus Nerve"
Neural Interfaces Conference 2021. (Virtual)
E. Peña, N.A. Pelot, W.M. Grill

Jun 2018: "Multi-objective Particle Swarm Optimization for Subthalamic Nucleus Deep Brain Stimulation Pathways"
Neural Interfaces Conference 2018. (Minneapolis, MN)
E. Peña, M. Goftari, S. Zhang, R. Patriat, J. E. Aman, J. L. Vitek, N. Harel, M.D. Johnson

Jun 2016: "Particle Swarm Optimization (PSO) for programming DBS arrays"
Neural Interfaces Conference 2016. (Baltimore, MD)
S. Zhang, E. Peña, Y. Xiao, S. Deyo, M.D. Johnson

Jun 2015: "Phase-amplitude coupling heterogeneity in the parkinsonian sensorimotor cortex"
International Congress of Parkinson's Disease and Movement Disorders 2015. (San Diego, CA)
E. Peña, L. Rosedahl, T. Mohammed, F. Mohammed, L. Soualmi, M.D. Johnson, J.A. Bajwa

Jun 2014: "Effective connectivity between SMA and M1 in Parkinson's disease using MEG."
International Congress of Parkinson's Disease and Movement Disorders 2014 (Stockholm, Sweden)
E. Peña, J.A. Bajwa, S. Nahrir, F. Mohammed, L. Shaar, T. Mohammed, L. Soualmi, M. D. Johnson

Apr 2014: "Volumetric Analysis of Basal Ganglia Structures in 7T MRI of Patients with Movement Disorders"
Minnesota Neuromodulation Symposium 2014. (Minneapolis, MN)
E. Peña, Y. Duchin, N. Harel

March 2013: "An Improved Shortest Paths Approach for Detecting Brain White Matter Connections"
Undergraduate Research Opportunities Program (UROP) Symposium 2013. (Irvine, CA)
E. Peña, F. Kruggel

Nov 2012: "Detecting Metastatic Brain Lesions with Positron Emission Tomography"
Society of Hispanic Professional Engineers (SHPE) National Conference 2012. (Fort Worth, TX)
E. Peña, C. Caskey, K. Ferrara

HONORS & AWARDS

Nov 2017: **Best Poster Award in Neuroengineering**, Institute for Engineering in Medicine, Annual Conference & Retreat, UMN
Sept 2015: **Awardee**, NSF Graduate Research Fellowship Program
Sept 2014: **Trainee**, NSF IGERT Systems Neuroengineering, UMN
Sept 2013: **Awardee**, Diversity of Views & Experiments (DOVE) Fellowship, UMN
Apr 2013: **Honorable Mention**, NSF Graduate Research Fellowship Program

TEACHING EXPERIENCE

Formal Training

May 2016: Certificate Recipient, Preparing Future Faculty Program, UMN
Jun 2013: Minor in Educational Studies, University of California, Irvine

Guest Lectures

Feb 2019: "Nerve Block Biophysics"; Neural Prosthetic Systems, Duke University
May 2016: "Circuit Analysis with Laplace Transforms"; Intro to Electrical Circuits, University of St. Thomas
Apr 2016: "Frequency Response and Spectrum"; Intro to Electrical Circuits, University of St. Thomas
Mar 2016: "Intro to Operational Amplifiers"; Intro to Electrical Circuits, University of St. Thomas
Feb 2015: "Peripheral Nerve Stimulation"; Neuromodulation, UMN
Apr 2011: "Chemical Reactions"; Chemistry, Segerstrom High School
Apr 2010: "Slope Intercept Form"; Algebra 1, Carr Intermediate
Nov 2009: "Energy"; Scientific Concepts, Whittier Elementary

SERVICE AND LEADERSHIP

Nov 2020 – Present: Duke Biomedical Engineering Committee on Diversity, Inclusion, and Equity
Jul 2015 – Jul 2016: National Board of Directors, Society of Hispanic Professional Engineers (SHPE) National
Jul 2014 – Jul 2015: Graduate Ambassador, SHPE at UMN
Jul 2011 – Jul 2012: President, SHPE at University of California, Irvine
Reviewer, Journal of Neural Engineering; Neuromodulation; Journal of Neuroscience Methods; Transactions in Biomedical Engineering; Nature Communications

REFERENCES

Warren M. Grill, Ph.D., Professor of Biomedical Engineering, Duke University
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Matthew D. Johnson, Ph.D., Professor of Biomedical Engineering, University of Minnesota, Twin Cities
612-626-6492 john5101@umn.edu

Noam Harel, Ph.D., Professor of Radiology and Neurosurgery, University of Minnesota, Twin Cities
612-625-8399 harel002@umn.edu

Frithjof Kruggel, M.D., Ph.D., Professor of Biomedical Engineering, University of California, Irvine
949-824-3729 fkruggel@uci.edu