

# R. JACOB VOGELSTEIN

JACOB.VOGELSTEIN@JHUAPL.EDU  
631 D STREET NW #533, WASHINGTON, DC 20004  
HOME: 202.483.1539 CELL: 443.858.8666 FAX: 309.403.1539

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## EDUCATION

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**Ph.D. in Biomedical Engineering**, Johns Hopkins University, Baltimore, MD (2001–2007)

- Awarded a National Science Foundation Graduate Research Fellowship.
- Conducted interdisciplinary research in neuroscience and electrical engineering.
- Dissertation: “Towards a spinal neuroprosthesis: restoring locomotion after spinal cord injury.”

**Sc.B. in Bio-Electrical Engineering**, Brown University, Providence, RI (1996–2000)

- Graduated with highest honors.
- Received the Engineering Department’s Outstanding Student Award.

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## PROFESSIONAL EXPERIENCE

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**Senior professional staff**, Johns Hopkins University Applied Physics Laboratory, Laurel, MD (2007–Present)  
*Neuroscience Section, Biomedical Engineering Group, National Security Technology Department*

**Lawrence Hafstad fellow and assistant research professor**, Johns Hopkins University, Baltimore, MD  
*Department of Electrical and Computer Engineering*

- Lead engineer: Revolutionizing Prosthetics 2009 Neural Interface
  - Design a system architecture that supports bidirectional communications with neurons in the central and peripheral nervous systems for the purposes of controlling and feeding back sensory information from a robotic neuroprosthetic upper limb.
  - Lead a team of engineers building hardware to wirelessly communicate with and control implanted neural interfaces.
  - Lead a team of engineers developing embedded software to encode and decode neural signals in real-time.
  - Work with academic collaborators to design and implement non-human primate neuroscience experiments and FDA-approved human clinical trials.
- Principal investigator: Applied Neuroscience / Neuroprosthetics
  - Identify and solicit new and synergistic research and development programs in the fields of applied neuroscience and neuroprosthetics.
  - Write whitepapers and grants, and respond to sponsor requests, in the areas of applied neuroscience and neuroprosthetics.

**Post-doctoral researcher**, Johns Hopkins University, Baltimore, MD (2007)

*Department of Electrical and Computer Engineering*

- Develop strategies to allow an amputee to sense and control a prosthetic limb via direct links to the central and peripheral nervous systems.
- Design and debug hardware and embedded software for recording and analysis of electromyographic signals.

**Technical consultant**, Singular Computing, Baltimore, MD (2007–Present)

<http://www.singularcomputing.com>

- Design neurally-inspired mixed-signal circuits for a novel computing architecture.
- Assist with development of a long-term strategy for the company’s core technology.

**Partner**, Global Domain Partners, LLC., Baltimore, MD (2006–Present)

<http://www.globaldomainpartners.com>

- Develop algorithms based on neuroscience models and neural network theory for commodity, currency, and equity trading on the futures market.
- Assist with strategic planning for sales and marketing.
- Participate in business development efforts, including client meetings and fundraising.

**Co-founder**, Stealth Mobile, LLC., New York, NY (2006–2007)

<http://www.stealthmob.com>

- Created an online Java-based mobile services application framework.
- Assisted with development of the company's business model and client outreach.
- Sold the company's intellectual property to Mobile Commons for an equity stake in the parent company.

**Research engineer**, City University of New York Graduate Center, New York, NY (2001)

*Department of Speech and Hearing Sciences*

- Designed a portable data acquisition system for real-time data collection from test subjects in the field.
- Helped design psychophysics experiments and created software for experiments.

**Software programmer**, Johns Hopkins Medical Institute, Baltimore, MD (1997)

*Oncology Center*

- Performed “Monte Carlo” statistical analyses on large databases of gene sequence data.
- Developed and released a new version of SAGE (Serial Analysis of Genetic Expression) software.

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## ACADEMIC EXPERIENCE

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**Graduate research assistant**, Johns Hopkins University, Baltimore, MD (2001–2007)

*Research advisor: Ralph Etienne-Cummings, Department of Electrical and Computer Engineering*

*Department advisor: Nitish V. Thakor, Department of Biomedical Engineering*

- Developed prototypes of a spinal neuroprosthesis that uses electrical stimulation of central and peripheral neurons to restore locomotion in paralyzed individuals.
- Conducted *in vivo* and *in vitro* experiments on vertebrate and invertebrate animal models.
- Used VLSI design techniques to create reconfigurable neuromorphic microchips containing large arrays of silicon neurons for use in real-time simulations of neural networks.

**Research assistant**, New York University Medical Center, New York, NY (2000)

*Primary advisor: John Welsh, Department of Physiology*

- Conducted *in vivo* physiology experiments to investigate theories of cerebellar motor learning.
- Conducted behavioral experiments to illuminate the mechanisms of myoclonus.

**Research assistant**, Mount Sinai School of Medicine, New York, NY (1999)

*Primary advisor: Ehud Kaplan, Department of Physiology and Biophysics*

- Designed and conducted *in vivo* experiments employing optical imaging of the visual cortex.
- Acquired single-cell electrophysiology recordings while performing electrical stimulation of larger groups of neurons in the brain.

**Research assistant**, Johns Hopkins Medical Institute, Baltimore, MD (1998)

*Primary advisor: Gislin Dagnelie, Lions Vision Research and Rehabilitation Center*

- Designed a set of strategies for implementing a cortical visual prosthesis in a blind subject.
- Conducted a study with human subjects to evaluate the effectiveness of phosphene-based vision.

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## TEACHING EXPERIENCE

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**Primary instructor and course creator**, Product Design Lab (2007 – Present)  
*Johns Hopkins University, Department of Electrical and Computer Engineering, Baltimore, MD*

**Teaching assistant**, Biomedical Signals and Dynamic Systems (2005)  
*Johns Hopkins University, Department of Biomedical Engineering, Baltimore, MD*

**Teaching assistant**, Models of the Neuron (2004)  
*Johns Hopkins University, Department of Biomedical Engineering, Baltimore, MD*

**Teaching assistant**, Instrumentation Design (1999)  
*Brown University, Department of Electrical Engineering, Providence, RI*

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## HONORS

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**Region 2 finalist**, IEEE Engineering in Medicine and Biology Society Student Paper Competition (2004)

**Best paper finalist**, IEEE International Conference on Electronics, Circuits, and Systems (2004)

**Graduate Research Fellow**, National Science Foundation (2003–2006)

**Outstanding Student Award**, Brown University Department of Engineering (2000)

*Magna cum laude (highest honors)*, Brown University (2000)

**Member**, *Tau Beta Pi* engineering honor society (2000–2007)

**Member**, *Sigma Xi* science honor society (2000–2007)

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## TECHNICAL COMMITTEE MEMBERSHIP

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IEEE Circuits and Systems Society Neural Systems and Applications Technical Committee (2007–Present)

IEEE Circuits and Systems Society Sensory Systems Technical Committee (2008–Present)

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## REVIEWING AND EDITING

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**Review editor**, *Frontiers in Neurorobotics* (2007–Present)

**Reviewer**, *Advances in Neural Information Processing Systems* (2008–Present)

**Reviewer**, *IEEE Transactions on Biomedical Circuits and Systems* (2007–Present)

**Reviewer**, *IEEE Sensors Journal* (2007–Present)

**Reviewer**, *IEEE Transactions on Circuits and Systems II* (2006–Present)

**Reviewer**, *IEEE Transactions on Circuits and Systems I* (2006–Present)

**Reviewer**, IEEE Transactions on Neural Systems and Rehabilitation Engineering (2005–Present)

**Reviewer**, IEEE Transactions on Neural Networks (2005–Present)

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## JOURNAL PUBLICATIONS

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**R. J. Vogelstein**, F. Tenore, L. Guevremont, R. Etienne-Cummings, and V. K. Mushahwar, “A silicon central pattern generator controls locomotion *in vivo*,” *IEEE Transactions on Biomedical Circuits and Systems*, vol. 2, no. 3, pp. 212–222, 2008.

**R. J. Vogelstein**, U. Mallik, E. Culurciello, G. Cauwenberghs, and R. Etienne-Cummings, “A multi-chip neuromorphic sensory information processing system,” *Neural Computation*, vol. 19, no. 9, pp. 2281–2300, 2007.

**R. J. Vogelstein**, U. Mallik, J. T. Vogelstein, and G. Cauwenberghs, “Dynamically reconfigurable silicon array of spiking neurons with conductance-based synapses,” *IEEE Transactions on Neural Networks*, vol. 18, no. 1, pp. 253–265, 2007.

**R. J. Vogelstein**, F. Tenore, R. Etienne-Cummings, M. A. Lewis, N. V. Thakor, and A. H. Cohen, “Dynamic control of the central pattern generator for locomotion,” *Biological Cybernetics*, vol. 95, no. 6, pp. 555–566, 2006.

**R. J. Vogelstein**, R. Etienne-Cummings, N. V. Thakor, and A. H. Cohen, “Phase-dependent effects of spinal cord stimulation on locomotor activity,” *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, vol. 14, no. 3, pp. 257–265, 2006.

V. Velculescu, L. Zhang, W. Zhou, **J. Vogelstein**, M. A. Basrai, D. E. Bassett Jr., P. Heiter, B. Vogelstein, and K. W. Kinzler, “Characterization of the yeast transcriptome,” *Cell*, vol. 88, pp. 243–251, 1997.

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## CONFERENCE PROCEEDINGS

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R. S. Armiger and **R. J. Vogelstein**, “Air-Guitar Hero: a real-time video game interface for training and evaluation of dexterous upper-extremity neuroprosthetic control algorithms,” *Proceedings of the IEEE Biomedical Circuits and Systems Conference* (Baltimore, MD), 2008. (In press)

P. Pouliquen, **R. J. Vogelstein**, and R. Etienne-Cummings, “Practical considerations for the use of a Howland current source for neuro-stimulation,” *Proceedings of the IEEE Biomedical Circuits and Systems Conference* (Baltimore, MD), 2008. (In press)

S. Chen, F. Folowosele, D. Kim, **R. J. Vogelstein**, E. Culurciello, R. Etienne-Cummings, “Size and position invariant human posture recognition algorithm with spike based image sensor,” *Proceedings of the IEEE Biomedical Circuits and Systems Conference* (Baltimore, MD), 2008. (In press)

F. Folowosele, **R. Jacob Vogelstein**, R. Etienne-Cummings, “Real-time silicon implementation of V1 in hierarchical visual information processing,” *Proceedings of the IEEE Biomedical Circuits and Systems Conference* (Baltimore, MD), 2008. (In press)

S. Bensmaia, S. S. Kim, A. Sripati, **R. J. Vogelstein**, “Conveying tactile feedback using a model of mechanotransduction,” *Proceedings of the IEEE Biomedical Circuits and Systems Conference* (Baltimore, MD), 2008. (In press)

- W. Bishop, B. M. Yu, G. Santhanam, A. Afshar, S. I. Ryu, K. V. Shenoy, **R. J. Vogelstein**, J. Beaty, and S. Harshbarger, "The use of a virtual integration environment for the real-time implementation of neural decode algorithms," *Proceedings of the 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 2008.
- W. Bishop, R. Armiger, J. Burck, M. Bridges, M. Hauschild, K. Englehart, E. Scheme, **R. J. Vogelstein**, J. Beaty, and S. Harshbarger, "A real-time virtual integration environment for the design and development of neural prosthetic systems," *Proceedings of the 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 2008.
- F. Tenore, R. Armiger, **R. J. Vogelstein**, D. Wenstrand, S. Harshbarger, and K. Englehart, "An embedded controller for a 7-degree of freedom prosthetic arm," *Proceedings of the 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 2008.
- F. O. Folowosele, **R. J. Vogelstein**, and R. Etienne-Cummings, "Spike-based MAX networks for nonlinear pooling in hierarchical vision processing," *Proceedings of the IEEE Biomedical Circuits and Systems Conference* (Montreal, Canada), 2007.
- F. Tenore, **R. J. Vogelstein**, and R. Etienne-Cummings, "Sensor-based dynamic control of the central pattern generator for locomotion," *Proceedings of the IEEE International Symposium on Circuits and Systems* (New Orleans, LA), 2007.
- R. J. Vogelstein**, R. Etienne-Cummings, N. V. Thakor, and A. H. Cohen, "Dynamic control of spinal locomotion circuits," *Proceedings of the IEEE International Symposium on Circuits and Systems* (Kos, Greece), 2006.
- F. Tenore, **R. J. Vogelstein**, R. Etienne-Cummings, G. Cauwenberghs, and P. Hasler, "A floating-gate programmable array of silicon neurons for central pattern generating networks," *Proceedings of the IEEE International Symposium on Circuits and Systems* (Kos, Greece), 2006.
- R. J. Vogelstein**, N. V. Thakor, R. Etienne-Cummings, and A. H. Cohen, "Electrical stimulation of a spinal central pattern generator for locomotion," *Proceedings of the International IEEE EMBS Conference on Neural Engineering* (Arlington, VA), pp. 475–478, 2005.
- F. Tenore, **R. J. Vogelstein**, R. Etienne-Cummings, M. A. Lewis, and P. Hasler, "A spiking silicon central pattern generator with floating gate synapses," *Proceedings of the IEEE International Symposium on Circuits and Systems* (Kobe, Japan), vol. 4, pp. 4106–4109, 2005.
- U. Mallik, **R. J. Vogelstein**, E. Culurciello, R. Etienne-Cummings, and G. Cauwenberghs, "A real-time spike-domain sensory information processing system," *Proceedings of the IEEE International Symposium on Circuits and Systems* (Kobe, Japan), vol. 3, pp. 1919–1922, 2005.
- R. J. Vogelstein**, U. Mallik, G. Cauwenberghs, E. Culurciello, and R. Etienne-Cummings, "Saliency-driven image acuity modulation on a reconfigurable silicon array of spiking neurons," *Advances in Neural Information Processing Systems 16* (Y. Weiss, B. Scholkopf, and J. Platt, eds.), pp. 1457–1464, Cambridge, MA: MIT Press, 2005.
- R. J. Vogelstein**, U. Mallik, E. Culurciello, G. Cauwenberghs, and R. Etienne-Cummings, "Spatial acuity modulation of an address-event imager," *Proceedings of the 11th IEEE International Conference on Electronics, Circuits and Systems* (Tel Aviv, Israel), pp. 207–210, 2004.
- R. J. Vogelstein**, K. Murari, P. H. Thakur, C. Diehl, S. Chakrabartty, and G. Cauwenberghs, "Spike sorting with support vector machines," *Proceedings of the 26th Annual International Conference of the IEEE Engineering in Medicine and Biology Society* (San Francisco, CA), vol. 1, pp. 546–549, 2004.

**R. J. Vogelstein**, U. Mallik, and G. Cauwenberghs, “Silicon spike-based synaptic array and address-event transceiver,” *Proceedings of the International Symposium on Circuits and Systems* (Vancouver, Canada), vol. 5, pp. 385–388, 2004.

**R. J. Vogelstein**, F. Tenore, R. Philipp, M. S. Adlerstein, D. H. Goldberg, and G. Cauwenberghs, “Spike timing-dependent plasticity in the address domain,” *Advances in Neural Information Processing Systems 15* (S. Becker, S. Thrun, and K. Obermayer, eds.), pp. 1147–1154, Cambridge, MA: MIT Press, 2003.

G. Dagnelie and **J. V. Vogelstein**, “Phosphene mapping procedures for prosthetic vision,” *Vision Science and its Applications: OSA Technical Digest*, pp. 294–297, Washington, DC: Optical Society of America, 1999.

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#### **ABSTRACTS, POSTERS, AND CONTRIBUTED TALKS (PEER-REVIEWED)**

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**R. J. Vogelstein**, L. Guevremont, F. Tenore, V. Mushahwar, and R. Etienne-Cummings, “A silicon central pattern generator controls locomotion *in vivo*,” *Neural Interfaces Workshop* (Bethesda, MD), 2006.

**R. J. Vogelstein**, N. V. Thakor, R. Etienne-Cummings, and A. H. Cohen, “Electrical stimulation of a spinal central pattern generator for locomotion,” *Neural Interfaces Workshop* (Bethesda, MD), 2004.

**R. J. Vogelstein**, F. Tenore, R. Philipp, M. S. Adlerstein, D. H. Goldberg, and G. Cauwenberghs, “A scalable neuromorphic architecture for spike-timing-based learning in silicon,” *7th International Conference on Cognitive and Neural Systems* (Boston, MA), 2003

**J. Vogelstein** and G. Dagnelie, “Phosphene mapping strategies for a cortical visual prosthesis,” *29th Neural Prosthesis Workshop* (Bethesda, MD), 1998.

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#### **INVITED ARTICLES AND TALKS (NOT REVIEWED)**

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**R. J. Vogelstein**, U. Mallik, and G. Cauwenberghs, “Beyond address-event communication: dynamically-reconfigurable spiking neural systems,” *The Neuromorphic Engineer*, vol. 1, no. 1, 2004.

**R. J. Vogelstein**, U. Mallik, G. Cauwenberghs, “Silicon hardware for rapid prototyping of spiking neural networks and spike-based learning rules,” *NIPS Workshops* (Whistler, Canada), 2003.

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#### **MISCELLANEOUS PUBLICATIONS**

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J. T. Vogelstein, **J. V. Vogelstein**, and B. Vogelstein, “Testing the effects of genetic variations using MINIME technology,” *Science*, vol. 286, pp. 2300–2301, 1999.

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#### **CITIZENSHIP**

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United States of America