Reid R. Harrison

President and Co-Founder

Intan Technologies, LLC *http://www.intantech.com*
8726 S. Sepulveda Blvd., Suite D2121
Los Angeles, CA 90045 USA

EDUCATION

Ph.D., Computation and Neural Systems, with additional study in **Electrical Engineering** 2000
California Institute of Technology – Pasadena, CA

B.S. with honors, Electrical Engineering 1994
University of Florida – Gainesville, FL

PROFESSIONAL EXPERIENCE

President and Co-Founder, *Intan Technologies, LLC,* Los Angeles, CA 2003 – present
http://www.intantech.com

Associate Professor, *University of Utah,* Salt Lake City, UT 2006 – 2010
Electrical & Computer Engineering Department

Adjunct Associate Professor, *University of Utah,* Salt Lake City, UT 2006 – 2010
Bioengineering Department

Visiting Associate Professor, *Stanford University,* Palo Alto, CA 2007 – 2008
Electrical Engineering Department

Assistant Professor, *University of Utah,* Salt Lake City, UT 2000 – 2006
Electrical & Computer Engineering Department

Adjunct Assistant Professor, *University of Utah,* Salt Lake City, UT 2000 – 2006
Bioengineering Department

Doctoral Research Assistant, *California Institute of Technology,* Pasadena, CA 1995 – 2000
Advisor: Prof. Christof Koch

Graduate Research Assistant, *Los Alamos National Laboratory,* Los Alamos, NM 1995
Biophysics Group – Magnetoencephalographic (MEG) studies of human visual cortex

Academic Research Assistant, *Jet Propulsion Laboratory,* Pasadena, CA 1994
Rover Technology Group – Mars Pathfinder Mission / Sojourner Rover

RESEARCH INTERESTS

- Analog and mixed-signal integrated circuit design and testing
- Low-power, low-noise integrated microelectronics for biomedical and neuroscience applications

- Microelectronics for wireless multi-unit neural recording and stimulation
- Micropower CMOS design using MOS transistors operating in moderate and weak inversion

AWARDS

- Anderson Scholar of Highest Distinction, University of Florida 1992
- Electric 'E' Award, University of Florida 1994
- National Science Foundation (NSF) Graduate Fellowship [declined] 1995
- National Defense Science and Engineering Graduate (NDSEG) Fellowship 1995 – 1998
- National Science Foundation CAREER Award 2002 – 2007
- University of Utah College of Engineering Outstanding Teaching Award 2006
- Jack Raper Award for Outstanding Technology Directions Paper, ISSCC 2006 2007
- Special-Topic Session Award for Organizing "Implantable and Prosthetic Devices", ISSCC 2007 2008

ACADEMIC FUNDING HISTORY

- B. Webb, R.R. Harrison (co-PI), "Combining sensorimotor systems: robot modelling of insect optomotor and phonotactic control," May 1999 – April 2000, **Gatsby Foundation,** £10,000 (approximately $18,000).
- C.J. Myers, C. Schlegel (co-PI), R.R. Harrison (co-PI), "Design Methodology for Mixed Analog/Asynchronous VLSI Implementations of Communication Systems," September 1999 – August 2002, **National Science Foundation**, $300,000; REU supplement $5,000.
- R.R. Harrison, "CAREER: Low-Power VLSI Circuits for Large-Scale Neuronal Recording," May 2002 – April 2007, **National Science Foundation**, $375,000.
- R.R. Harrison, "Development of a Biologically-Inspired Algorithm for Moving Target Detection," November 2002 – April 2004, **Naval Air Warfare Center**, $17,200.
- R.R. Harrison, S. Blair, M. Miller, V.J. Mathews, "Microelectronic Device Characterization Advanced Teaching Lab," 2002, **Micron Foundation,** $100,000.
- R.R. Harrison, "Microelectronic Device Characterization Advanced Teaching Lab," 2002, **University of Utah Base Engineering Equipment Fund (BEEF),** $66,000.
- R.R. Harrison, Donation of over 350 custom-designed 0.5-µm microchips for a new graduate-level Analog Integrated Circuits Laboratory class, **AMI Semiconductor, Inc.** (Gift), 2002, valued at $34,500.
- R.R. Harrison, S. Guillory (co-PI), "STTR Phase I: Low-Power VLSI Circuits for Large-Scale Neuronal Recording," **National Science Foundation** through Bionic Technologies, LLC, July 2002 – June 2003, $55,800 to University of Utah.
- R. Beer, M. Branicky (co-PI), H. Chiel (co-PI), R.R. Harrison (co-PI), "BITS: Reconfigurable and Multifunction Behavioral Pattern Generators," **National Science Foundation** through Case Western Reserve University, September 2002 – August 2005, $135,500 to University of Utah.
- R.R. Harrison, "Analog Integrated Circuits Program Development," **Micron Technology, Inc.** (Gift), 2003, $2,000.
- C. Furse, R.R. Harrison (co-PI), B. Farhang-Boroujeny (co-PI), "Sensors for Critical Fault Location for Aging Wire Networks," September 2003 – August 2006, **National Science Foundation**, $420,000.
- F. Solzbacher, R.R. Harrison (co-PI), R.A. Normann (co-PI), "Chronic Microelectrode Recording Arrays," September 2004 – August 2009, **National Institutes of Health**, $2,906,000.

- G. Clark, R.A. Normann (co-PI), F. Solzbacker (co-PI), P. Tresco (co-PI), R.R. Harrison (co-PI), D. Hutchinson, "Revolutionizing Prosthetics," February 2006 – October 2009, **DARPA,** $10,200,000.
- R.R. Harrison, F. Gabbiani (co-PI), "Wireless Telemetry of In-Flight Collision Avoidance Neural Signals in Insects," July 2007 – June 2010, **Air Force Research Laboratory,** $325,000.
- F. Solzbacher, R.R. Harrison (co-PI), R. Normann (co-PI), G. Clark (co-PI), and B. Greger (co-PI), "Next generation wireless neural interfaces for chronic and acute applications," August 2009 – July 2011, **National Institutes of Health,** $2,865,000.

GRADUATE STUDENTS ADVISED (UNIVERSITY OF UTAH, 2000-2010)

- Ph.D. – Shuhuan Yu, *Design and Test of Error Control Decoder in Analog CMOS*, 2004
  (currently with **Luxtera**, Carlsbad, CA)
- Ph.D. – Chirag Sharma, *Low-Power CMOS Sensor for Detecting Faults in Aircraft Wiring,* 2008
  (currently a **professor at Nitte Meenakshi Institute of Technology**, Bangalore, India)
- Ph.D. – Brandon Thurgood, *A Wireless Integrated Circuit for 100-Channel Constant Current Charge-Balanced Neural Stimulation,* 2010
  (currently with **ON Semiconductor**, American Fork, UT)
- Ph.D. – Ryan Kier, *Low Power PLL Building Blocks,* 2010
  (currently with **SiFlare**, Sandy, UT)
- M.S. – Anand Gopalan, *A CMOS Imager with On-Chip Temporal Filtering for Motion Pre-Processing*, 2002
  (currently with **Texas Instruments**, Dallas, TX)
- M.S. – James Bergstrom, *A Digital Analysis and Implementation of a Biologically-Inspired Motion Detection Algorithm*, 2003
  (currently with **Sandia National Laboratories**, Livermore, CA)
- M.S. – Cameron Charles, *Electrical Components for a Fully Implantable Neural Recording System*, 2003
  (currently with **Synapse**, Seattle, WA)
- M.S. – Ryan Kier, *Design of Pattern Generators in Analog Integrated Circuits*, 2004
  (currently with **SiFlare**, Sandy, UT)
- M.S. – Nathan Neihart, *Circuits for Transcutaneous Power and Data Transfer*, 2004
  (currently an **assistant professor at Iowa State University**, Ames, IA)
- M.S. – Robert Lovejoy, *Low-Power Successive Approximation Analog-to-Digital Converters for Integrated Neural Interface Systems*, 2005
  (currently with **Sandia National Laboratories**, Albuquerque, NM)
- M.S. – Daniel Black, *A Power, Clock, and Data Recovery System for Fully-Implantable Neural Recording Devices*, 2006
  (currently with **St. Jude Medical**, Dallas, TX)
- M.S. – Keith Tracey, *A Charge-Balanced Current Driver and Electrode Characterization for an Implantable Neural Stimulator*, 2007
  (currently with **Sandia National Laboratories**, Albuquerque, NM)
- M.S. – Grant Anderson, *Integrated Low Noise, Low Power Amplifiers and Control for the Recording of Electro-corticograms*, 2009
  (currently pursuing a Ph.D. at the **Massachusetts Institute of Technology**, Cambridge, MA)
- M.S. – Patrick Griffin, *Design of Buck Switching Regulators with Integrated Filter for Low Power Integrated Circuits,* 2010
  (currently with **Hill Air Force Base**, Ogden, UT)

COURSES TAUGHT (UNIVERSITY OF UTAH, 2000-2010)

- ECE 3110 – Engineering Electronics II, Fall 2000*, 2001, 2002, 2003*, 2004, 2006, 2009*
- ECE 6722 – Analog Integrated Circuits Testing, Fall 2003, 2004*, 2005*, 2006, 2008, 2009* (*Developed course*)
- ECE 6721 – Analog Integrated Circuits Laboratory, Spring 2003, 2004, 2005, 2006, 2007*, 2009, 2010 (*Developed course*)
- ECE/CS 5720/6720 – Analog Integrated Circuit Design, Spring 2002*, 2003*, 2004, 2005*, 2006, 2007*, 2009*, 2010*
- ECE 7950 – RF Integrated Circuit Design, Fall 2004 (*Developed course*)
- ECE 6961-004 – Integrated Circuit Projects, Fall 2000*, Spring 2001
- ECE 6961-009 – Low Power Circuit Design, Spring 2001 (*Developed course*)
- ECE 6961-001 – Bio-Inspired Sensors Seminar, Fall 2003* (*Developed course*)

* Rated top 15% instructor in the University of Utah College of Engineering by student evaluations

CONFERENCE AND WORKSHOP ORGANIZATION / REVIEWING

- Technical Staff, NSF Workshop on Neuromorphic Engineering, Telluride, Colorado, 1997-1999.
- Reviewer, IEEE International Symposium on Circuits and Systems (ISCAS) 2000-2010.
- Reviewer, IEEE International Solid-State Circuits Conference (ISSCC), 2007-2009.
- Reviewer, IEEE Biomedical Circuits and Systems Conference (BioCAS) 2007-2009.
- Program committee, ARVLSI 2001: 19th Conference on Advanced Research in VLSI.
- Publicity chair, ASYNC 2001: Seventh International Symposium on Asynchronous Circuits and Systems.
- Publicity chair, ARVLSI 2001: 19th Conference on Advanced Research in VLSI.
- Organizer, IEEE SSCTC Workshop on Low-Power Circuit Design, Arlington, VA, October 11-12, 2001.
- Co-Organizer, Integrated Neural Interfaces special session; IEEE International Symposium on Circuits and Systems (ISCAS) 2006.
- Organizer, Implantable and Prosthetic Devices special technical session; IEEE International Solid-State Circuits Conference (ISSCC) 2007.
- Reviewer, IEEE International Midwest Symposium on Circuits and Systems (MWSCAS/NEWCAS) 2007.
- Co-Organizer, Integrated Neural Implants special session; IEEE International Symposium on Circuits and Systems (ISCAS) 2007
- Organizer, Integrated Neural Interfaces forum; IEEE International Solid-State Circuits Conference (ISSCC) 2009.
- Member, Technical Subcommittee for Imagers, MEMS, Medical and Display; IEEE International Solid-State Circuits Conference (ISSCC), 2006 – 2009.
- Member, Biomedical Circuits and Systems Technical Committee; IEEE International Symposium on Circuits and Systems (ISCAS), 2006 – 2010.

JOURNAL REVIEWING

- IEEE Journal of Solid-State Circuits
- IEEE Transactions on Circuits and Systems – I
- IEEE Transactions on Circuits and Systems – II
- IEEE Transactions on Biomedical Circuits and Systems
- IEEE Transactions on Biomedical Engineering
- IEEE Transactions on Neural Systems and Rehabilitation Engineering
- IEEE Transactions on Neural Networks
- IEEE Transactions on VLSI
- IEEE Transactions on Systems, Man, and Cybernetics, Part B
- Microelectronics Journal
- Journal of Neuroscience Methods
- Frontiers in Integrative Neuroscience
- Electronics Letters
- Biological Cybernetics
- Integration – The VLSI Journal
- The Biological Bulletin
- International Journal of Computer Vision

PROFESSIONAL MEMBERSHIP

- IEEE Solid State Circuits Society
- IEEE Circuits and Systems Society
- IEEE Engineering in Medicine and Biology Society
- Society for Neuroscience

PUBLICATIONS

JOURNAL ARTICLES

1. L. Matthies, E. Gat, R. Harrison, B. Wilcox, R. Volpe, and T. Litwin, "Mars microrover navigation: performance evaluation and enhancement," *Autonomous Robots* **2:**291-311, 1995.
2. H.W. Chen, C.J. Aine, E. Best, D. Ranken, R.R. Harrison, E.R. Flynn, and C.C. Wood, "Nonlinear analysis of biological systems using short m-sequences and sparse-stimulation techniques," *Annals of Biomedical Engineering* **24:**513-536, 1996.
3. R.R. Harrison and C. Koch, "A robust analog VLSI motion sensor based on the visual system of the fly," *Autonomous Robots* **7:**211-224, 1999.
4. R.R. Harrison and C. Koch, "An analog VLSI implementation of a visual interneuron: enhanced sensory processing through biophysical modeling," *International Journal of Neural Systems* **9:**391-395, 1999.

5. R.R. Harrison and C. Koch, "A silicon implementation of the fly's optomotor control system," *Neural Computation* **12:**2291-2304, 2000.

6. R.R. Harrison and C. Koch, "A robust analog VLSI Reichardt motion sensor," *Analog Integrated Circuits and Signal Processing* **24:**213-229, 2000.

7. R.R. Harrison, J.A. Bragg, P. Hasler, B.A. Minch, and S.P. DeWeerth, "A CMOS programmable analog memory-cell array using floating-gate circuits," *IEEE Transactions on Circuits and Systems – II* **48:**4-11, January 2001.

8. R.R. Harrison and C. Charles, "A low-power, low-noise CMOS amplifier for neural recording applications," *IEEE Journal of Solid-State Circuits* **38**:958-965, June 2003. **(Note: This paper is currently the 12th most cited paper from the *IEEE Journal of Solid-State Circuits* during the decade 2000-2009.)**

9. A. Gopalan and R.R. Harrison, "A CMOS imager with on-chip temporal filtering for motion pre-processing," *Analog Integrated Circuits and Signal Processing* **37:**243-251, 2003.

10. C. Winstead, J. Dai, S. Yu, C. Myers, R.R. Harrison, and C. Schlegel., "CMOS analog MAP decoder for (8,4) Hamming code," *IEEE Journal of Solid-State Circuits* **39:**122-131, January 2004.

11. B. Webb, R.R. Harrison, and M.A. Willis, "Sensorimotor control of navigation in arthropod and artificial systems," *Arthropod Structure and Development* **33:**301-330, 2004.

12. N.M. Neihart and R.R. Harrison, "Micropower circuits for bidirectional wireless telemetry in neural recording applications," *IEEE Transactions on Biomedical Engineering* **52:**1950-1959, November 2005.

13. R.R. Harrison, "A biologically-inspired analog IC for visual collision detection," *IEEE Transactions on Circuits and Systems – I* **52:**2308-2318, November 2005.

14. R.J. Kier, J.C. Ames, R.D. Beer, and R.R. Harrison, "Design and implementation of multipattern generators in analog VLSI," *IEEE Transactions on Neural Networks* **17:**1025-1038, July 2006.

15. C.J. Myers, R.R. Harrison, D. Walter, N. Seegmiller, and S. Little, "The case for analog circuit verification," *Electronic Notes in Theoretical Computer Science* **153:**53-63, 2006.

16. C.A. Chestek, P. Samsukha, M. Tabib-Azar, R.R. Harrison, H.J. Chiel, and S.L. Garverick, "Microcontroller-based wireless recording unit for neurodynamic studies in saltwater," *IEEE Sensors Journal* **6:**1105-1114, Oct. 2006.

17. R.R. Harrison, P.T. Watkins, R.J. Kier, R.O. Lovejoy, D.J. Black, B. Greger, and F. Solzbacher, "A low-power integrated circuit for a wireless 100-electrode neural recording system," *IEEE Journal of Solid-State Circuits* **42:**123-133, January 2007. **(Note: This paper is currently the most cited paper from the *IEEE Journal of Solid-State Circuits* in the year 2007.)**

18. C.R. Sharma, C. Furse, and R.R. Harrison, "Low-power STDR CMOS sensor for locating faults in aging aircraft wiring," *IEEE Sensors Journal* **7:**43-50, January 2007.

19. S. Kim, K. Zoschke, M. Klein, D. Black, K. Buschick, M. Toepper, P. Tathireddy, R. Harrison, H. Oppermann, and F. Solzbacher, "Switchable polymer-based thin film coils as a power module for wireless neural interfaces," *Sensors & Actuators A,* **136:**467-474, 2007.

20. R.R. Harrison, "The design of integrated circuits to observe brain activity," *Proceedings of the IEEE* **96:**1203-1216, July 2008.

21. R.R. Harrison, R.J. Kier, C.A. Chestek, V. Gilja, P. Nuyujukian, S.I. Ryu, B. Greger, F. Solzbacher, and K.V. Shenoy, "Wireless neural recording with single low-power integrated circuit," *IEEE Transactions on Neural Systems and Rehabilitation Engineering* **17:**322-329, August 2009.

22. C.A. Chestek, V. Gilja, P. Nuyujukian, R.J. Kier, F. Solzbacher, S. Ryu, R.R. Harrison, and K.V. Shenoy, "HermesC: Low-power wireless neural recording system for freely moving primates," *IEEE Transactions on Neural Systems and Rehabilitation Engineering* **17:**330-338, August 2009.

23. S. Kim, R. Harrison, and F. Solzbacher, "Influence of system integration and packaging on its inductive power link for an integrated wireless neural interface," *IEEE Transactions on Biomedical Engineering* **56:**2927-2936, December 2009.
24. B.K. Thurgood, D.J. Warren, N.M. Ledbetter, G.A. Clark, and R.R. Harrison, "A wireless integrated circuit for 100-channel charge-balanced neural stimulation," *IEEE Transactions on Biomedical Circuits and Systems* **3:** 405-414, December 2009.
25. A. Sharma, L. Rieth, P. Tathireddy, R. Harrison, and F. Solzbacher, "Long term *in vitro* stability of fully integrated wireless neural interfaces based on Utah slant electrode array," *Applied Physics Letters* **96:** 073702, 2010.

BOOK CHAPTERS

1. R.R. Harrison, "Fly-inspired VLSI vision sensors," in *Neurotechnology for Biomimetic Robots*, J. Ayers, J.L. Davis, and A. Rudolph, Eds., Cambridge, MA: MIT Press, pp. 31-56, 2002.
2. B. Webb and R.R. Harrison, "Phonotaxis in crickets and robots," in *Neurotechnology for Biomimetic Robots*, J. Ayers, J.L. Davis, and A. Rudolph, Eds., Cambridge, MA: MIT Press, pp. 533-552, 2002.
3. R.R. Harrison, "Integrated Circuits for Neural Interfacing: Neuroelectrical Recording," in *VLSI Circuits for Biomedical Applications,* K. Iniewski, Ed., Boston, MA: Artech House, pp. 165-178, 2008.
4. T. Denison, G. Molnar, and R.R. Harrison, "Integrated amplifier architectures for efficient coupling to the nervous system," in *Analog Circuit Design: High-Speed Clock and Data Recovery, High-Performance Amplifiers, Power Management,* M. Steyaert, A.H.M. van Roermund, and H. Casier, Eds., New York, NY: Springer, pp. 167-192, 2009.

REFEREED CONFERENCE PAPERS

1. S. Caselli, K.L. Doty, R.R. Harrison, F. Zanichelli, "Mobile robot navigation in enclosed large-scale space," In: *Proceedings of the 1994 IEEE Industrial Electronics Conference (IECON),* **2:**1043-1047, 1994.
2. R.R. Harrison and C. Koch, "An analog VLSI model of the fly elementary motion detector," In: *Advances in Neural Information Processing Systems (NIPS) 10,* MIT Press: Cambridge, MA, pp. 880-886, 1998.
3. R.R. Harrison, P. Hasler, and B.A. Minch, "Floating-gate CMOS analog memory cell array," In: *Proceedings of the 1998 IEEE International Symposium on Circuits and Systems (ISCAS '98),* **2:**204-207, Monterey, CA, 1998.
4. R.R. Harrison, "Floating-gate current mirror for gain correction in CMOS translinear circuits," In: *Proceedings of the 1999 IEEE International Symposium on Circuits and Systems (ISCAS '99),* **2:**404-407, Orlando, FL, 1999.
5. R.R. Harrison and C. Koch, "An analog VLSI implementation of a visual interneuron: enhanced sensory processing through biophysical modeling," In: *Proceedings of the Second European Workshop on Neuromorphic Systems,* Stirling, Scotland, 1999.
6. B. Webb and R. Harrison, "Eyes and ears: combining sensory motor systems modelled on insect physiology," In: *Proceedings of the 2000 IEEE International Conference on Robotics and Automation,* San Francisco, CA, 3913-3916, 2000.
7. B. Webb and R. Harrison, "Integrating sensorimotor systems in a robot model of cricket behavior," In: *Sensor Fusion and Decentralized Control in Robotics Systems III (SPIE),* P.S. Schenker, G.T. McKee, Eds., pp. 113-124, 2000.
8. J.A. Bragg, R.R. Harrison, P. Hasler, and S. DeWeerth, "A Floating-gate *p*FET-based CMOS programmable analog memory cell array," In: *Proceedings of the 2000 IEEE International Symposium on Circuits and Systems (ISCAS '00),* **3:**339-342, Geneva, Switzerland, 2000.

9. C. Winstead, C. Myers, C. Schlegel, and R. Harrison, "Analog decoding of product codes," In: *Proceedings of the 2001 IEEE Information Theory Workshop (ITW 2001),* pp. 131-133, Cairns, Australia, 2001.

10. A. Gopalan and R.R. Harrison, "A CMOS imager with on-chip temporal filtering for motion pre-processing," In: *Proceedings of the 2002 IEEE International Symposium on Circuits and Systems (ISCAS 2002),* **2:**336-339, Scottsdale, AZ, 2002.

11. J. Dai, C.J. Winstead, C.J. Myers, R.R. Harrison, and C. Schlegel, "Cell library for automatic synthesis of analog error control decoders," In: *Proceedings of the 2002 IEEE International Symposium on Circuits and Systems (ISCAS 2002),* **4:**481-484, Scottsdale, AZ, 2002.

12. R.R. Harrison, "A wide-range subthreshold CMOS transconductor employing the back-gate effect," In: *Proceedings of the 2002 IEEE International Symposium on Circuits and Systems (ISCAS 2002),* **3:**727-730, Scottsdale, AZ, 2002.

13. R.R. Harrison, "A low-power, low-noise CMOS amplifier for neural recording applications," In: *Proceedings of the 2002 IEEE International Symposium on Circuits and Systems (ISCAS 2002),* **5:**197-200, Scottsdale, AZ, 2002.

14. C. Winstead, J. Dai, S. Yu, R. Harrison, C. Myers, and C. Schlegel, "Analog decoding of product codes," *Proceedings of the International Symposium on Information Theory (ISIT 2002),* p. 230, Lausanne, Switzerland, 2002.

15. C. Charles and R.R. Harrison, "A floating-gate common-mode feedback circuit for low noise amplifiers," in *Proceedings of the 2003 IEEE Southwest Symposium on Mixed-Signal Design (SSMSD 2003),* pp. 180-185, Las Vegas, Nevada, 2003.

16. R.R. Harrison, "A low-power integrated circuit for adaptive detection of action potentials in noisy signals," In: *Proceedings of the 2003 International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC 2003),* pp. 3325-3328, Cancún, Mexico, 2003.

17. R.A. Blum, J.D. Ross, C.M. Simon, E.A. Brown, R.R. Harrison, and S.P. DeWeerth, "A custom multielectrode array with integrated low-noise preamplifiers," In: *Proceedings of the 2003 International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC 2003),* pp. 3396-3399, Cancún, Mexico, 2003.

18. R.R. Harrison, "A low-power analog VLSI visual collision detector," In: *Advances in Neural Information Processing Systems 16*, Eds: S. Thrun, L.K Saul, and B. Schölkopf, pp. 987-994, Vancouver, Canada, 2004.

19. R.R. Harrison, "A single-chip CMOS visual orientation sensor," In: *Proceedings of the 2004 IEEE International Symposium on Circuits and Systems (ISCAS 2004),* **4:**944-947, Vancouver, Canada, 2004.

20. R.J. Kier, R.R. Harrison, and R.D. Beer, "An MDAC synapse for analog neural networks," In: *Proceedings of the 2004 IEEE International Symposium on Circuits and Systems (ISCAS 2004),* **5:**752-755, Vancouver, Canada, 2004.

21. N.M. Neihart and R.R. Harrison, "A low-power FM transmitter for use in neural recording applications," In: *Proceedings of the 2004 International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC 2004),* pp. 2117-2120, San Francisco, CA, 2004.

22. P.T. Watkins, G. Santhanam, K.V. Shenoy, and R.R. Harrison, "Validation of adaptive threshold spike detector for neural recording," In: *Proceedings of the 2004 International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC 2004),* pp. 4079-4082, San Francisco, CA, 2004.

23. R.R. Harrison, G. Santhanam, and K.V. Shenoy, "Local field potential measurement with low-power analog integrated circuit," In: *Proceedings of the 2004 International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC 2004),* pp. 4067-4070, San Francisco, CA, 2004.

24. C. Chestek, P. Samsukha, M. Tabib-Azar, R. Harrison, H. Chiel, and S. Garverick, "Wireless multi-channel sensor for neurodynamic studies," In: *Proceedings of the 3rd IEEE Conference on Sensors,* pp. 915-918, Vienna, Austria, 2004.

25. R. Harrison, P. Watkins, R. Kier, R. Lovejoy, D. Black, R. Normann, and F. Solzbacher, "A low-power integrated circuit for a wireless 100-electrode neural recording system," In: *IEEE International Solid-State*

Circuits Conference (ISSCC 2006) Digest of Technical Papers, pp. 554-555, San Francisco, CA, 2006. (Invited paper)

26. S. Kim, O. Scholz, K. Zoschke, R. Harrison, F. Solzbacher, M. Klein, and M. Toepper, "FEA simulation of thin film coils to power wireless neural interfaces," *2006 NSTI Nanotechnology Conference and Trade Show (Nanotech 2006)*, Boston, MA, 2006.
27. S. Chakravarty, P. Tathireddy, L. Rieth, R.A. Normann, R. Harrison, F. Solzbacher, M. Klein and H. Oppermann, "Biocompatible hybrid system integration of silicon based neural interface device," *2006 NSTI Nanotechnology Conference and Trade Show (Nanotech 2006)*, Boston, MA, 2006.
28. D.J. Black and R.R. Harrison, "Power, clock, and data recovery in a wireless neural recording device," In: *Proceedings of the 2006 IEEE International Symposium on Circuits and Systems (ISCAS 2006),* pp. 5083-5086, Kos, Greece, 2006.
29. R.J. Kier and R.R. Harrison, "Power minimization of a 433-MHz *LC* VCO for an implantable neural recording system," In: *Proceedings of the 2006 IEEE International Symposium on Circuits and Systems (ISCAS 2006),* pp. 3225-3228, Kos, Greece, 2006.
30. P. Watkins, R. Kier, R. Lovejoy, D. Black, and R.R. Harrison, "Signal amplification, detection and transmission in a wireless 100-electrode neural recording system," In: *Proceedings of the 2006 IEEE International Symposium on Circuits and Systems (ISCAS 2006),* pp. 2193-2196, Kos, Greece, 2006.
31. M. Töpper, L. Dietrich, K. Orth, O. Ehrmann, S. Kim, M. Klein, R. Harrison, P. Tathireddy, F. Solzbacher, and H. Reichl, "Wafer level packaging based on electroplating for medical implantable devices," In: *Proceedings of the Second PEAKS Conference on Electrochemical Processing for Microelectronics,* Whitefish, MT, 2006.
32. S. Kim, R. Normann, R. Harrison, and F. Solzbacher, "Preliminary study of thermal impact of a microelectrode array implanted in the brain," In: *Proceedings of the 2006 International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC 2006),* pp. 2986-2989, New York, NY, 2006.
33. R.R. Harrison, P.T. Watkins, R.J. Kier, D.J. Black, R.O. Lovejoy, R.A. Normann, and F. Solzbacher, "Design and testing of an integrated circuit for multi-electrode neural recording," In: *Proceedings of the 20th International Conference on VLSI Design (VLSID 2007),* Bangalore, India, 2007.
34. R.R. Harrison, "Designing efficient inductive power links for implantable devices," In: *Proceedings of the 2007 IEEE International Symposium on Circuits and Systems (ISCAS 2007)*, pp. 2080-2083, New Orleans, LA, 2007.
35. R.R. Harrison, "A versatile integrated circuit for the acquisition of biopotentials," In: *IEEE 2007 Custom Integrated Circuits Conference (CICC 2007) Digest of Technical Papers*, San Jose, CA, pp. 115-122, 2007. (Invited paper)
36. C. Furse, R. Harrison, and F. Solzbacher, "Recent advances in biomedical telemetry," In: *International Conference on Electromagnetics in Advanced Applications (ICEAA 2007),* Torino, Italy, 2007. (Invited paper)
37. R.R. Harrison, R.J. Kier, C.A. Chestek, V. Gilja, P. Nuyujukian, S.I. Ryu, B. Greger, F. Solzbacher, and K.V. Shenoy, "Wireless neural signal acquisition with single low-power integrated circuit," In: *Proceedings of the 2008 IEEE International Symposium on Circuits and Systems (ISCAS 2008)*, Seattle, WA, pp. 1748-1751, 2008.
38. C.A. Chestek, V. Gilja, P. Nuyujukian, R.J. Kier, F. Solzbacher, S.I. Ryu, R.R. Harrison, and K.V. Shenoy, "HermesC: RF wireless low-power neural recording for freely behaving primates," In: *Proceedings of the 2008 IEEE International Symposium on Circuits and Systems (ISCAS 2008)*, Seattle, WA, pp. 1752-1755, 2008.
39. T. Denison and R.R. Harrison, "Amplifier architectures for efficient coupling to the nervous system," In: *17th Workshop on Advances in Analog Circuit Design (AACD 2008),* Pavia, Italy, 2008. (Invited paper)
40. S. Kim, R. Harrison, and F. Solzbacher, "Influence of system integration and packaging for a wireless neural interface on its wireless powering performance," In: *Proceedings of the 2008 International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC 2008),* pp. 2986-2989, Vancouver, Canada, 2008.
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1. K.L. Doty and R.R. Harrison, "Sweep strategies for a sensory-driven, behavior-based vacuum cleaning agent," *AAAI Fall Symposium, Instantiating Read-World Agents,* Raleigh, NC, pp. 42-50, 1993. **(Note: This paper was cited by iRobot in their patent for the Roomba vacuum cleaning robot, U.S. Patent #7,663,333.)**
2. R.R. Harrison and C. Koch, "A neuromorphic visual motion sensor for real-world robots," *Workshop on Defining the Future of Biomorphic Robotics, IROS 1998,* Victoria, BC, Canada, 1998.
3. R.R. Harrison and C. Koch, "An analog VLSI implementation of the fly optomotor control system," *AAAI 1998 Fall Symposium Series, Robots and Biology: Developing Connections,* Orlando, FL, pp. 11-27, 1998.
4. S. Kim, K. Buschick, K. Zoschke, M. Klein, M. Toepper, D. Black, R. Harrison, P. Tathireddy, and F. Solzbacher, "Polymer based thin film coils as a power module of wireless neural interfaces," *2006 IEEE Workshop on Microelectronics and Electron Devices (WMED 2006)*, pp. 15-16, Boise, ID, 2006.
5. R.R. Harrison, R.J. Kier, B. Greger, R.A. Normann, and F. Solzbacher, "The Utah Integrated Neural Interface: wireless gateway to the brain," *1st Global COE International Symposium, Electronic Devices Innovation (EDIS 2008)*, Osaka, Japan, 2008.

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1. "A machine with a fly's-eye view," News of the Week, *Science* **285:**1472, 3 September 1999.
2. R.R. Harrison, "Toward a silicon housefly visual system," *SPIE Robotics and Machine Perception Newsletter* **8:**8-9, September 1999.
3. "Researchers simulate fly's vision," *Photonics Spectra,* pp. 26-28, November 1999.
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5. R. Żbikowski, "Fly like a fly," *IEEE Spectrum,* pp. 46-51, November 2005.
6. N. Mokhoff, "If you can believe your eyes and ears," *EE Times,* pp. 22-24, 13 February 2006.
7. E. Zielinska, "Of cells and wires," *The Scientist,* vol. 23, no. 1, pp. 32-37, January 2009.
8. S. Adee, "The revolution will be prosthetized," *IEEE Spectrum,* vol. 46, no. 1, pp. 45-48, January 2009.
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2. R. Harrison, C. Furse, and C. Sharma, "Reflectometry test system using a sliding pseudo-noise reference," *U.S. Patent #7,548,071,* June 16, 2009.

INVITED PRESENTATIONS

1.	1997 NSF Workshop on Neuromorphic Engineering, Telluride, CO	1997
2.	Neuroscience Seminar, Max Planck Institute, Tübingen, Germany	1997
3.	Institute for Neuroinformatics Seminar, ETH Zürich, Switzerland	1997
4.	Neurobiology Seminar, University of Bielefeld, Germany	1997
5.	IEEE/RSJ Workshop on Biomorphic Robots, IROS '98, Victoria, BC, Canada	1998
6.	Biological Computation Group Seminar, Bell Labs, Murray Hill, NJ	1998
7.	Machine Intelligence Laboratory Seminar, University of Florida, Gainesville, FL	1999
8.	Center for Integrated Space Microelectronics Seminar, Jet Propulsion Laboratory, Pasadena, CA	1999
9.	Micro Flying Insect Group Seminar, University of California, Berkeley, CA	1999
10.	Electrical Engineering & Computer Science Seminar, Case Western Reserve University, Cleveland, OH	1999
11.	DARPA Conference on Neurotechnology for Biomimetic Robotics, Nahant, MA	2000
12.	19th Conference on Advanced Research in VLSI (ARVLSI 2001), Salt Lake City, UT	2001
13.	2001 NSF Workshop on Neuromorphic Engineering, Telluride, CO	2001
14.	2002 NSF Workshop on Neuromorphic Engineering, Telluride, CO	2002
15.	2004 NSF Workshop on Neuromorphic Engineering, Telluride, CO	2004
16.	2004 International Congress of Neuroethology, Nyborg, Denmark	2004
17.	Caltech Center for Neuromorphic Systems Engineering 10th Anniversary Symposium, Pasadena, CA	2004
18.	Analog Devices VLSI Seminar Series, Cornell University, Ithaca, NY	2005
19.	DARPA Defense Sciences Research Council Workshop, Arlington, VA	2005
20.	IEEE International Solid-State Circuits Conference (Invited Paper), San Francisco, CA	2006
21.	Medtronic, Inc. Technical Forum, Minneapolis, MN	2006
22.	20th International Conference on VLSI Design, Bangalore, India	2007
23.	Low Power Analog IC Seminar Series, University of Washington, Seattle, WA	2007
24.	Wireless Integrated Microsystems ERC Seminar Series, University of Michigan, Ann Arbor, MI	2007
25.	IEEE Custom Integrated Circuits Conference (Invited Paper), San Jose, CA	2007
26.	1st Global COE International Symposium, Electronic Devices Innovation (Plenary Talk), Osaka, Japan	2008
27.	GCOE Global Seminar, Advances in Neuroengineering, Osaka, Japan	2008
28.	IC NeuroTech Workshop, University of California, Los Angeles, CA	2008

29. Mixed-Signal, RF, and Microwave Seminar Series, Caltech, Pasadena, CA 2008
30. Integrated Neural Interfaces Forum, IEEE ISSCC, San Francisco, CA 2009
31. Biomedical Engineering Seminar Series, Purdue University, West Lafayette, IN 2009
32. Technical Challenges in Extracellular Electrophysiology Workshop, HHMI Janelia Farm, Ashburn, VA 2009
33. Analog Challenges for Biomedical Applications Workshop, University of Texas, Dallas, TX 2009
34. Advanced Topics Tutorial, Custom Integrated Circuits Conference (CICC), San Jose, CA 2009
35. Biomedical Electronics Forum, Custom Integrated Circuits Conference (CICC), San Jose, CA 2009
36. Electrical Engineering Seminar Series, University of California, Los Angeles, CA 2010

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