

## **Stephen P. DeWeerth**

Professor

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### **Academic Training**

B.A., Mathematics/Chemistry, Wartburg College (Waverly, IA), 1985

M.S., Computer Science, California Institute of Technology, 1987

Ph.D., Computation and Neural Systems, California Institute of Technology, 1991

Thesis topic: Analog VLSI Circuits for Sensorimotor Integration

Thesis advisor: Carver A. Mead

### **Academic Appointments**

Assistant Professor, School of Electrical and Computer Engineering

Georgia Institute of Technology, 1991–1997

Associate Professor, School of Electrical and Computer Engineering

Georgia Institute of Technology, 1997–2003

Associate Professor, Wallace H. Coulter Department of Biomedical Engineering

Georgia Institute of Technology / Emory University School of Medicine, 1999–2003

Professor, School of Electrical and Computer Engineering

Georgia Institute of Technology, 2003–present

Professor, Wallace H. Coulter Department of Biomedical Engineering

Georgia Institute of Technology / Emory University School of Medicine, 2003–present

Associate Chair for Graduate Studies, Wallace H. Coulter Department of BME

Georgia Institute of Technology / Emory University School of Medicine, 2004–2008

### **Campus Participation and Honors**

Recipient, Outstanding Interdisciplinary Activities Award, Georgia Tech, 2005

Member, Georgia Tech Analog Consortium (GTAC), 1991–present

Member, Interdepartmental Bioengineering Graduate Program, 1992–present

Founding Director, Laboratory for Neuroengineering, 1998–2004

Member, Institute Graduate Committee, 1999–2005

Director, Innovative Technology Initiative, NSF Center for Behavioral Neuroscience,

1999–present

Member, Neuroscience Graduate Program (Emory), 2001–present

Member, Graduate Executive Council (Emory), 2008–present

## **Society Participation and Honors**

Fellow, American Institute for Medical and Biological Engineering (AIMBE), 2006–present

Senior Member (previously Member), Institute of Electrical and Electronics Engineers, 1991–present

Member, Society for the Neural Control of Movement, 1997–2002

Member, American Society for Engineering Education, 2001–present

Member, Society for Neuroscience, 2002–present

Member, Biomedical Engineering Society, 2005–present

Member, Academic Council, American Institute for Medical and Biological Engineering (AIMBE), 2004–2008

Member, Organizing Committee, IEEE International Symposium on Circuits and Systems (ISCAS '96), 1996 May

Member, Organizing Committee, IEEE International Conference on Acoustics Speech, and Signal Processing (ICASSP '96), 1996 May

Workshop Organizer, “Movement Primitives: Building Blocks for Learning Motor Control,” Neural Information Processing Systems Conference, 1998 December

General Chair, Twentieth Anniversary Conference on Advanced Research in VLSI, 1999 March

Session Co-chair, EMBC/BMES 2002, Houston, TX

Session Co-chair, Biomimetic Signal Processing, BMES 2007, Los Angeles, CA

Session Co-chair, Neural Interfacing, BMES 2008, St. Louis, MO

Associate Editor, *Chaos*, 2001–2004

Associate Editor, *IEEE Transactions on Biomedical Engineering*, 2002–2003

Associate Editor, *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 2005–present

Associate Editor, *IEEE Transactions on Biomedical Circuits and Systems*, 2006–present

Member, IEEE EMBS Technical Committee on Neuroengineering (TCNE), 2008–present

## **Consulting**

Pacific Northwest National Labs, 1996–1998. Designed and tested integrated circuits for interfacing to chemical-sensor arrays.

Modular Design Works, 1999–2004. Developed an assistive device for Parkinson's patients.

Control Dynamics, Inc., 2000–2004. Designed and tested integrated nonlinear oscillator arrays.

CardioMEMS, 2005–2007, Consulted on design of low-power circuitry for implantable devices

## Publications, Presentations, and Patents

### Journal Publications

James D. Ross, D. Kacy Cullen, Michelle C. LaPlaca, and Stephen P. DeWeerth, Three-dimensional image processing techniques for rapid automated segmentation of neuronal somata with dense neurite outgrowth. *Journal of Neuroscience Methods*, accepted for publication.

Yoonkey Nam, Edgar A. Brown, James D. Ross, Richard Blum, Bruce C. Wheeler, and Stephen P. DeWeerth. A retrofitted neural recording system with a novel stimulation IC to monitor early neural responses from a stimulating electrode. *Journal of Neuroscience Methods*, 178:99–102, 2009.

Edgar A. Brown, James D. Ross, Richard A. Blum, Yoonkey Nam, Bruce C. Wheeler, and Stephen P. DeWeerth. Stimulus-Artifact Elimination in a Multi-Electrode System. *Transaction on Biomedical Circuits and Systems*, 2:1:10–21, March 2008.

Jevin E. Scrivens, Stephen P. DeWeerth, and Lena H. Ting, A robotic device for understanding neuromechanical interactions during standing balance control. *Bioinspiration and Biomimetics*, 3:2, June 2008.

Kathleen W. Meacham, Richard J. Giuly, Liang Guo, Shawn Hochman, Stephen P. DeWeerth, A Lithographically-Patterned, Elastic Multi-electrode Array for Surface Stimulation of the Spinal Cord. *Biomedical Microdevices*, 10:2:259–269, April 2008.

Richard A. Blum, James D. Ross, Edgar A. Brown, and Stephen P. DeWeerth. An Integrated System for Simultaneous, Multichannel Stimulation and Recording. *IEEE Transactions on Circuits and Systems I*, 54:12:2608–2618, December 2007.

Michael E. Sorensen and Stephen P. DeWeerth. Functional consequences of model complexity in rhythmic systems: II. Systems performance of model and hybrid oscillators. *Journal of Neural Engineering*, 4:189–196, September 2007.

Michael E. Sorensen and Stephen P. DeWeerth. Functional consequences of model complexity in rhythmic systems: I. Systematic reduction of a bursting neuron model. *Journal of Neural Engineering*, 4:179–188, September 2007.

Carrie A. Williams and Stephen P. DeWeerth. Resonance tuning of a neuromechanical system with two negative sensory feedback configurations. *NeuroComputing*, 70:10–12:1954–1959, June 2007.

Carrie A. Williams and Stephen P. DeWeerth. A comparison of resonance tuning with positive versus negative sensory feedback. *Biological Cybernetics*, 96:6:603–614, June 2007.

Michael S. Reid, Edgar A. Brown, and Stephen P. DeWeerth. A parameter-space search algorithm tested on a Hodgkin–Huxley model. *Biological Cybernetics*, 96:6:625–634, June 2007.

Shane A. Migliore, Edgar A. Brown, and Stephen P. DeWeerth. Novel nonlinear elastic actuators for passively controlling robotic joint compliance. *Journal of Mechanical Design*, 129:4:406–412, April 2007.

Stephen P. DeWeerth, Michael S. Reid, Edgar A. Brown, and Robert J. Butera, Jr., A Comparative Analysis of Multi-Conductance Neuronal Models in Silico. *Biological Cybernetics*, 96:2:181–194, February 2007.

Mario F. Simoni and Stephen P. DeWeerth. Sensory feedback in a half-center oscillator model. *IEEE Transactions on Biomedical Engineering*, 54:2:193–204, February 2007.

Swaminathan Rajaraman, Seong-O Choi, Richard H. Shafer, James D. Ross, Jelena Vukasinovic, Yoonsu Choi, Stephen P. DeWeerth, Ari Glezer, and Mark G. Allen. Microfabrication technologies for a coupled three-dimensional microelectrode microfluidic array. *Journal of Micromechanics and Microengineering*, 17:1:163–171, January 2007.

Michael S. Reid, Edgar A. Brown, and Stephen P. DeWeerth. Subthreshold CMOS array for generating a gaussian distribution of currents. *IEEE Transactions on Circuits and Systems II*, 53:10:1123–1127, October 2006.

Mario F. Simoni and Stephen P. DeWeerth. Two-dimensional variation of bursting properties in a silicon-neuron half-center oscillator. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 14:3:281–289, September 2006.

Michael E. Sorensen and Stephen P. DeWeerth. An Algorithmic Method for Reducing Conductance-Based Neuron Models. *Biological Cybernetics*, 95:2:185–192, August 2006.

Girish N. Patel, Michael S. Reid, David E. Schimmel, and Stephen P. DeWeerth. An asynchronous architecture for modeling intersegmental neural communication. *IEEE Transactions on VLSI Systems*, 14:2:97–110, February 2006.

Gustavo R. Prado, James D. Ross, Stephen P. DeWeerth, and Michelle C. LaPlaca. Mechanical trauma induces immediate changes in neuronal network activity. *Journal of Neural Engineering*, 2:4:148–158, 2005.

V. E. Bondarenko, Gennady S. Cymbalyuk, Girish N. Patel, Stephen P. DeWeerth, and Ronald L. Calabrese. Bifurcation of synchronous oscillations into torus in a system of two reciprocally inhibitory silicon neurons: experimental observation and modeling. *Chaos*, 14:4:995–1003, December 2004.

Michael E. Sorensen, Stephen P. DeWeerth, Gennady S. Cymbalyuk, and Ronald L. Calabrese. Using a hybrid neural system to reveal regulation of neuronal network activity by an intrinsic current. *Journal of Neuroscience*, 24:23:5427–5438, June 9 2004.

Julian A. Bragg, Edgar A. Brown, and Stephen P. DeWeerth. A tunable voltage correlator. *Analog Integrated Circuits and Signal Processing*, 39:1:89–94, April 2004.

Mario F. Simoni, Gennady S. Cymbalyuk, Michael E. Sorensen, Ronald L. Calabrese, and Stephen P. DeWeerth. A multiconductance silicon neuron with biologically matched dynamics. *IEEE Transactions on Biomedical Engineering*, 51:2:342–354, February 2004.

Tina A. Hudson, Julian A. Bragg, Paul E. Hasler, and Stephen P. DeWeerth. An analog VLSI model of muscular contraction. *IEEE Transactions On Circuits and Systems II: Analog and Digital Signal Processing*, 50:7:329–342, 2003.

V.E. Bondarenko, Gennady S. Cymbalyuk, Girish N. Patel, Stephen P. DeWeerth, and Ronald L. Calabrese. A bifurcation of a synchronous oscillations into a torus in a system of two mutually inhibitory aVLSI neurons: experimental observation. *NeuroComputing*, 52:4:691–698, 2003.

Mario F. Simoni, Michael E. Sorensen, Gennady S. Cymbalyuk, Ronald L. Calabrese, and Stephen P. DeWeerth. Control of bursting properties in a silicon neuron CPG. *NeuroComputing*, 44-46:645–651, 2002.

Mario F. Simoni and Stephen P. DeWeerth. Two-dimensional modulation of bursting properties in a silicon-neuron half-center oscillator. ***Journal of Computational Neuroscience***, 2002.

Brian K. Meadows, Theodore Heath, Joseph D. Neff, Edgar A. Brown, D.W. Fogliatti, M. Gabbay, V. In, Paul Hasler, Stephen P. DeWeerth, and William L. Ditto. Nonlinear antenna technology. ***Proceedings of the IEEE***, 90:5:882-897, 2002.

Tina A. Hudson, Julian A. Bragg, David C. Lin, and Stephen P. DeWeerth. An integrated circuit implementation of the Huxley sarcomere model. ***IEEE Transactions on Biomedical Engineering***, 48:12:1471-1479, 2001.

Reid R. Harrison, Julian A. Bragg, Paul E. Hasler, Bradley A. Minch, and Stephen P. DeWeerth. A CMOS programmable analog memory-cell array using floating-gate circuits. ***IEEE Transactions On Circuits and Systems II: Analog and Digital Signal Processing***, 48:1:4-11, 2001.

Gennady S. Cymbalyuk, Girish N. Patel, Ronald L. Calabrese, Stephen P. DeWeerth, and Avis H. Cohen. Modeling alternation to synchrony with inhibitory coupling: A neuromorphic VLSI approach. ***Neural Computation***, 12:10:2259-2278, 2000.

Mario F. Simoni and Stephen P. DeWeerth. Adaptation in an a VLSI model of a neuron. ***IEEE Transactions On Circuits and Systems II: Analog and Digital Signal Processing***, 46:7:967-970, 1999.

B. J. Polk, J. A. Smith, Stephen P. DeWeerth, Z. P. Zhou, Jiri Janata, and K. Domansky. Design of solid state array for simultaneous potentiometric and impedance sensing in gas phase. ***Electroanalysis***, 11:10-11:707-711, 1999.

Tonia G. Morris and Stephen P. DeWeerth. A smart-scanning analog VLSI visual-attention system. ***International Journal for Analog Integrated Circuits and Signal Processing***, 21:1:67-78, 1999.

Tina A. Hudson, Julian A. Bragg, and Stephen P. DeWeerth. Biological motor control. ***IEEE Potentials***, 18:5:36-39, 1999.

Denise M. Wilson and Stephen P. DeWeerth. Analog VLSI circuits for adaptive chemical discrimination. ***Sensors and Materials***, 10:3:169-183, 1998.

Tonia G. Morris, Timothy K. Horiuchi, and Stephen P. DeWeerth. Object-based selection within an analog VLSI visual attention system. ***IEEE Transactions On Circuits and Systems II: Analog and Digital Signal Processing***, 45:12:1564-1572, 1998.

Denise M. Wilson and Stephen P. DeWeerth. Signal processing for improving gas sensor response time. ***Sensors and Actuators B***, 41:1-3:63-70, 1997.

Girish N. Patel and Stephen P. DeWeerth. Analogue VLSI Morris-Lecar neuron. ***Electronics Letters***, 33:12:997-998, 1997.

Tonia G. Morris and Stephen P. DeWeerth. Analog VLSI excitatory feedback circuits for attentional shifts and tracking. ***Analog Integrated Circuits and Signal Processing***, 13:1:79-92, 1997.

Stephen P. DeWeerth, Girish N. Patel, and Mario F. Simoni. Variable linear-range subthreshold OTA. ***Electronics Letters***, 33:15:1309-1311, 1997.

Denise M. Wilson and Stephen P. DeWeerth. Compact CMOS circuit for outlier removal. ***Electronics Letters***, 32:11:991-992, 1996.

Denise M. Wilson and Stephen P. DeWeerth. Odor discrimination using steady-state and transient characteristics of tin-oxide sensors. ***Sensors and Actuators B***, 28:2:123-128, 1995.

Girish N. Patel and Stephen P. DeWeerth. Compact current-mode loser-take-all circuit. ***Electronics Letters***, 31:24:2091-2092, 1995.

Tonia G. Morris and Stephen P. DeWeerth. An analogue VLSI morphological image processing circuit. ***Electronics Letters***, 31:23:1998-1999, 1995.

Susan M. Fike, Brent Buchanan, Nan M. Jokerst, Martin A. Brooke, Tonia G. Morris, and Stephen P. DeWeerth. 8x8 array of thin-film photodetectors vertically electrically interconnected to silicon circuitry. ***IEEE Photonics Technology Letters***, 7:10:1168-1170, 1995.

Stephen P. DeWeerth and Denise M. Wilson. Fixed-ratio adaptive thresholding using CMOS circuits. ***Electronics Letters***, 31:10:788-789, 1995.

Stephen P. DeWeerth and Tonia G. Morris. CMOS current mode winner-take-all circuit with distributed hysteresis. ***Electronics Letters***, 31:13:1051-1053, 1995.

Stephen P. DeWeerth. Converting spatially encoded sensory information to motor signals using analog VLSI circuits. ***Autonomous Robots***, 2:2:93-104, 1995.

Denise M. Bednarczyk and Stephen P. DeWeerth. Smart chemical sensing arrays using tin-oxide sensors and analog winner-take-all signal processing. ***Sensors and Actuators B***, 27:1-3:271-274, 1995.

M.A. Brooke and S.P. DeWeerth, Merging optics and electronics in neural networks, ***Optics and Photonics News***, Vol. 4, No. 6, pp. 26-29, June 1993.

Stephen P. DeWeerth. Analog VLSI circuits for stimulus localization and centroid computation. ***International Journal of Computer Vision***, 8:3:191-202, 1992.

Stephen P. DeWeerth, Lars Nielsen, Carver A. Mead, and Karl J. Åström. A simple neuron servo. ***IEEE Transactions on Neural Networks***, 2:2:248-251, 1991.

Mary Ann C. Maher, Stephen P. DeWeerth, Misha A. Mahowald, and Carver A. Mead. Implementing neural architectures using analog VLSI circuits. ***IEEE Transactions On Circuits and Systems***, 36:5:643-652, 1989.

## **Books and Book Chapters**

Stephen P. DeWeerth and Andreas G. Andreou, Neuromorphic VLSI Circuits. ***The Handbook of Brain Theory and Neural Networks, Second Edition***, (Michael A. Arbib, ed.), MIT Press, 2002.

D.S. Wills and S.P. DeWeerth (eds.), Proceedings of the 20<sup>th</sup> Anniversary Conference on Advanced Research in VLSI, IEEE Computer Science Press, 1999.

T.G. Morris and S.P. DeWeerth, Analog VLSI excitatory feedback circuits for attentional shifts and tracking. ***Neuromorphic Systems Engineering: Neural Networks in Silicon*** (Tor Sverre Lande, ed.), Kluwer Academic Publishers: Boston, MA, 1998.

## **Refereed Conference Publications**

Edgar A. Brown and Stephen P. DeWeerth, Stimulation and Recording of Neural Tissue, Closing the Loop on the Artifact, ***IEEE International Symposium on Circuits and Systems***. Seattle, WA, May 2008. pp. 356-359

- Rajaraman, S., McClain, M. A., Choi, James D. Ross, Stephen P. DeWeerth, Michelle C. LaPlaca, and Mark G. Allen. Three-dimensional metal transfer micromolded microelectrode arrays (MEAs) for in-vitro brain slice recordings. *Solid-State Sensors, Actuators and Microsystems Conference. TRANSDUCERS*. Lyon, France, June 2007. pp. 1251–1254
- Rowe, L., Choi, Y., Ross, J., Lee, K., Fogleman, N., Brewer, G.J., Vukasinovic, J., Glezer, A., DeWeerth, S.P., Frazier, A.B., A Fully Functional, Packaged Active Microscaffold System with Fluid Perfusion and Electrical Stimulation/Recording Functionalities for 3-D Neuronal Culture Studies. *Solid-State Sensors, Actuators and Microsystems Conference. TRANSDUCERS*, June 2007. pp. 1389–1392
- James D. Ross, Nakul E. Reddy, Douglas J. Bakkum, Steve M. Potter, & Stephen P. DeWeerth, Experimental Platform for the Study of Region Specific Excitation and Inhibition in Neural Tissue. *IEEE Engineering in Medicine and Biology Conference*, Lyon, France, August, 2007. pp. 4759–4762
- Liang Guo, Kathleen K. Williams, Richard J. Giuly, and Stephen P. DeWeerth. A PDMS-based Elastic Multi-Electrode Array for Spinal Cord Surface Stimulation and Its Electrode Modification to Enhance Performance, *Materials Research Society Spring Meeting*. San Francisco, CA, April 2007.
- Jevin E. Scrivens, Lena H. Ting, and Stephen P. DeWeerth. Scaling of Feedback Control Gains with Stance Width. *IEEE Engineering in Medicine and Biology Conference*, New York, NY, 2006.
- Kartik Sundar, Lena H. Ting, and Stephen P. DeWeerth. Passive dynamics of a hybrid neuromechanical joint incorporating living muscle. *IEEE Engineering in Medicine and Biology Conference*, New York, NY, 2006.
- S. A. Migliore, E. A. Brown, and S. P. DeWeerth, Biologically inspired joint stiffness control, *IEEE International Conference on Robotics and Automation*, Barcelona, Spain, 2005.
- Y. Zhong, G.C. McConnell, J.D. Ross, S. DeWeerth, and R.V. Bellamkonda, Anti-inflammatory coating for neural implants, *Proceedings of the IEEE Conference on Neural Engineering*, Washington, DC, 2005.
- J. D. Ross, G. Prado, Y. Choi, M. Allen, M. C. LaPlaca, and S. P. DeWeerth, "A novel system for measurement of electrophysiological signals associated with traumatic neuronal injury," *Micro Total Analysis Systems Conference*, 2003.
- J.A. Bragg, E.A. Brown, P.E. Hasler, and S.P. DeWeerth, A silicon model of an adapting motoneuron. *IEEE International Symposium on Circuits and Systems*, Vol. 4 (261–264). IEEE Press: Piscataway, NJ, 2002.
- R.A. Blum, C.S. Wilson, P.E. Hasler, and S.P. DeWeerth, A CMOS imager with real-time frame differencing and centroid computation. *IEEE International Symposium on Circuits and Systems*, Vol. 3 (329–332). IEEE Press: Piscataway, NJ, 2002.
- J.D. Neff, B.K. Meadows, E.A. Brown, S.P. DeWeerth, and P.E. Hasler, A CMOS coupled nonlinear oscillator array. *IEEE International Symposium on Circuits and Systems*, Vol. 4 (301–304). IEEE Press: Piscataway, NJ, 2002.
- M.F. Simoni, G. Cymbalyuk, M.E. Sorensen, R.L. Calabrese, and S.P. DeWeerth, Development of hybrid systems: Interfacing a silicon neuron to a leech heart interneuron. *Neural Information Processing Systems*, Vol. 13, MIT Press: Boston, MA, 2001.

M.F. Simoni, G. Cymbalyuk, M.E. Sorensen, R.L. Calabrese, and S.P. DeWeerth, Analysis of a multi-conductance VLSI neuron for constructing motor pattern generating networks. *Proceedings of the Tenth Annual Computational Neuroscience Meeting (CNS '01)*, 2001.

T.A. Hudson, D.C. Lin, J.A. Bragg, E.A. Brown, and S.P. DeWeerth, An Analog VLSI Model of Muscle Sarcomeres. *Proceedings of the IEEE International Symposium on Circuits and Systems*, Vol 1 (431–434). IEEE Press: Piscataway, NJ, 2000.

J.A. Bragg, R.R. Harrison, P. Hasler, and S.P. DeWeerth, A floating-gate pFET-based CMOS programmable analog memory cell array. *Proceedings of the IEEE International Symposium on Circuits and Systems*, Vol. 3 (339–342), IEEE Press: Piscataway, NJ, 2000.

C.S. Wilson, P.E. Hasler, and S.P. DeWeerth, Synchrony detection for spike-mediated computation. *Proceedings of the IEEE International Symposium on Circuits and Systems*, Vol. 2 (305–308), IEEE Press: Piscataway, NJ, 2000.

G.N. Patel, E.A. Brown, and S.P. DeWeerth, A neuromorphic VLSI system for modeling the neural control of axial locomotion. *Neural Information Processing Systems*, Vol. 12, MIT Press: Boston, MA, 2000.

G.N. Patel, G.S. Cymbalyuk, R.L. Calabrese, and S.P. DeWeerth, Bifurcation analysis of a silicon neuron. *Neural Information Processing Systems*, Vol. 12, MIT Press: Boston, MA, 2000.

T.A. Hudson and S.P. DeWeerth, Implementation of motoneuronal behavior using analog VLSI circuits. *Proceedings of the Midwest Symposium on Circuits and Systems*, Vol. 1 (145–148), IEEE Press: Piscataway, NJ, 1999.

C.S. Wilson, T.G. Morris, and S.P. DeWeerth, A two-dimensional, object-based analog VLSI visual attention system. *Proceedings of the 20th Anniversary Conference on Advanced Research in VLSI*, (291– 308), IEEE Computer Society Press: Los Alamitos, CA, 1999.

J.A. Bragg, C.D. Knight, and S.P. DeWeerth, Java Programming for Engineers: Developing Courseware for a Computer-Enhanced Curriculum. *Proceedings of the 1999 American Society for Engineering Education Conference*, 1999.

C.S. Wilson, T.G. Morris, and S.P. DeWeerth, Segmentation coding for object-based attentive selection systems. *Proceedings of the IEEE International Symposium on Circuits and Systems*, Vol. 3 (227–230), IEEE Press: Piscataway, NJ, 1998.

M.F. Simoni and S.P. DeWeerth, Adaptation in an aVLSI Model of a Neuron. *Proceedings of the IEEE International Symposium on Circuits and Systems*, Vol. 3 (111–114), IEEE Press: Piscataway, NJ, 1998.

J.D. Neff, G.N. Patel, B.K. Meadows, S.P. DeWeerth, and W.L. Ditto, Spatiotemporal dynamics of a stochastic VLSI array. *Proceedings of the IEEE International Symposium on Circuits and Systems*, Vol. 3 (542–545), IEEE Press: Piscataway, NJ, 1998.

G.N. Patel, J.H. Holleman, and S.P. DeWeerth, Analog VLSI model of intersegmental coordination with nearest-neighbor coupling. *Advances in Neural Information Processing Systems*, Vol. 10 (719–725), M. Jordan, M. Kearns, S. Solla, eds., Morgan-Kaufmann: Cambridge, MA, 1998.

T.H. Zobel, B.C. Harris, and S.P. DeWeerth, AVLSI biologically-based motor control circuits. *Proceedings of the 1998 Midwest Symposium on Circuits and Systems*, (564–567), 1998.

- T.G. Morris, C.S. Wilson, and S.P. DeWeerth, An analog VLSI focal-plane processing array that performs object-based attentive selection. *Proceedings of the Midwest Symposium on Circuits and Systems*, Vol. 1 (43–46), 1997.
- S.P. DeWeerth, G.N. Patel, M.F. Simoni, D.E. Schimmel, and R.L. Calabrese, A VLSI architecture for modeling intersegmental coordination. *Proceedings of the 17th Conference on Advanced Research in VLSI (Richard Brown and Alex Ishii, eds.)*, (182–200), IEEE Computer Society Press: Los Alamitos, CA, 1997.
- M.F. Simoni, G.N. Patel, S.P. DeWeerth, and R.L. Calabrese, Analog VLSI model of the leech heartbeat elemental oscillator. *Proceedings of the Sixth Annual Computational Neuroscience Meeting*, 1997.
- T.K. Horiuchi, T.G. Morris, C. Koch, and S.P. DeWeerth, Analog VLSI circuits for attention-based visual tracking. *Advances in Neural Information Processing Systems*, Vol. 9 (706–712), (M.C. Mozer, M.I. Jordan, and T. Petsche, eds.), MIT Press: Cambridge, MA, 1997.
- C.D. Knight, S.P. DeWeerth, A distance learning laboratory for engineering education. *Proceedings of the 1997 ASEE Conference*. June 1997.
- T.G. Morris and S.P. DeWeerth, Analog VLSI circuits for covert attentional shifts. *Proceedings of the Fifth International Conference on Microelectronics for Neural Networks and Fuzzy Systems (MicroNeuro '96)*, IEEE Computer Society Press: Los Alamitos, CA. (30–37), 1996.
- H. Urey, W.T. Rhodes, S.P. DeWeerth, and T.J. Drabik, Optoelectronic image processor for multiresolution Gabor filtering. *Proceedings of the 1996 IEEE International Conference on Acoustics, Speech, and Signal Processing*, Vol. 6 (3236–3239), 1996.
- C.D. Knight and S.P. DeWeerth, World-wide-web-based automatic testing of analog circuits. *Proceedings of the 39th Midwest Symposium on Circuits and Systems*, Vol. 1 (295–298), August 1996.
- C.D. Knight and S.P. DeWeerth, A shared remote testing environment for engineering education. *Proceedings of the 26th Annual Frontiers in Education Conference (FIE '96)*, Vol. 3 (1003–1006), November 1996.
- D.M. Wilson and S.P. DeWeerth, Rank-order filtering in analog VLSI. *Proceedings of the 1996 IEEE Symposium on Circuits and Systems*, Vol. 1 (105–108), 1996.
- T.G. Morris, C.S. Wilson, and S.P. DeWeerth, Analog VLSI circuits for sensory attentive processing. *Proceedings of the IEEE/SICE/RSJ International Conference on Multisensor Fusion and Integration for Intelligent Systems*, IEEE Press: Piscataway, NJ. (395–402), 1996.
- D.M. Wilson and S.P. DeWeerth, Nonlinear preprocessing for smart chemical sensing systems. *Proceedings of the 8th International Conference on Solid-State Sensors and Actuators and Eurosensors IX*, Vol. 1 (814–817), 1995.
- D. Wilson, T. Hudson, S. Fletcher, B. Harris, C. Knight, T. Morris, G. Patel, and S. DeWeerth, Establishing the foundations for engineering education in K–5. *Proceedings of the 25th Annual Frontiers in Education Conference*, Vol. 2, 1995.
- T.G. Morris, D.M. Wilson, and S.P. DeWeerth, Analog VLSI circuits for manufacturing inspection. *Proceedings of the 16th Conference on Advanced Research in VLSI*, (241–255), IEEE Computer Society Press: Los Alamitos, CA, 1995.

- G.N. Patel and S.P. DeWeerth, An analog VLSI loser-take-all circuit. *Proceedings of the 1995 IEEE International Symposium on Circuits and Systems*, Vol. 2 (850–853), 1995.
- B.C. Harris and S.P. DeWeerth, Analog encoding circuits for a digital CMOS neural oscillator. *Proceedings of the 1995 IEEE International Symposium on Circuits and Systems*, Vol. 2 (1336–1339), 1995.
- D.M. Wilson and S.P. DeWeerth, Winning isn't everything (runner-up circuit). *Proceedings of the 1995 IEEE International Symposium on Circuits and Systems*, Vol. 2 (850–853), 1995.
- T.G. Morris and S.P. DeWeerth, Analog VLSI arrays for morphological image processing. *Proceedings of the International Conference on Application Specific Array Processors*, (132–142), 1994.
- S.P. DeWeerth and T.G. Morris, Analog VLSI circuits for primitive sensory attention. *Proceedings of the 1994 IEEE International Symposium on Circuits and Systems*, Vol. 6 (507–510), 1994.
- D.M. Bednarczyk, B. Harris, and S.P. DeWeerth, Analog VLSI circuits for odor discrimination. *Proceedings of the 37th Midwest Symposium on Circuits and Systems*, Vol. 2 (1536–1539), 1994.
- B. Buchanan, C. Camperi-Ginestet, T. Morris, M. Brooke, S. DeWeerth, N. Jokerst, and M. Allen, High-density focal-plane signal processing using 3-D vertical interconnects. *Proceedings of the 37th Midwest Symposium on Circuits and Systems*, Vol. 1 (191–194), 1994.
- D.M. Bednarczyk and S.P. DeWeerth, Smart chemical sensing arrays using tin-oxide sensors and analog winner-take-all signal processing,” *Euroensors VIII*, September 1994.
- S.P. DeWeerth, A VLSI-based system for tracking visual stimuli. *Proceedings of the 1991 IEEE International Conference on Robotics and Automation*, Vol. 2 (1336–1341), 1991.
- S.P. DeWeerth, An analog VLSI framework for sensory–motor feedback. *Proceedings of the Second Australian Conference on Neural Networks (ACNN '91)*, (26–29), 1991.
- S.P. DeWeerth, L. Nielsen, C.A. Mead, and K.J. Åström, A neuron-based pulse servo for motion control. *Proceedings of the IEEE International Conference on Robotics and Automation*, pp. 1698-1703, March 1990.
- S.P. DeWeerth and C.A. Mead, An Analog VLSI model of adaptation in the vestibulo-ocular reflex. In *Neural Information Processing Systems*, Vol. 2 (D.S. Touretzky, Ed.), Morgan Kaufmann, San Mateo, CA, pp. 742-749, 1990.
- C.B. Umminger and S.P. DeWeerth, Implementing gradient following in analog VLSI. In *Advanced Research in VLSI* (C.L. Seitz, Ed.), MIT Press, Cambridge, MA, pp. 195-208. 1989.
- S.P. DeWeerth, A VLSI model of oculomotor integration, Neural Networks for Computing, Snowbird, UT, April 1989.

### **Conference Abstracts/Presentations**

- [Michelle Kuykendal, James D. Ross, and Stephen P. DeWeerth, ... Neuroscience 2008.](#)
- [James D. Ross, Michelle Kuykendal, and Stephen P. DeWeerth, ... BMES 2008.](#)

Kathleen K. Williams, Liang Guo, Shawn Hochman, and Stephen P. DeWeerth, 'A Conformable Elastomer-Substrate Microelectrode Array (Mea) for Stimulation of Spinal White Matter Tracts', in *Cellular and Network Functions of the Spinal Cord Conference*, Madison, WI, 2007.

Terrence M. Wright, Jeremy Lewi, Isaac Clements, Amanda Zimmerman, JoAnna Todd, Scott Buscemi, Jr. Robert J. Butera, and Stephen P. DeWeerth. Hybrid neural microsystems: Development of co-advisory relationships through hybrid neural microsystem projects. *Society for Neuroscience Annual Meeting*, Atlanta, GA, October 14–18, 2006.

Jevin Scrivens, Stephen P. DeWeerth, and Lena H. Ting. Increased stance width necessitates decreased feedback gain in a bipedal model of postural control. *Society for Neuroscience Annual Meeting*, Atlanta, GA, October 14–18, 2006.

Carrie A. Williams, Edgar A. Brown, and Stephen P. DeWeerth. Comparing the stability of resonance tuning with negative and positive sensory feedback. *Society for Neuroscience Annual Meeting*, Atlanta, GA, October 14–18, 2006.

James D. Ross, Brock A. Wester, Yoonsu Choi, Robert H. Lee, Michelle C. LaPlaca, Mark G. Allen, and Stephen P. DeWeerth. Mechanically actuated microtweezers for simultaneous cellular manipulation and electrophysiological recording. *Society for Neuroscience Annual Meeting*, Atlanta, GA, October 14–18, 2006.

JoAnna L. Todd, Stefan Clemens, and Stephen P. DeWeerth. Intracellular recording reveals that extracellular electrical stimulation can cause enduring dynamic changes of cellular properties. *Society for Neuroscience Annual Meeting*, Atlanta, GA, October 14–18, 2006.

Kartik Sundar, Stephen P. DeWeerth, and Lena H. Ting. Control of an inverted pendulum actuated by living reflexive muscle. *Society for Neuroscience Annual Meeting*, Atlanta, GA, October 14–18, 2006.

James D. Ross, Brock A. Wester, Yoonsu Choi, Robert H. Lee, Michelle C. LaPlaca, Mark G. Allen, and Stephen P. DeWeerth, Mechanically Actuated Microtweezers for Neural Interfacing Applications, *Biomedical Engineering Society Annual Meeting*, Chicago, IL, October 11–14, 2006.

C. A. Williams and S. P. DeWeerth, "Resonance tuning of a neuromechanical system with two negative sensory feedback configurations," *CNS 2006*, Edinburgh, U.K., July 16–18, 2006.

Edgar A. Brown, Richard A. Blum, James D. Ross, Yoonkey Nam, Bruce C. Wheeler, and Stephen P. DeWeerth, An Integrated System for Simultaneous Multichannel Stimulation and Recording, *International Meeting on Substrate-Integrated Micro-Electrode Arrays*, Reutlingen, Germany, July 4–7, 2006.

Shane A. Migliore, Edgar A. Brown, and Stephen P. DeWeerth, Biomimetic Actuators for the Control of Robot Joint Compliance, *First International Symposium for Biologically Inspired Design in Science and Engineering*, Atlanta, GA, May 10–12, 2006.

Kartik Sundar, Stephen P. DeWeerth, and Lena H. Ting, Investigating Nonlinear Intrinsic Muscle Stiffness and Damping as an Autonomous Controller, *First International Symposium for Biologically Inspired Design in Science and Engineering*, Atlanta, GA, May 10–12, 2006.

Shane A. Migliore, Edgar A. Brown, and Stephen P. DeWeerth, Novel Nonlinear Elastic Actuators for Passively Controlling Robotic Joint Compliance, *Dynamic Walking*, Ann Arbor, MI, May 6–8, 2006.

Kartik Sundar, Stephen P. DeWeerth, and Lena H. Ting, Contribution of Intrinsic Muscle Stiffness and Damping During Joint Stabilization, *South East Biomechanical Conference*, Atlanta, GA, March 31–April 1, 2006.

R. A. Blum, J. D. Ross, E. A. Brown, and S. P. DeWeerth, "An analog VLSI stimulation and recording system for extracellular interfacing," *2nd International IEEE Conference on Neural Engineering*, Washington, DC, 2005.

C. A. Williams and S. P. DeWeerth, "Influence of sensory feedback synaptic connections on the tuning of a neuromechanical system to the mechanical resonant frequency," presented at Neural Control of Movement Annual Meeting, Key Biscayne, FL, 2005.

Y. Zhong, G. C. McConnell, J. D. Ross, S. P. DeWeerth, and R. V. Bellamkonda, "Anti-inflammatory coating for neural implants," presented at 2nd International IEEE Conference on Neural Engineering, Washington, DC, 2005.

M. E. Sorensen and S. P. DeWeerth, "Functional Consequences of Model Complexity on Global Performance of Neuron Models," presented at Neuroscience 2005, Washington, D.C., 2005.

M. E. Sorensen and S. P. DeWeerth, "Systematic reduction of a bursting neuron model," presented at IEEE Engineering in Medicine and Biology Conference, Shanghai, PRC, 2005.

M. Sorensen, R. L. Calabrese, and S. P. DeWeerth, "Analyzing the dimensionality of a bursting neuron model," presented at Society for Neuroscience, San Diego, CA, 2004.

C. A. Williams and S. P. DeWeerth, "Resonance tuning in a hybrid neuromechanical system," presented at Society for Neuroscience, San Diego, CA, 2004.

K. K. Williams, K. Sundar, S. Hochman, and S. P. DeWeerth, "Time and frequency domain evaluation of various motor activities evoked in the isolated neonatal rat spinal cord," presented at Society of Neuroscience, San Diego, CA, 2004.

Y. Zhong, G. C. McConnell, J. D. Ross, S. P. DeWeerth, and R. V. Bellamkonda, "In vitro and in vivo study of a novel drug releasing coating for implanted neural electrodes," presented at NPP Workshop, Washington, DC, 2004.

J. D. Ross, S. M. O'Connor, R. A. Blum, E. A. Brown, and S. P. DeWeerth, "Multielectrode impedance tuning: reducing noise and improving stimulation efficacy," presented at IEEE Engineering in Medicine and Biology, 2004.

J. D. Ross, R. Madhavan, S. M. Potter, E. A. Brown, and S. P. DeWeerth, "The effect of electrode impedance on stimulation of dissociated cultures," presented at Society for Neuroscience, San Diego, CA, 2004.

S. K. Das, R. A. Blum, J. D. Ross, E. A. Brown, and S. P. DeWeerth, "Integrated circuits for extracellular interfacing to neural tissue," presented at GEDC Industry Advisory Board, Atlanta, GA, 2004.

M.E. Sorensen, G.S. Cymbalyuk, R.L. Calabrese, and S.P. DeWeerth, Control of rhythmic activity with intrinsic current in a hybrid half-center oscillator. Society for Neuroscience Annual Meeting, Orlando, FL, November 2002.

M.F. Simoni and S.P. DeWeerth, Sensorimotor Feedback in a closed-loop model of biological rhythmic movement control. Joint BMES/EMBS Conference, Houston, TX, October 2002.

M.E. Sorensen, G.S. Cymbalyuk, R.L. Calabrese, and S.P. DeWeerth, Effect of a hyperpolarization-activated inward current on rhythmic activity in a hybrid half-center oscillator. Joint BMES/EMBS Conference, Houston, TX, October 2002.

S.P. DeWeerth, M.E. Sorensen, G.S. Cymbalyuk, and R.L. Calabrese, Dynamical Properties of Hybrid Neural-Microelectronic Oscillators. Proceedings of the Biomedical Engineering Society Conference, Durham, NC, October 2001.

J.A. Bragg, T.A. Hudson, and S.P. DeWeerth, A real-time analog VLSI model of a skeletal motor unit. Proceedings of the Biomedical Engineering Society Conference, Durham, NC, October 2001.

M. E. Sorensen, M. F. Simoni, G. S. Cymbalyuk, R. L. Calabrese, and S. P. DeWeerth, "Hybrid systems: Interfacing living neurons and microelectronic models," presented at Houston Society for Engineering in Medicine and Biology Annual Conference, 2001.

M.E. Sorensen, G.S. Cymbalyuk, R.L. Calabrese, and S.P. DeWeerth, Dynamic Properties of a Hybrid Neuro-Microelectronic Half-Center Oscillator. Society for Neuroscience Annual Meeting, San Diego, CA, October 2001.

J.A. Bragg, T.A. Hudson, D.C. Lin, and S.P. DeWeerth, Real-Time Implementation of a Huxley Crossbridge-Based Sarcomere Model. Society for Neuroscience, New Orleans, LA, November 2000.

M.F. Simoni, M. Sorensen, G. Cymbalyuk, R.L. Calabrese, and S.P. DeWeerth, Building Hybrid Systems Using a VLSI Model of the Leech Heart Interneuron. Society for Neuroscience, New Orleans, LA, November 2000.

P.S. Garcia, R.T. Ellis, R.L. Calabrese, S.P. DeWeerth, R.J. Butera, and W.L. Ditto, Computing with neuronal dynamics. Society for Neuroscience, Vol. 26 (1580), New Orleans, LA, November 2000.

T.A. Hudson, J.A. Bragg, E.A. Brown, D.C. Lin, and S.P. DeWeerth, An analog VLSI model of muscular contraction. Abstracts of the 20<sup>th</sup> Anniversary Conference on Advanced Research in VLSI, Atlanta, GA, 1999.

J.D. Neff, B.K. Meadows, W.L. Ditto, G.N. Patel, and S.P. DeWeerth, Array-enhanced stochastic resonance in a VLSI neuronal array. Abstracts of the 20<sup>th</sup> Anniversary Conference on Advanced Research in VLSI, Atlanta, GA, 1999.

M.F. Simoni, G.N. Patel, and S.P. DeWeerth, Analog VLSI models of central pattern-generating circuits. Abstracts of the 20<sup>th</sup> Anniversary Conference on Advanced Research in VLSI, Atlanta, GA, 1999.

T.A. Hudson, J.A. Bragg, E.A. Brown, D.C. Lin, and S.P. DeWeerth, Development of a sarcomere model using hardware. Joint BMES/EMBS Conference, Vol. 1 (552), Atlanta, GA, 1999.

M.F. Simoni, G.N. Patel, and S.P. DeWeerth, Sensory feedback in an intersegmentally coupled network. Proceedings of the Satellite Meeting on Computational Modeling at Neural Control of Movement, Key West, FL, April 1998.

T.H. Zobel, J.A. Bragg, E.A. Brown, D.C. Lin, T.R. Nichols, and S.P. DeWeerth, Simulation of circuits for implementation of muscular contraction model. Proceedings of the Satellite Meeting on Computational Modeling at Neural Control of Movement, Key West, FL, April 1998.

G.N. Patel and S.P. DeWeerth, Towards analog VLSI models of segmented locomotory systems, Neurons, Networks, and Motor Behavior Symposium, Tuscon, AZ, November 1995.

## **Patents and Invention Disclosures**

E. A. Brown, J. D. Neff, S. P. DeWeerth, P. Hasler, and B. K. Meadows, "Method and apparatus for an improved nonlinear oscillator," patent no. 6,822,522, 2004.

Yoonsu Choi, Mark G. Allen, James Ross, Stephen P. DeWeerth, "Microfabricated Mechanically Actuated Microtool and Methods," U.S. Patent Number 7,461,882, 2008.

R. A. Blum, E. A. Brown, S. P. DeWeerth, and J. D. Ross, "Integrated Circuit for Stimulation Artifact Rejection," U.S. Patent Application, 2006.

S. P. DeWeerth, J. D. Ross, and E. A. Brown, "Impedance Controlled Electroplating Device," invention disclosure, 2006.

[Invention disclosure, Rick and Kate, 2007](#)

[Invention disclosure, Liang, 2008](#)

## **Research Supervision**

### **Postdoctoral Fellows and Research Faculty**

David C. Lin, Postdoctoral Fellow

Period of involvement: 1997–1999 (co-supervised with T. Richard Nichols)

Present position: Assistant Professor, Washington State University

Michael E. Sorensen, Postdoctoral Fellow

Period of involvement: 2005

Present position: Postdoctoral Fellow, Emory University

Stefan Clemens, Instructor (Research Faculty)

Period of involvement: 2004–2008

Present position: Assistant Professor, East Carolina University School of Medicine

Edgar Brown, Research Engineer II (Research Faculty)

Period of involvement: 2000–present

### **Ph.D. Graduates**

Denise M. Wilson, Ph.D. (ECE 1995)

Thesis topic: Analog VLSI Architectures for Chemical Sensing Microsystems

Present position: Associate Professor, University of Washington

Tonia G. Morris, Ph.D. (ECE 1996)

Thesis topic: Analog VLSI Visual Attention Systems

Present position: Engineering Manager, Intel Corporation

Clinton D. Knight, Ph.D. (ECE 1998)

Thesis topic: Remote Testing of Analog VLSI Circuits

Present position: Engineering Manager, IBM

Girish N. Patel, Ph.D. (ECE 1998)

Thesis topic: Neuromorphic VLSI Systems for Motor-Pattern Generation

Present position: Research Engineer, Microtune, Inc.

Tina M. Hudson, Ph.D. (ECE 2000)

Thesis topic: Hardware Models of Skeletal Muscle

Present position: Assistant Professor, Rose–Hulman Institute of Technology

Mario F. Simoni, Ph.D. (ECE 2002)

Thesis topic: The Effects of Sensorimotor Feedback on Neuronal Oscillators

Present position: Assistant Professor, Rose–Hulman Institute of Technology

Julian Alex Bragg, M.D., Ph.D. (Bioengineering 2002)

Thesis topic: Hardware Models of Biological Motor Units

Present position: Resident, Department of Neurology, Emory University

Michael E. Sorensen, Ph.D. (Bioengineering 2005)

Thesis title: Functional Consequences of Model Complexity in Hybrid Neural-Microelectronic Circuits

Present position: President, Simatra Technologies

Carrie A. Williams, Ph.D. (Bioengineering 2006)

Thesis title: Influence of Sensorimotor Feedback on the Energetic Cost and Stability of Biological Rhythmic Movement: A Computational Study of Resonance Tuning

Present position: Postdoctoral Fellow, Emory University

Michael S. Reid, Ph.D. (ECE 2006)

Thesis title: The Role of Heterogeneity in Rhythmic Networks of Neurons

Present position: Research Engineer, IBM

Richard A. Blum, Ph.D. (ECE, 2007)

Thesis title:

Present Position: Research Engineer, Integrated Device Technology, Inc.

Jevin Scrivens, Ph.D. (BioE/ME, 2007)

Thesis title:

Present Position: Research Engineer, Mako Surgical Corp.

Shane A. Migliore, Ph.D. (ECE, 2007)

Thesis title:

Present Position: Research Engineer, Sandia National Laboratories

James D. Ross, Ph.D. (Bioengineering, 2008)

Thesis title:

Present Position: Chief Science Officer, Axion Biosystems, Inc.

Kathleen W. Meacham, Ph.D. (Biomedical Engineering, 2008)

Thesis title:

Present Position: Medical student, Emory University School of Medicine

### **Current Ph.D. Students**

Liang Guo

Research topic: Elastic electrode arrays for neural interfacing

Michelle Kuykendal

Research topic: Modeling and control of selective extracellular stimulation

Dustin Li

Research topic: Feedback modulation of rhythmic movement

Sarah Steinmetz

Research Topic: Rhythmic tuning in reptile locomotion  
Co-advised with Dan Goldman (Physics, Georgia Tech)

Kartik Sundar

Research topic: Effects of muscle nonlinearities on closed-loop control

JoAnna Todd

Research topic: Control of spinal motor circuits using optimized stimulation  
Co-advised with Shawn Hochman (Physiology, Emory)

## **M.S. Thesis/Research Graduates**

Chris Burnette, 1992 Fall, Algorithmic VLSI design

Chris Himmel, 1993 Spring, Analog VLSI circuits for robot control

Brannon Harris, 1995 Winter, Analog VLSI modeling of skeletal muscle

Rob Taylor, 1996 Fall, A mechanical model of the mammalian oculomotor plant

Jason Meeks, 1999 Fall, Mechanical models of skeletal muscle

Joseph Fernald, 1999 Fall, Analog circuits for focal-plane imagers

Mara Carey, 2000 Fall, Analog VLSI circuits for muscle modeling

Samir Das, 2005 Spring, Neural stimulation

A. Scott Buscemi, 2007 Spring, MEA-based neural stimulation systems

Lauren Reese, 2008 Summer, Oscillatory tuning via sensory feedback in non-resonant systems

## **Grants and Contracts**

**As Principal or Co-Principal Investigator (Total as PI: \$15.4M; Total as Co-PI: \$5.6M)**

**BME/Neurology seed grant program**

Closed-Loop Control of Spinal Motor Circuits using a Multi-electrode Interface (PI)

National Institutes of Health—R01

\$1,388,628, 2007 February – 2011 January

Center for Behavioral Neuroscience—GT Subcontract (PI)

National Science Foundation—Science and Technology Center

\$1,557,194, 1999 November – 2009 October

Center for Behavioral Neuroscience—GT Subcontract (PI)

Georgia Research Alliance

\$1,500,000, 1999 November – 2009 October

Hybrid Neural Microsystems: Integrating Neural Tissue and Engineered Systems (PI)

National Science Foundation — Integrative Graduate Education and Research

Traineeship (IGERT)

\$3,967,717, 2003 September – 2009 August

A 3-D Microfluidic/electronic Neural Interfacing System (PI)  
National Institutes of Health—Bioengineering Research Partnership  
\$7,188,997, 2002 September – 2008 August

Advancing Neural Modeling Methods and Technology (Co-PI)  
National Institutes of Health—R01  
\$1,259,658, 2003 May – 2007 April

Software and Hardware Tools for Hybrid Systems Analysis (Co-PI)  
National Institutes of Health—R21/R33  
\$885,984, 2002 February – 2006 January

Implementation and Analysis of Neuromorphic Motor-Pattern Generating Systems (PI)  
National Science Foundation  
\$450,000, 2002 September – 2005 August

A Distributed Programming Infrastructure for Integrating Smart Sensors (Co-PI)  
National Science Foundation – Information Technology Research Program  
\$1,350,000, 2001 October – 2004 September

GRA Sensors Cluster (Co-PI)  
Georgia Research Alliance  
\$600,000, 2001 July – 2003 June

A VLSI Model of Muscular Mechanics, Architecture, and Control (PI)  
National Science Foundation  
\$252,444, 1998 October – 2002 September

A Distributed Programming Infrastructure for Integrating Smart Sensors (Co-PI)  
Georgia Tech Broadband Institute  
\$120,000, 2000 July – 2002 June

A Large-Scale, Heterogeneous, Cross-Bridge-Based Model of Muscle using Analog VLSI Circuits (PI)  
Whitaker Foundation  
\$177,117, 1999 January – 2001 December

Hybrid Parallel/Serial Attentive Processing Systems for Image Computation (PI)  
Intel Corporation  
\$142,555, 1998 January – 2000 December

Research in Focal-Plane Imaging (PI)  
NHK (Japan Broadcasting Corporation)  
\$20,000, 1999 August – 2000 July

The Laboratory for Neuroengineering (PI)  
GT Focused Research Program Initiative  
\$30,000, 1999 July – 2000 June

Analog VLSI Modeling of Intersegmental Coordination (PI)  
National Science Foundation  
\$319,749, 1995 August – 1999 July

Dupont Young Faculty Grant (PI)  
Dupont Corporation  
\$75,000, 1996 July – 1999 June

Georgia Center for Neural Computation and Communication (Co-PI)

Georgia Research Alliance

\$1,100,000, 1996 July – 1998 June

Research Experiences for Undergraduates (PI)

National Science Foundation

\$4,000, 1996 September – 1997 June

An Object-Based Environment for Remote Testing of Electronic and Optoelectronic Systems (PI)

AT&T Special-Purpose Grant

\$25,000, 1993 December – 1996 November

VLSI Implementation of Visual-Based Attentive Processing (PI)

Army Research Laboratories

\$10,000, 1996 May – 1996 October

Analog-VLSI and Computer Modeling of the Leech Circulatory System (Co-PI)

Emory/Georgia Tech Biomedical Technology Research Center

\$28,000, 1995 July – 1996 June

Neural Feedback for Computational Vision (Co-PI)

Georgia Tech Research Institute

\$120,016, 1994 March – 1996 February

Remote Testing of High-Speed Optoelectronics (Co-PI)

AT&T Special-Purpose Grant

\$45,000, 1994 December – 1995 November

Analog VLSI Modeling of the Leech Circulatory System (PI)

Emory/Georgia Tech Biomedical Technology Research Center

\$25,000, 1994 July – 1995 June

Automated Testing of Optoelectronic Systems (equipment grant) (Co-PI)

Keithley Instruments

\$6,691, 1995 March

Automated and Remote Testing of Analog VLSI Systems (PI)

AT&T Special-Purpose Grant

\$25,000, 1993 December – 1994 November

Curriculum for Very Large-Scale Integration (PI)

Georgia Tech Foundation, Curriculum Grant

\$7500, 1993 July – 1994 June

Automated Design and Test of Analog VLSI Systems (equipment grant) (PI)

Keithley Instruments, Inc.

\$32,915, 1993 October

Infrared Imaging Array Integrated in Three Dimensions (Co-PI)

Office of Naval Research

\$91,982, 1992 April – 1993 March

Testing of Analog VLSI Circuits (equipment grant) (PI)

Tektronix, Inc.

\$2355, 1992 May

**As Investigator/Participant (Total: \$89.0M)**

Center for Behavioral Neuroscience  
National Science Foundation—Science and Technology Center  
\$38,000,000, 1999–2009  
Role: Member of Executive Committee, Director of Innovative Technology Initiative

BME Departmental Naming Grant  
Coulter Foundation  
\$25,000,000, 2000–2005  
Role: Member of the BME faculty

BME Departmental Leadership–Development Award  
Whitaker Foundation  
\$16,000,000, 2000–2005  
Role: Director of the Neuroengineering Research Thrust

Low-Cost Electronics Packaging Research Center  
National Science Foundation—Engineering Research Center  
\$10,000,000, 1994–1999  
Role: Member of the Systems-Integration Thrust for three years