

Jonathan C. Erickson

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CURRENT POSITION

Washington and Lee University, Lexington, VA
Associate Professor, Physics and Engineering Department 2015 –
Assistant Professor 2009 – 2015

ACADEMIC TRAINING

Auckland Bioengineering Institute, Auckland, New Zealand 2016 – 2017
Visiting Research Fellow,
Gastrointestinal Electrical Mapping Technologies and Devices

Vanderbilt University, Nashville, TN 2007 – 2009
Postdoctoral Research Fellow, Departments of Physics and Surgery

California Institute of Technology, Pasadena, CA 2001 – 2008
Ph.D. Bioengineering

Harvey Mudd College, Claremont, CA 1997 – 2001
B.S. Physics, *cum laude*

TEACHING at W&L

Electrical Circuits with Lab (ENGN/PHYS 207), Fall 2009-2014, 2017-2021. Required core course for majors. Topics covered include DC and AC circuit analysis, op-amps, passive and active filters, and microcontrollers interfacing to analog and digital components. Emphasis on hands-on designing, building, testing practical circuits systems (vibration measurement for structural health monitoring; electromyography for prosthetics; LED light organ syncing music to laser light show). Community Based Learning (CBL) partnership with local elementary after school program starting Fall 2019: [“Electric Mondays!”](#)

Electronics (ENGN/PHYS 208), Winter 2011, 2012, 2015, 2019. Project-based elective course for majors with emphasis on design, construction, and testing of electronics systems for real world applications. Projects integrate microcontrollers, wireless devices, digital sensors (accelerometers, distance sensors, etc.). Past projects have included the [SmartRock](#) capsule for geological measurements, hi-fi transistor audio amplifiers, wireless communication “spy circuits”, and biomedical equipment targeted for the visually impaired.

Applied Signal Processing (ENGN 395), Spring 2020. New project-based course I developed which studies a variety of signal processing methods applied to real world problems. Topics/projects covered include: Step-counter from accelerometer measurements (event detection; energy transforms, statistical thresholding); hunting gravity waves in the LIGO database (digital filtering; time-frequency analysis Fourier transforms; continuous wavelet transforms); compression of earthquake ground acceleration and biomedical data (discrete wavelet transform compression and denoising); hunting gastrointestinal waves from multichannel electrical recordings (blind source separation, spatial intensity mapping).

Bioengineering, and Bioinspired Design (ENGN/BIOL 267), Fall 2010, 2011, 2013, Winter 2015, 2016, 2018, 2020. Elective course I developed which studies animal systems from an integrated physics-engineering-biology perspective. Model systems covered include: cephalopod optical camouflage, mantis shrimp optics; neural interfacing for building insect biobots, kinematics of ocean swimmers (jellyfish, manta rays); bioinspired robotics. Emphasis is placed both on how key principles from biological systems can be integrated into the next generation of human-engineered designs.

Capstone Design (ENGN 379), Winter 2018-2020. Second-half of a year-long sequence. Senior majors work together in teams to design and implement engineering solutions to real-world problems. Project topics span and wide range, including: Hands-free, no-tie shoes for the elderly; SmartGate electronics module for home pets; W&L storm water runoff management; Lexington, VA traffic study and traffic flow optimization.

Mathematical Methods for Physics and Engineering (ENGN/PHYS 225), Winter 2016, 2018. Required core course for majors. Topics covered include: vector calculus, eigenvalue problems, complex analysis, Fourier transforms, ODEs and PDEs.

Mechanical Vibrations (ENGN 330), Winter 2010, 2011, 2014, 2016. Elective course for majors. Topics covered include single and multi-degree of freedom and continuous systems, damped-driven oscillations, stability, force isolation, normal modes, vibration measurement instrumentation, and earthquake engineering.

Introductory Physics Lab II (PHYS 114), Winter 2010. Required core course for majors. Instrumentation and analysis of experiments with electricity and magnetism, simple harmonic motion, geometrical optics, and modern physics.

Physics of Music (PHYS/MUS 102), Spring 2011, 2012, 2014, 2015, 2016, 2018. Course for non-majors and the musically-inclined. Topics include wave mechanics and modal analysis; design and operational principles of winds, strings, voice, etc.; perception of sound in the human auditory system. Primary mode of inquiry is hands-on investigation to connect scientific quantities to aesthetic qualities of music.

Honors Thesis (ENGN/PHYS 493), 2011-12, 2013-14, 2014-15, 2019-20.

Laura Bruce '20. *Is Detection of Colon Motility Waves Possible?: An Investigation of Two Spatial Filtering Techniques with Electrocolonography (EcolG)*

Cort Hammond '15. *Low-cost techniques for assessing the quality of drinking water from biosand filters.*

Alvin Thomas '14. *Plasticity in Dissociated Neuronal Networks under Chronic Stimulation.*

Raisa Velasco-Castedo '12. *Algorithms for and Assesment of Small Intestine Spike Activity During Onset of Ischemia*

Directed Independent Study (ENGN/PHYS 421/422/423)

Smartrock: Wireless electronics module for measuring pressure and kinematics of rock plucking in rivers (Stevan Kriss '20 and Laws Smith '20; in collaboration with Dr. David Harbor, W&L Geology Department)

Mapping slow waves and spikes in ischemic small intestine (Joy Putney '16, Jamie Hayes '17, and Alfred Rwagaju '18)

Wireless neural-electric stimulus and path-tracking for cockroach biobots (John Kirby '16 and Ann Catherine Bokinsky, '16)

SERVICE and PROFESSIONAL ACTIVITIES

- W&L [Engineering Community Development student club](#) faculty adviser (ECD), 2010 - Helped organize, lead, and implement local and international projects in Virginia, USA; Belmopan, Belize; Monterrey, Mexico; Santiago de Atitlán, Guatemala, and Pampoyo, Bolivia.
- Academic Calendar, Scheduling, and Registration Committee (ACSR), appointed member 2017-2022.
- General Education Development Committee (GEDC), elected member, 2019 –
- University Assurance of Learning Committee (AOL), appointed member 2019-2022
- Community Based Learning Teacher-Scholar Cohort Fellow (CBL), 2018 –
- Institute Animal Care and Use Committee (IACUC), appointed member, 2011 – 2015.
- Peer reviewer: Annals of Biomedical Engineering; Journal of the Royal Society Interface; PLoS ONE; Journal of Neuroscience Methods, Biomedical Signal Processing and Control; American Journal of Physiology: Gastroenterology & Hepatology; IEEE-Engineering in Medicine and Biology; Journal of Online Visualized Experiments (JOVE); Journal of Insect Research; Soft Robotics.

RESEARCH INTERESTS and EXPERIENCE

Interdisciplinary problems at the boundary of engineering, physics, and biology. Currently, my lab is developing electronics hardware instrumentation and automated signal processing methods to detect gastrointestinal electrical activity patterns. Our ultimate aim is to enabling precision diagnostics and treatment strategies for motility disorders. In the past, my lab has developed neural-electric interfaces for hybrid insect biobots.

ACTIVE COLLABORATORS

Gastrointestinal Systems Group, Auckland Bioengineering Institute, New Zealand. *Developing signal processing tools and investing electrical activity in the gastrointestinal system*

Prof. David Harbor, W&L Geology Department. *Smartrock: Wireless electronics module for measuring pressure and kinematics of rock plucking in rivers*

Dr. William Schreiber, Department of Psychology, Elon University, USA. *Automated image processing for quantifying adaptive stimulus-response behaviors in ants.*

REFEREED JOURNAL PUBLICATIONS (* = ungraduated student co-author)

Erickson J, Bruce L*, Taylor A*, Higgins C*, Richman J*, Wells C, and O'Grady G. (2019) Electrocolonography: Non-invasive detection of colonic cyclic motor activity from multielectrode body surface recordings, *IEEE Trans. Biomed. Engn.*; 67(6): 1628 -1637. [[doi: 10.1109/TBME.2019.2941851](https://doi.org/10.1109/TBME.2019.2941851)]

O'Grady G, Angeli TR, Paskaranandavadivel N, **Erickson J**, Wells C, Gharibans AA, Cheng LK, and Du P. (2018) Methods for high-resolution electrical mapping in the gastrointestinal tract, *IEEE Rev. Biomed. Engn.*; 12: 287-302 [[doi: 10.1109/RBME.2018.2867555](https://doi.org/10.1109/RBME.2018.2867555)]

Erickson J, Hayes J*, Bustamanate M*, Joshi R*, Rwagaju A*, Paskaranandavadivel N, and Angeli TR. (2018) Intsy: a low-cost, open-source, wirelessly multi-channel bioamplifier system, *Physiol. Meas.*; 39: 035008. [[doi: 10.1088/1361-6579/aaad51](https://doi.org/10.1088/1361-6579/aaad51)]

Mayne T, Paskaranandavadivel N, **Erickson J**, O'Grady G, and Cheng LK. (2018) Improved visualization of gastrointestinal slow wave propagation using a novel wavefront-orientation interpolation technique, *IEEE Trans. Biomed Eng.*; 65(2):319-326. [[doi: 10.1109/TBME.2017.2764945](https://doi.org/10.1109/TBME.2017.2764945)]

O'Grady G, Paskaranandavadivel N, Du P, Angeli T, **Erickson J**, Cheng LK. (2017) Correct techniques for extracellular recordings of electrical activity in gastrointestinal muscle, *Nature Reviews – Gastroenterology and Hepatology*; 14(6): 372. [[doi: 10.1038/nrgastro.2017.15](https://doi.org/10.1038/nrgastro.2017.15)]

Wang T, Du P, Angeli TR, Paskaranandavadivel N, **Erickson J**, Abell T, Cheng LK, and O'Grady G. (2017) Relationships between gastric slow wave frequency, velocity, and extracellular amplitude studied by a joint experimental-theoretical approach, *Neurogastroenterology and Motility*; 30(1):e13152. [[doi: 10.1111/nmo.13152](https://doi.org/10.1111/nmo.13152)]

Erickson J, Putney J*, Hilbert D*, O'Grady G, Cheng LK, and Angeli TR. (2016) Iterative Covariance-based Removal of Time-Synchronous Artifacts: Application to Gastrointestinal Electrical Recordings, *IEEE Trans. Biomed. Eng.* 63(11): 2262-2272. [[doi: 10.1109/TBME.2016.2521764](https://doi.org/10.1109/TBME.2016.2521764)]

Bradshaw L, Cheng LK, Chung E, Obioha CB, **Erickson J**, Gorman BL, Somarajan S, and Richards WO. (2016) Diabetic gastroparesis alters the biomagnetic signature of the gastric slow wave. *Neurogastroenterology and Motility*; 28(6): 837-848. [[doi: 10.1111/nmo.12780](https://doi.org/10.1111/nmo.12780)]

Erickson J, Bustamante M*, Herrera M*, Shingiro A*, and Bowen T*. (2015) Effective Stimulus Parameters for Directed Locomotion in Madagascar Hissing Cockroach Biobot. *PLoS ONE* 10(8): e0134348 [[doi: 10.1371/journal.pone.0134348](https://doi.org/10.1371/journal.pone.0134348)]

Erickson J, Velasco-Castedo R*, Obioha CB, Angeli TA, Cheng LK, and O'Grady G. (2013) Automated Algorithm for GI Spike Burst Detection and Demonstration of Efficacy in Ischemic Small Intestine, *Ann. Biomed. Eng.* 41(10): 2215-2228. [[doi: 10.1007/s10439-013-0812-8](https://doi.org/10.1007/s10439-013-0812-8)]

Erickson J, Paskaranandavadivel N, and Bull S. (2013) Quantitative Analysis of Electrical Activity in the Gastrointestinal Tract, in Cheng LK, ed., *New Advances in Gastromotility Research*, Springer Science. [[doi: 10.1007/978-94-007-6561-0_5](https://doi.org/10.1007/978-94-007-6561-0_5)]

Obioha C, **Erickson J**, Suseela S, Hajri T, Chung E, Richards W, Bradshaw LA. (2013) Effect of Body Mass Index on the sensitivity of Magnetogastrogram and Electrogastrogram. *J. Gastroenterology and Hepatology Research*; 2(4): 512-518. [[doi: 10.6051/j.issn.2224-3992.2013.02.244](https://doi.org/10.6051/j.issn.2224-3992.2013.02.244)]

Angeli TR, O'Grady G, Paskaranandavadivel N, **Erickson J**, Du P, Pullan AJ, Bissett I, and Cheng LK. (2013) Experimental and Automated Techniques for High-Resolution Electrical Mapping of Small Intestine Slow Wave Activity. *J. Neurogastroenterology and Motility*, 19(2):179-191. [[doi: 10.5056/jnm.2013.19.2.179](https://doi.org/10.5056/jnm.2013.19.2.179)]

Yassi R, O'Grady G, Paskaranandavadivel N, Du P, Angeli TR, Cheng LK, and **Erickson J** (2012) The Gastric Electrical Mapping Suite (GEMS): Software for analyzing and visualizing high-resolution (multi-electrode) recordings in spatiotemporal detail. *BMC Gastroenterology* 12(60). [[doi: 10.1186/1471-230X-12-60](https://doi.org/10.1186/1471-230X-12-60)]

Erickson J, O'Grady G, Du P, Egbuji, JE, Pullan AJ, and Cheng LK. (2011) Automated Gastric low wave cycle partitioning and visualization for high-resolution activation time maps. *Ann. Biomed. Eng.* 39(1): 469-483 [[doi: 10.1007/s10439-010-0170-8](https://doi.org/10.1007/s10439-010-0170-8)]

Erickson J, O'Grady G, Du P, Obioha C, Qiao W, Richards WO, Bradshaw LA, Pullan AJ, and Cheng LK. (2010) Falling-Edge, Variable Threshold (FEVT) Method for the Automated Detection of Gastric Slow Wave Events in High-Resolution Serosal Electrode Recordings. *Ann. Biomed. Eng.* 38(4): 1511-1529 [[doi: 10.1007/s10439-009-9870-3](https://doi.org/10.1007/s10439-009-9870-3)]

Erickson J, Obioha C, Bradshaw LA., Goodale A, and Richards WO. (2009) Detection of Small Bowel Slow-Wave Frequencies From Noninvasive Biomagnetic Measurements. *IEEE Trans. Biomed. Eng.* 56(9): 2181-9. [[doi: 10.1109/TBME.2009.2024087](https://doi.org/10.1109/TBME.2009.2024087)]

Erickson J, Tooker A, Tai Y-C, and Pine J. (2008) The Neurochip: a parylene-based microdevice for non-invasive probing of cultured neural network connectivity at the single neuron level. *J. Neurosci. Meth.* 175(1): 1-16. [[doi:10.1016/j.jneumeth.2008.07.023](https://doi.org/10.1016/j.jneumeth.2008.07.023)]

SELECTED CONFERENCE PROCEEDINGS (* = Student Co-author)

Erickson J, Reed .*, Wharton J*, Thapa U*, Robey J*, Shrestha R*. (2020) Open-source 128-channel Bioamplifier Module for Ambulatory Monitoring of Gastrointestinal Electrical Activity, *Conf. Proc. IEEE-EMBS 2020*, 4429-2243.

Neely L*, Gaiennie J*, Noble N*, and **Erickson J**. (2016) Stingray-inspired robot with simply actuated intermediate motion. *Proc SPIE 9797, Bioinspiration, Biomimetics and Bioreplication*, 2016. [[doi: 10.1117/12.2219494](https://doi.org/10.1117/12.2219494)]

Putney J*, O'Grady G, Angeli TA, Paskaranandavadivel N, Cheng LK, **Erickson J**, Du P. (2015) Determining the efficient inter-electrode distance for high-resolution mapping using mathematical model of human gastric dysrhythmias. *Conf. Proc. IEEE-EMBS 2015* [[doi: 10.1109/EMBC.2015.7318642](https://doi.org/10.1109/EMBC.2015.7318642)]

Paskaranandavadivel N, Du P, **Erickson J**, O'Grady G, Cheng LK. (2015) Extending the automated gastrointestinal analysis pipeline: Removal of invalid slow wave marks in gastric serosal recordings *Conf. Proc. IEEE-EMBS* 2015. [doi: 10.1109/EMBC.2015.7318763]

Erickson J, Engel E*, Strickland K*, Wasden WA*, and Overholtzer J. (2014) Microbiological and Economic Assessment of Ceramic Pot Filters Used Long-Term in Households in San Pedro La Laguna, Guatemala. *World Environmental and Water Resources Congress 2014*: 1617-1626 [doi: 10.1061/9780784413548.160]

Erickson J. (2012) New course in bioengineering and bioinspired design. *Biomed Sci Instrum.*, 48:96-103 [PMID: 22846270]

Giampalmo S*, Absher B*, Bourne WT*, Steves L*, Vodenski V*, O'Donnell P*, and **Erickson J**. (2011) Generation of Complex Motor Patterns in American Grasshopper Via Current-Controlled Thoracic Electrical Interfacing. *Conf. Proc. IEEE-EMBS* 2011, 1275 - 1278. [doi: [10.1109/IEMBS.2011.6090300](https://doi.org/10.1109/IEMBS.2011.6090300)]

Angeli TR, O'Grady G, **Erickson J**, Du P, Paskaranandavadivel N, Bissett IP, Cheng LK, and Pullan AJ. (2011) Mapping Small Intestine Bioelectric Activity Using High-Resolution Printed Circuit-Board Electrodes. *Conf. Proc. IEEE-EMBS* 2011, 4951 – 4954. [doi:10.1109/IEMBS.2011.6091227]

Erickson J, Tooker A, Tai Y-C, and Pine J. (2008) First Network Studies with the Caged-Neuron Multielectrode Array. *Conf Proc 6th International Meeting on Substrate-Integrated Multi Electrode Arrays*. Reutlingen, Germany, July 2008, 287-289.

Erickson J, Obioha C, Goodale A, Bradshaw LA, and Richards WO. (2008) Noninvasive Detection of Small Bowel Electrical Activity from SQUID Magnetometer Measurements using SOBI. *Proc. IEEE-EMBS* 2008, Vancouver, B.C., pp 1871-1874. [doi:10.1109/IEMBS.2008.4649550]

SELECTED CONFERENCE ABSTRACTS

Colavita M*, Witherell H*, **Erickson J**, and Schreiber W. (2019) Measurement of Discrete Behaviors in Ants Using Spatially Averaged Intensity Gradients. *Society for Integrate and Comparative Biology Annual Meeting*, Tampa, FL, Jan 2019.

Calder S, **Erickson J**, O’Grady G, Cheng LK, Du P. (2018) Wave front tracking and velocity profiling of EGG signatures. *Digestive Diseases Week – international Gastrointestinal Electrophysiology Society Meeting*, Washington, DC, June 2, 2018.

Putney J*, Hayes J*, **Erickson J**, and Angeli T. (2016) The Quantification of Slow Wave Behavior after Induction of Intestinal Ischemia in a Porcine Model. *Conf. Proc. IEEE-EMBS 2016*, Orlando, FL.

Yassi R, O’Grady G, Cheng LK, and **Erickson J**. (2011) The Gastric Electrical Mapping Suite (GEMS): Software for analyzing and visualizing gastrointestinal multi-electrode recordings. *Digestive Diseases Week* (1030948), Chicago, IL, May 7 – 10 (Invited oral presentation, top 10% of abstracts)

Erickson J, O’Grady G, Du P, Pullan AJ, and Cheng LK. (2010) “Automated Event Detection and Activation Mapping for High Resolution Gastric Slow Wave Recordings.” *Digestive Diseases Week*, New Orleans, May 2010.

Goodale A, **Erickson J**, Obioha C., Irimia A, Williams B., Bradshaw LA, and Richards WO. (2008) Partial Mesenteric Ischemia Alters Biomagnetic Slow Wave. Conference Proceedings: *Digestive Diseases Week*, San Diego, 2008 (W1289).

UNDERGRADUATE SUMMER RESEARCH MENTORSHIP (selected projects)

Summer 2020: *On the outside looking in: automated method for tracking propagating wavefronts in the distal colon.* (Emily Hassid ’22, Lauren Shelby ’23, Elen Stepanyan ’22, and Jeremy Wharton ’23)

Summer 2019: *Mapping cyclic contractions of the colon with high spatial density.* (Beth Reed, ’22, Jack Robey ’20, Riwanj Shrestha ’22, Utkrist Thapa ’21, and Jeremy Wharton ’23)

Summer 2018: *Electrocolonography: body surface recordings detect underlying contractions of the colon in meal response study* (Laura Bruce’20, Andrew Taylor ’20, Jack Richman ’20, Connor Higgins ’20, and Nicole Chin ’22)

Summer 2017: *Quantifying and characterizing spike burst activity in ischemic small intestine.* (Alfred Rwagaju ’18)

Summer 2016: *In vivo assessment and quantification of new electronics module for measuring gastrointestinal slow waves.* (Jamie Hayes ’17)

Summer 2015: *Non-invasive, Low-Cost, Wireless Electronics for Detecting Gastrointestinal Slow Waves* (Jamie Hayes ’17, Alfred Rwagaju ’18, and Rajwol Joshi ’18)