

Curriculum Vitae

Associate Professor Ross M. Walker

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Contact Information

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Education

- **Stanford University**, Department of Electrical Engineering, 2005 – 2013
Ph.D. Electrical Engineering, conferred September 2013
Thesis: [Interface Electronics for Emerging Sensor Systems](#)
Adviser: Prof. Boris Murmann
Co-advisers: Krishna V. Shenoy, Kofi A. A. Makinwa, Roger T. Howe, Teresa H. Meng
M.S. Electrical Engineering, conferred June 2007
- **University of Arizona**, Depts. of Electrical Engineering and Computer Science, 2001 – 2005
B.S. Electrical Engineering with Honors Summa Cum Laude, conferred August 2005
B.S. Computer Science Summa Cum Laude, conferred August 2005

Research Overview

My research revolves around sensing systems, with a particular focus on implantable devices and biomedical applications. My group is working to advance knowledge in the areas of electronic circuit and system design, data readout and processing, integrated device design, and in vivo device characterization. Our extensive work on neural interface technology is relevant to experimental neuroscience, brain machine interfacing, neuromodulation, neural prosthetics, medical diagnostics, and disease state monitoring. A core theme of our work is holistic, system-aware design drawing from subjects such as mixed signal integrated circuits, instrumentation and measurement methodology, embedded systems, sensor and device physics, and signal processing.

Employment

1. **Associate Professor**, 2019 – current
University of Utah, Department of Electrical and Computer Engineering, Salt Lake City, UT
Research and teaching and related to mixed-signal sensor interface electronics and sensor systems
2. **Assistant Professor**, 2013 – 2019
University of Utah, Department of Electrical and Computer Engineering, Salt Lake City, UT
Research and teaching and related to mixed-signal sensor interface electronics and sensor systems
3. **Graduate Research Assistant**, 2007 – 2013
Stanford University, Department of Electrical Engineering, Palo Alto, CA
Researched interface electronics for emerging sensor systems
4. **Mixed-Signal Integrated Circuit Design Intern**, June 2006 – August 2006
Linear Technology, Milpitas, CA
Designed and tested electronics for data conversion products
5. **Power Management Applications Engineering Intern**, June 2004 – August 2004
National Semiconductor Corporation (now Texas Instruments), Tucson, AZ
Tested and characterized electronics for switch mode power conversion products

6. **Logic Design Intern**, June 2003 – June 2004
International Business Machines (IBM), Tucson, AZ
Developed and supported Enterprise Storage Server products

Honors, Awards, and Memberships

1. 2020 Outstanding Service Award, Dept. of Electrical and Computer Eng., University of Utah
2. 2018 Top 15% Teachers Award, College of Engineering, University of Utah
3. 2017 Outstanding Teaching Award, Dept. of Electrical and Computer Eng., University of Utah
4. 2015 Top 15% Teachers Award, College of Engineering, University of Utah
5. 2010 – 2011 Achievement Awards for College Scientists (ARCS) Graduate Fellowship
6. 2009 Analog Devices Outstanding Designer Award, ISSCC
7. 2005 Electrical Engineering Outstanding Senior Award, University of Arizona
8. 2005 International Engineering Consortium Academic Excellence Award
9. 2004 – 2005 ISS Undergraduate Scholarship
10. 2003 – 2004 Clarence P. Wilson Scholarship
11. Member of the Tau Beta Pi engineering honor society, 2002 – present
12. Member IEEE, 2014 – present
13. Student Member IEEE, 2004 – 2013

Journal Publications

1. M. Sharma, H.J. Strathman, R.M. Walker, “Verification of a rapidly multiplexed circuit for scalable action potential recording,” *IEEE Transactions on Biomedical Circuits and Systems (TBCAS)*, vol. 13, no. 6, pp. 1655-1663, 2019.
2. S. Fischer, D. Muratore, S. Weinreich, A. Peña-Perez, R.M. Walker, C. Gupta, R.T. Howe, B. Murmann, “Low-noise integrated potentiostat for affinity-free protein detection with 12 nV/rt-Hz at 30 Hz and 1.8 pA_{rms} resolution,” *IEEE Solid-State Circuits Letters (SSCL)*, vol. 2, no. 6, pp. 41-44, 2019.
3. A. Nag, A. Shafiee, R. Balasubramonian, V. Srikumar, R. Walker, J.P. Strachan, N. Muralimanohar, “Newton: Gravitating towards the physical limits of crossbar acceleration,” *IEEE Micro*, vol. 38, no. 5, pp. 41-49, 2018.
4. M. Sharma, A.T. Gardner, H.J. Strathman, D.J. Warren, J. Silver, R.M. Walker, “Acquisition of neural action potentials using rapid multiplexing directly at the electrodes,” *Micromachines*, vol. 9, no. 10, 2018, PMID 30424410. *Invited Paper, Featured Paper*
5. A.T. Gardner, H.J. Strathman, D.J. Warren, R.M. Walker, “Impedance and noise characterizations of Utah and microwire electrode arrays,” *IEEE Journal of Electromagnetics, RF, and Microwaves in Medicine and Biology*, vol. 2, no. 3, pp. 1-8, 2018.
6. C. Gupta, R. M. Walker, S. Chang, S. R. Fischer, M. Seal, B. Murmann, R. T. Howe, “Quantum tunneling currents in a nanoengineered electrochemical system,” *The Journal of Physical Chemistry C*, vol. 121, pp. 15085–15105, 2017.
7. J.D. Foster, P. Nuyujukian, O. Freifeld, H. Gao, R. Walker, S.I. Ryu, T.H. Meng, B. Murmann, M.J. Black, & K.V. Shenoy, “A freely-moving monkey treadmill model,” *Journal of Neural Engineering*, vol. 11, no. 4, pp. 046020 (14pp.), 2014, PMID 24995476.
8. H. Gao, R.M. Walker, P. Nuyujukian, K.A.A. Makinwa, K.V. Shenoy, B. Murmann, and T.H. Meng, “HermesE: A 96-channel full data rate direct neural interface in 0.13 μ m CMOS,” *IEEE Journal of Solid-State Circuits*, vol. 47, no. 4, pp. 1043-1055, 2012.
9. E.M. Kanter, R.M. Walker, S.L. Marion, M. Brewer, P.B. Hoyer, J.K. Barton, “Dual modality imaging of a novel rat model of ovarian carcinogenesis,” *Journal of Biomedical Optics*, vol. 11, no. 4, pp. 41123-1-10, 2006, PMID 16965151.

Conference Publications

1. A.T. Gardner, H.J. Strathman, R.M. Walker, "A multiplexed electrochemical measurement system for characterization of implanted electrodes," *IEEE International Symposium on Circuits and Systems (ISCAS)*, pp. 1-5, 2020. Oral Presentation, Invited Paper
2. N. Tasneem, T. Ahmed, R.M. Walker, "Design of a 180 nm CMOS transceiver for implantable wire-line communication, achieving 800 Mbps at BER<1e-12 with 22.4 dB of channel loss," *IEEE Midwest Symposium on Circuits and Systems (MWSCAS)*, pp. 1155-1158, 2019. Oral Presentation, Invited Paper
3. T. Ahmed, N. Tasneem, R.M. Walker, "High-speed communication up to 600 Mbps over FDA-cleared implantable wirelines," *IEEE Biomedical Circuits and Systems Conference (BioCAS)*, pp. 1-4, 2018.
4. J. Liu, R.M. Walker, "A compact, low-noise, chopped front-end for peripheral nerve recording in 180 nm CMOS," *IEEE Biomedical Circuits and Systems Conference (BioCAS)*, pp. 1-4, 2018.
5. A.T. Gardner, H.J. Strathman, D.J. Warren, R.M. Walker, "Signal and noise sources from microwire arrays implanted in rodent cortex," *IEEE Life Sciences Conference*, pp. 97-100, 2018. Oral Presentation
6. A.T. Gardner, J. Mize, D.J. Warren, R.M. Walker, "Comparative characterization of in vivo and in vitro noise of the SIROF Utah Electrode Array," *IEEE SENSORS*, pp. 1-3, 2017.
7. T. Ahmed, N. Tasneem, R.M. Walker, "Feedforward-equalized communication link for implantable systems achieving 400 Mbps," *Biomedical Engineering Society Annual Meeting (BMES)*, 2017. Oral Presentation
8. R.M. Walker, I.S. Subramanian, A.A. Bajwa, L. Rieth, J. Silver, T. Ahmed, N. Tasneem, M. Sharma, A.T. Gardner, "Integrated neural interfaces," *IEEE Midwest Symposium on Circuits and Systems (MWSCAS)*, pp. 1045-1048, 2017. Oral Presentation, Invited Paper
9. N. Tasneem, T. Ahmed and R.M. Walker, "Wireline communication over an implantable lead," *IEEE EMBS Conference on Biomedical Engineering and Sciences (IECBES)*, pp. 321-325, 2016. Oral Presentation
10. M. Sharma, A.T. Gardner, J. Silver and R.M. Walker, "Noise and impedance of the SIROF Utah Electrode Array," *IEEE SENSORS*, pp. 1-3, 2016.
11. P.E. Gaillardon, R. Magni, L. Amaru, M. Hasan, R. Walker, B.S. Rodriguez, J.F. Christmann, E. Beigne, "Three-Independent-Gate Transistors: Opportunities in digital, analog and RF applications," *Latin-American Test Symposium (LATS)*, pp. 195-200, 2016. Oral Presentation
12. P.E. Gaillardon, M. Hasan, A. Saha, L. Amarú, R. Walker and B.S. Rodriguez, "Digital, analog and RF design opportunities of three-independent-gate transistors," *IEEE International Symposium on Circuits and Systems (ISCAS)*, pp. 405-408, 2016. Oral Presentation, Invited Paper
13. C. Gupta, R.M. Walker, R. Gharpuray, M. Shulaker, Z. Zhang, M. Javanmard, R.W. Davis, B. Murmann, R.T. Howe, "Electrochemical quantum tunneling for electronic detection and characterization of biological toxins," *Proc. of SPIE: Micro- and Nanotechnology Sensors, Systems, and Applications*, vol. 8373, no. 4, pp. 837303-1-837303-14, 2012. Oral Presentation, Invited Paper
14. R.M. Walker, H. Gao, P. Nuyujukian, K.A.A. Makinwa, K.V. Shenoy, T.H. Meng, B. Murmann, "A 96-channel full data rate direct neural interface in 0.13 μ m CMOS," *2011 Symposium on VLSI Circuits*, pp.144-145, 2011. Oral Presentation
15. E. Kanter, R. Walker, S. Marion, P.H. Hoyer, and J.K. Barton, "Use of multiple imaging modalities to detect ovarian cancer," *Proc. of SPIE: Photonic Therapeutics and Diagnostics*, vol. 5686, pp. 596-605, 2005. Oral Presentation

Invited Talks

1. **Analog Front-Ends for Large Scale Neural Recording**, 3/22/2020
Educational Session, 2020 IEEE Custom Integrated Circuits Conference (CICC), Boston, MA, USA.
2. **Strategies for Scaling Neural Interface Recording and Stimulation Systems**, 06/25/2018
2018 Neural Interfaces Conference (NIC), Minneapolis, Minnesota, USA.
3. **Direct Neural Interfaces for Medical and Non-Medical Applications**, 05/10/2018
2018 Emerging Technologies Conference (ET CMOS), Whistler, BC, CA.
4. **Integrated Neural Interfaces**, 08/09/2017
2017 Midwest Symposium on Circuits and Systems (MWSCAS), Boston, Massachusetts, USA.
5. **Neural Interface Circuits and Systems**, 05/28/2017
Half Day Tutorial, 2017 IEEE International Symposium on Circuits and Systems (ISCAS), Baltimore, Maryland, USA.
6. **Design of Reliable Neural Interfaces**, 12/14/2016
2016 Annual BRAIN Initiative Principal Investigators Meeting, Bethesda, Maryland, USA.
7. **Rapid Electrode Multiplexing for Scalable Neural Recording**, 12/11/2016
2016 Annual BRAIN Initiative Principal Investigators NIH pre-meeting, Bethesda, Maryland, USA.
8. **Physiological Sensor Systems**, 09/20/2016
Physiologically Aware Virtual Agents Workshop, 2016 Intelligent Virtual Agents Conference (IVA), Los Angeles, CA, USA.
9. **Integrated Neural Interfaces**, 06/30/2016
Army Research Laboratories, Adelphi, Maryland, USA.
10. **Integrated Neural Interfaces**, 05/19/2016
Stanford System-X Seminar Series, Stanford University, Stanford, CA, USA.
11. **Breakthroughs in Analog and RF Circuit Performance through Steep-Slope FinFETs**, 03/17/2016
2016 GOMACTech Conference, Orlando, FL, USA.
12. **Front-End ASIC Design for the HermesE/F Wireless Neural Interface Systems**, 03/06/2013
1st Bernstein Sparks Workshop: "Towards Long-Term Cortical Neuro-Interfaces"
Hanse-Wissenschaftskolleg, Institute for Advanced Study, Delmenhorst, Germany.

Active Grants and Awards

Deep Integration of Thin Flexible Microsystems for Vision Correction

National Science Foundation (NSF): #1932602, 12/01/2019 – 11/30/2022

This project seeks to address vision loss in the aging population by creating smart contact lenses that correct refractive errors in the human eye. My role is to direct research on the electronic circuits and system components of the smart contact lenses. Role: co-PI

Massively Multiplexed Gold Microprobe Arrays for Whole-Mouse-Brain Recording

National Institutes of Health (NEI): R21EY030710, 08/01/2019 – 07/31/2021

This project will develop new device concepts to enable ultra-large-scale intracortical electrode arrays, which can measure neural signals with high resolution but also over large areas of the brain. My role is to lead the development of electronic circuits and systems, and supervise in vivo experiments. Role: co-PI

Completed Grants and Awards

Rapid Electrode Multiplexing for Scalable Neural Recording

National Institutes of Health (NIH): R21EY027618, 09/30/2016 – 07/31/2019

This project generated the first demonstration of rapidly multiplexed neural recording, directly at the electrodes, without preamplification or buffering. I directed the overall project including electrode characterization, CMOS integrated circuit design, and in vivo verification. Role: PI

EAGER: Ultra-High-Performance Terahertz Detection Exploiting Super-Steep-Subthreshold-Slope (S₄) – FinFETs

National Science Foundation (NSF): #1644592, 08/15/2016 – 06/31/2018

This project executed preliminary research to enable the use of novel nanoscale transistors (S₄-FinFETs) for ultrasensitive terahertz electromagnetic detection. I led efforts to characterize the S₄-FinFET devices in order to understand their noise performance. Role: co-PI

A Wireline-Deployed Tool for Monitoring Fluid Flow within an EGS Borehole

Department of Energy (DoE), SBIR: #DE-SC0010132, 06/22/2015 – 07/27/2016

This grant supported development of a fluid flow sensor package for geothermal wells, in collaboration with a local University of Utah startup company (FluidTracer). My role was supervision of the design and testing of custom electronics. Role: co-PI

Other Research

1. **Academic Consultant Residency**, summer 2016
Army Research Labs West, Playa Vista, CA.
Researched opportunities for sensor system projects at the new ARL-West facility
2. **Rotating Student**, Spring 2007
Prof. Kwabena Boahen's Neuromorphic Circuit Design Lab, Stanford University, Palo Alto, CA
Researched neuromorphic hardware architectures for flexor/extensor muscle pair control
3. **Undergraduate Research Assistant**, 2004 – 2005
Prof. Jennifer Barton's Biomedical Optics Lab, University of Arizona, Tucson, AZ
Designed electronics for optical coherence microscopy (OCM) and tomography (OCT) imaging

Teaching

University of Utah

1. **Instructor**, ECE 6725, Advanced Analog Integrated Circuit Design, Spring 2020
2. **Instructor**, ECE 6720, Fundamentals of Analog Integrated Circuit Design, Fall 2019
3. **Instructor**, ECE 3110, Engineering Electronics II, Spring 2019
4. **Instructor**, ECE 6720, Fundamentals of Analog Integrated Circuit Design, Fall 2018
5. **Instructor**, ECE 6725, Advanced Analog Integrated Circuit Design, Spring 2018
6. **Instructor**, ECE 6720, Fundamentals of Analog Integrated Circuit Design, Fall 2017
7. **Instructor**, ECE 6725, Advanced Analog Integrated Circuit Design, Spring 2017
8. **Instructor**, ECE 6720, Fundamentals of Analog Integrated Circuit Design, Fall 2016
9. **Instructor**, ECE 6720, Analog IC Design, Spring 2016
10. **Instructor**, ECE 6960-008, Analog IC Design in VLSI Environments, Fall 2015
11. **Instructor**, ECE 6720, Analog IC Design, Spring 2015
12. **Instructor**, ECE 6960-008, Analog IC Design in VLSI Environments, Fall 2014

Stanford University

13. **Guest Lecturer**, EE315A VLSI Signal Conditioning Circuits, Spring 2012
14. **Course Instructor**, EE315A VLSI Signal Conditioning Circuits, Spring 2011
Co-taught with Prof. Boris Murmann
15. **Guest Lecturer**, EE315A VLSI Signal Conditioning Circuits, Spring 2010
16. **Teaching Assistant**, EE315A VLSI Signal Conditioning Circuits, 1st offering Spring 2009
17. **Teaching Assistant**, EE214 Analog Integrated Circuit Design, Autumn 2007
EE214 was later reorganized into 214A, 214B, and 315A

Undergraduate Advising

1. **Faculty Mentor**, Univ. of Utah Undergraduate Research Opportunities Program (UROP), 2020

- Supervised an ECE student, Multiplexed Electrochemical Characterization of Neural Microelectrodes
2. **Faculty Mentor**, Univ. of Utah Undergraduate Research Opportunities Program (UROP), 2017
Supervised an ECE student, Automated Microelectrode Array Characterization
 3. **Faculty Mentor**, Univ. of Utah Senior Capstone Project, 2016 – 2017
Supervised two individual ECE student projects, Experiments in Audio Design
Electrical Engineering Award Winner
Supervised two ECE students, 3-Dimensional Test Fixture for Neural Recording in Rats
 4. **Faculty Mentor**, Univ. of Utah Senior Capstone Project, 2014 – 2015
Supervised a group of five ECE students, Wireless Hand-Held Neural Stimulator Device
Industry sponsor: Dr. John Cadwell, Cadwell Laboratories
 5. **Interviewer**, ECE outgoing senior interviews, 2014

Service Activity

IEEE Society Governance

1. **Board Member**, IEEE Circuits and Systems Society (CASS) Board of Governors, 2019 – present
2. **Treasurer**, IEEE Solid State Circuits Society (SSCS) Utah Section, 2019 – present
3. **Chair**, IEEE Solid State Circuits Society (SSCS) Utah Section, 2017 – 2019
4. **Technical Committee Member**, IEEE Biomed. & Life Science Circuits and Systems, 2016 – present
5. **Vice Chair**, IEEE Solid State Circuits Society (SSCS) Utah Section, 2016 – 2017

Conference Service

1. **Technical Program Committee Member**
2021 IEEE International Symposium on Circuits and Systems (ISCAS), Daegu.
2020 IFIP/IEEE International Conference on Very Large Scale Integration (VLSI-SoC), Singapore.
2020 IEEE International Conference on Electronics Circuits and Systems (ICECS), Glasgow.
2019 IEEE International Conference on Electronics Circuits and Systems (ICECS), Genova.
2018 IEEE International Conference on Electronics Circuits and Systems (ICECS), Bordeaux.
2. **Local Co-Chair and Technical Program Committee Member**
2020 IFIP/IEEE International Conference on Very Large Scale Integration (VLSI-SoC), Salt Lake.
3. **Panel Moderator and Plenary Session Chair**
Strategies for Scaling Neural Interface Recording and Stimulation Systems
2018 Neural Interfaces Conference (NIC), Minneapolis, Minnesota, USA.
4. **Session Chair**
IEEE CASS Student Design Competition International Finals
2020 IEEE International Symposium on Circuits and Systems (ISCAS), Seville.
Innovative NeuroTechnologies: Conveying Sensible Innovation For Health & Well-Being
2020 IEEE International Symposium on Circuits and Systems (ISCAS), Seville.
Lab-On-Chip & Point-Of-Care For Biomedical Diagnostics
2020 IEEE International Symposium on Circuits and Systems (ISCAS), Seville.
Biotechnology and Biomedical Technologies
2018 Emerging Technologies Conference (ET CMOS), Whistler.
Biosignal Amplifiers
2017 IEEE International Symposium on Circuits and Systems (ISCAS), Baltimore.

University of Utah

1. **Committee Chair**, ECE Undergraduate Committee, 2019 – present
2. **Committee Member**, ECE Faculty Awards Committee, 2019
3. **Committee Member**, Faculty Committee on Community and Government Relations, 2016
4. **Committee Member**, Senate Consolidated Hearing Committee, 2017 – present
5. **Committee Member**, Senate Advisory Committee on Information Technology, 2016 – 2018
6. **Committee Member**, ECE Faculty Search Committee, 2014 – 2016

7. **Committee Member**, CoE Academic Misconduct Committee, 2014 – 2015
8. **Lab Director**, Electrical Characterization Lab, 2013 – present
9. **Judge**, Electrical and Computer Engineering Senior Capstone Projects, 2014, 2017
10. **Interviewer**, Electrical and Computer Engineering Outgoing Senior Interviews, 2014, 2017
11. **Seminar Speaker**
 - Freshman Orientation Faculty Panel, College of Engineering, 2018, 2019
 - Engineering Day Workshops for Prospective Undergrads, College of Engineering, Summer 2017
 - Sophomore Seminar, Electrical and Computer Engineering, Spring 2015, Fall 2015, Fall 2016
 - Computer Engineering Junior Seminar, Electrical and Computer Engineering, Fall 2014
 - Graduate Seminar, Electrical and Computer Engineering, Fall 2013, Fall 2014

Local Community

1. **Judge and Student Mentor**, University of Utah Science and Engineering Fair, 2016, 2017

Review Activity

1. **Review committee member**, IEEE Biomedical Circuits and Systems Conference (BioCAS) 2017, 2018, 2019
2. **Review committee member**, IEEE International Symposium on Circuits and Systems (ISCAS) 2017, 2018, 2019, 2020
3. **Reviewer**, IEEE Transactions on Biomedical Systems (TBCAS)
4. **Reviewer**, IEEE Transactions on Circuits and Systems (TCAS)
5. **Reviewer**, IEEE Journal of Solid State Circuits (JSSC)
6. **Reviewer**, IEEE Transactions on Circuits and Systems (TCAS)
7. **Reviewer**, IEEE Transactions on Very Large Scale Integration (TVLSI)
8. **Reviewer**, IEEE Transactions on Nanotechnology (TNANO)
9. **Reviewer**, IEEE Open Journal of Circuits and Systems (OJCAS)
10. **Reviewer**, Multidisciplinary Digital Publishing Institute Sensors Journal
11. **Reviewer**, Multidisciplinary Digital Publishing Institute Energies Journal
12. **Reviewer**, Multidisciplinary Digital Publishing Institute Micromachines Journal
13. **Reviewer**, IET Electronics Letters (EL)
14. **Reviewer**, Nature Neuroscience
15. **Reviewer**, Journal of Neuroscience Methods
16. **Reviewer**, IEEE Electron Device Letters (EDL)
17. **Reviewer**, International Business Machines (IBM) Journal of Research and Development
18. **Reviewer**, IEEE Biomedical Circuits and Systems Conference (BioCAS)
19. **Reviewer**, IEEE International Midwest Symposium on Circuits and Systems (MWSCAS)
20. **Reviewer**, IEEE International Symposium on Circuits and Systems (ISCAS)
21. **Reviewer**, IEEE Sensors Conference (SENSORS)