

DREW A. HALL

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An updated version may be available online.

EDUCATION

Stanford University Stanford, CA	Ph.D. in Electrical Engineering Advisers: Shan X. Wang and Boris Murmann	2011
Stanford University Stanford, CA	MS in Electrical Engineering Advisers: Shan X. Wang and Boris Murmann	2008
University of Nevada, Las Vegas Las Vegas, NV	BS in Computer Engineering Minor in Applied Mathematics with honors, <i>summa cum laude</i>	2005

RESEARCH INTERESTS

My broad research interests lie in the design of mixed-signal biomedical ICs and high performance biochips. I am interested in addressing applications such as *in-vitro* diagnostics, DNA sequencing, proteomics, point-of-care (POC) testing, neural detection and stimulation, healthcare monitoring, and smart medical devices. My general strategy is to leverage the advantages of IC design, VLSI systems, nanotechnology, and MEMS to improve the performance of existing technologies or develop new novel devices that can address the various challenges of biotechnology.

AWARDS AND HONORS

NSF CAREER Award	<i>National Science Foundation program designed to support junior faculty in their dual roles as teacher-scholars. CAREER Awards provide recipients the opportunity to enhance their professional career development, better integrate their research and education responsibilities, and build academic leadership abilities</i>	2015
Undergraduate Teaching Award	<i>Recipient of the ECE department's annual teaching award for excellence in undergraduate education</i>	2014
Hellman Fellowship	<i>Recipient of the Hellman Fellowship for interdisciplinary research</i>	2014
ARCS Fellowship	<i>Recipient of the national Achievement Rewards for College Scientists (ARCS) fellowship for someone who will contribute to the nation's scientific and technological strength</i>	2010
1 st place Stanford BASES E-Challenge Business Plan Competition	<i>Winner of the Business Association of Stanford Entrepreneurial Students (BASES) business plan competition on the nanoLAB, a handheld point-of-care diagnostic device for global health</i>	2010
1 st place in IEEE Change the World Competition	<i>Winner (Student Humanitarian Supreme) of the inaugural international invention competition for "nanoLAB: A Hand-Held Diagnostic Laboratory."</i>	2009
1 st place in BME-IDEA Invention Competition	<i>Winner of the national bioengineering invention competition for "Lab-on-a-stick: A Hand-Held Diagnostic Laboratory"</i>	2009
Tau Beta Pi Fellow	<i>One of 35 engineering students selected nationally, Fife No. 70</i>	2005
1 st place in IEEE Micromouse Competition	<i>Winner of the southwest regional (region 6) Micromouse (an autonomous maze solving robot) competition</i>	2005

PUBLICATIONS (H-INDEX: 13)

Ph.D. Thesis

Drew A. Hall, "GMR Spin-Valve Biochips and Interface Electronics for Ultrasensitive *in-vitro* Diagnostics," Ph.D. Thesis, Stanford University, 2011.

Committee: Shan X. Wang (Adviser), Boris Murmann (Co-Adviser), Bruce Wooley, Hector Garcia-Molina

Journal Papers (Peer Reviewed)

- J23. Po-Han Peter Wang, Haowei Jiang, Li Gao, Pinar Sen, Young-Han Kim, Gabriel M. Rebeiz, Patrick P. Mercier, and **Drew A. Hall**, "A Near-Zero-Power Wake-up Receiver Achieving -69 dBm Sensitivity," *Journal of Solid-State Circuits (JSSC)*, In Press.
- J22. Xiahan Zhou, Chih-Cheng Huang, and **Drew A. Hall**, "Giant Magnetoresistive Biosensor Array for Detecting Magnetorelaxation," *IEEE Transactions on Biomedical Circuits and Systems (TBioCAS)*, vol. 11, no. 4, pp. 755-764, Aug. 2017.
- J21. Alexander Sun, Tom Phelps, Chengyang Yao, A. G. Venkatesh, Douglas Conrad, and **Drew A. Hall**, "Smartphone-based pH Sensor for at Home Monitoring of Pulmonary Exacerbations in Cystic Fibrosis," *Sensors*, vol. 17, no. 6, p. 1245, May 2017.
- J20. Chih-Cheng Huang, Xiahan Zhou, and **Drew A. Hall**, "Giant Magnetoresistive Biosensors for Time-Domain Magnetorelaxometry: A Theoretical Investigation and Progress Toward an Immunoassay," *Scientific Reports*, vol. 17, p. 45493, Apr 2017.
- J19. Christoph Carter, Kevan Akrami, **Drew Hall**, Davey Smith, and Eliah Aronoff-Spencer, "Lyophilized Visually Readable Loop-Mediated Isothermal Reverse Transcriptase Nucleic Acid Amplification Test for Detection Ebola Zaire RNA," *Journal of Virological Methods*, vol. 244, pp. 32-38, Jun. 2017.
- J18. Haowei Jiang, Alex Sun, A. G. Venkatesh, and **Drew A. Hall**, "An Audio Jack-Based Electrochemical Impedance Spectroscopy Sensor for Point-of-Care Diagnostics," *IEEE Sensors Journal*, vol. 17, no. 3, pp. 589-597, Feb. 2017.
- J17. E. Aronoff-Spencer, A.G. Venkatesh, A. Sun, H. Brickner, D. Looney, and **D. A. Hall**, "Detection of Hepatitis C core antibody by dual-affinity yeast chimera and smartphone-based electrochemical sensing," *Biosensors and Bioelectronics*, vol. 86, pp. 690-696, Dec. 2016.
- J16. A. Sun, A.G. Venkatesh, and **D. A. Hall**, "A Multi-Technique Reconfigurable Electrochemical Biosensor: Enabling Personal Health Monitoring in Mobile Devices," *IEEE Transactions on Biomedical Circuits and Systems (TBioCAS)*, vol. 10, no. 5, pp. 945-954, Oct. 2016. **(Invited paper)**
- J15. Jung-Rok Lee, D. James Haddon, Nidhi Gupta, Jordan V. Price, Grace M. Credo, Vivian K. Diep, Kyunglok Kim, **Drew A Hall**, Emily C. Baechler, Michelle Petri, Madoo Varma, Paul J. Utz, and Shan X. Wang, "High Resolution Analysis of Antibodies to Post-Translational Modifications Using Peptide Nanosensor Microarrays," *ACS Nano*, vol 10, no. 12, pp. 10652-10660, Sep. 2016.
- J14. Jung-Rok Lee, Noriyuki Sato, Daniel Bechstein, Sebastian Osterfeld, Junyi Wang, Adi Gani, **Drew Hall**, and Shan Wang, "Experimental and theoretical investigation of the precise transduction mechanism in giant magnetoresistive biosensors," *Scientific Reports*, vol. 6, p. 18692, Jan. 2016.
- J13. Chung-Lun Hsu, A. G. Venkatesh, Howie Jiang, and **Drew A. Hall**, "A Hybrid Semi-Digital Transimpedance Amplifier with Noise-Cancellation Technique for Nanopore-Based DNA Sequencing," *Transaction on Biomedical Circuits and Systems (TBioCAS)*, vol. 9, no. 5, pp. 652-661, Nov 2015. **(Invited paper.)**
- J12. Brandon Hong, Alexander Sun, Lin Pang, A.G. Venkatesh, **Drew Hall**, and Yeshaiahu Fainman, "Integration of Faradaic electrochemical impedance spectroscopy into a scalable surface plasmon biosensor for in tandem detection," *Optics Express*, vol. 23, no. 23, pp. 30237-30249, Nov. 2015.

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- J11. Daniel J. B. Bechstein, Elaine Ng, Jung-Rok Lee, Stephanie G. Cone, Richard S. Gaster, Sebastian J. Osterfeld, **Drew A. Hall**, James A. Weaver, Robert J. Wilson and Shan X. Wang, "Microfluidic multiplexed partitioning enables flexible and effective utilization of magnetic sensor arrays," *Lab on a Chip*, vol. 15, no. 22, pp. 4273–4276, Oct. 2015.
- J10. A.G. Venkatesh, Alex Sun, Howard Brickner, David Looney, **Drew A. Hall**, and Eliah Aronoff-Spencer, "Yeast Dual-Affinity BioBricks: Progress Towards Renewable Whole-Cell Biosensors", *Biosensors and Bioelectronics*, vol. 70, pp. 462–468, Aug. 2015.
- J9. Dokyoon Kim, Francesco Marchetti, Zuxiong Chen, Sasa Zaric, Robert J. Wilson, **Drew A. Hall**, Richard S. Gaster, Jung-Rok Lee, Junyi Wang, Sebastian J. Osterfeld, Heng Yu, Robert M. White, William F. Blakely, Leif Peterson, Sandhya Bhatnagar, Brandon Manion, Serena Tseng, Kristen Roth, Matthew Coleman, Antoine Snijders, Andrew J. Wyrobek, Francesco Marchetti, and Shan X. Wang, "Nanosensor dosimetry of mouse blood proteins after exposure to ionizing radiation," *Scientific Reports*, 3, 2013.
- J8. **Drew A. Hall**, Richard S. Gaster, Kofi Makinwa, Shan X. Wang, and Boris Murmann, "A 256 pixel magnetoresistive biosensor microarray in 0.18 μ m CMOS," *Journal of Solid State Circuits*, 48, 1290-1301, 2013.
- J7. Richard S. Gaster, Liang Xu, Shu-Jen Han, Robert J. Wilson, **Drew A. Hall**, Sebastian J. Osterfeld, Heng Yu, and Shan X. Wang, "Quantification of Protein Interactions and Solution Transport Using High-Density GMR Sensor Arrays," *Nature Nanotechnology*, 6, 314-320, 2011.*
**This paper is highlighted in Nature Nanotechnology – 6, 266-267 (2011).*
- J6. R.S. Gaster, **D.A. Hall**,[†] Shan X. Wang, "nanoLAB: An ultraportable, hand-held diagnostic laboratory for global health," *Lab on a Chip*, 11, 950-956, 2011.**
†These authors contributed equally to this work.
***This article was one of the top ten accessed articles in February 2011.*
- J5. Richard S. Gaster, **Drew A. Hall**, Shan X. Wang, "Autoassembly Protein Arrays for Analyzing Antibody Cross-Reactivity," *Nano Letters*,* 11, 2579-2583, 2011.
**Selected for June 2011 cover art.*
- J4. **D.A. Hall**, R.S. Gaster, T. Lin, S.J. Osterfeld, S. Han, B. Murmann, and S.X. Wang, "GMR biosensor arrays: a system perspective," *Biosensors and Bioelectronics*, 25, 2051-2057, 2010.
- J3. **D.A. Hall**, R.S. Gaster, S.J. Osterfeld, B. Murmann, and S.X. Wang, "GMR biosensor arrays: correction techniques for reproducibility and enhanced sensitivity," *Biosensors and Bioelectronics*, 25, 2177-2181, 2010.
- J2. Richard S. Gaster,[†] **Drew A. Hall**,[†] Carsten Neilson, Sebastian J. Osterfeld, Heng Yu, Kathleen Mach, Robert J. Wilson, Boris Murmann, Joseph C Liao, Sanjiv S. Gambhir, Shan X. Wang, "Matrix-insensitive protein assays push the limits of biosensors in medicine," *Nature Medicine*, 15, 1327-1332, 2009.**
†These authors contributed equally to this work.
***This paper is highlighted in Nature – 461, 890-891 (2009).*
- J1. S. J. Osterfeld, H. Yu, R. S. Gaster, S. Caramuta, L. Xu, S.-J. Han, **D. A. Hall**, R. J. Wilson, S. Sun, R. L. White, R. W. Davis, N. Pourmand, and S. X. Wang, "Multiplex Protein Assays Based on Real-Time Magnetic Nanotag Sensing," *PNAS*, 105, 20637-20640, 2008.

Conference Papers (Peer Reviewed)

- C24. Haowei Jiang,* Xiahan Zhou,* Saurabh Kulkarni, Michael Uranian, Rajesh Seenivasan, and **Drew A. Hall**, "A Sub-1 μ W Multiparameter Injectable BioMote for Continuous Alcohol Monitoring," *Custom Integrated Circuits Conference (CICC)*, To Appear.
- C23. Chung-Lun Hsu, Alexander Sun, Yunting Zhao, Eliah Aronoff-Spencer, and **Drew A. Hall**, "A 16 \times 20 Electrochemical CMOS Biosensor Array with In-Pixel Averaging Using Polar Modulation," *Custom Integrated Circuits Conference (CICC)*, To Appear.
- C22. Chung Lun Hsu and **Drew A. Hall**, "A Current Measurement Front-end with 160dB Dynamic Range and 7 ppm INL," *IEEE International Solid-State Circuits Conference (ISSCC)*, San Francisco, CA, Feb. 12-14, 2018.

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- C21. Chih-Cheng Huang, Xiahan Zhou, Da Ying, and **Drew A. Hall**, "A GMR-Based Magnetic Flow Cytometer Using Matched Filtering," *Proceedings of IEEE Sensors*, Glasgow, Scotland, Oct. 30 – Nov. 1, 2017.
- C20. Bassem Ibrahim, **Drew A. Hall**, and Roozbeh Jafari, "Bio-Impedance Spectroscopy (BIS) Measurement System for Wearable Devices," *IEEE Biomedical Circuits and Systems Conference (BioCAS)*, Turin, Italy, Oct. 19-21, 2017.
- C19. Xiahan Zhou, Chih-Cheng Huang, and **Drew A. Hall**, "Magnetoresistive Biosensors for Quantitative Proteomics," *Proceedings of SPIE Optics + Photonics*, San Diego, CA, Aug. 6-10, 2017.
- C18. Po-Han Peter Wang, Haowei Jiang, Li Gao, Pinar Sen, Young-Han Kim, Gabriel M. Rebeiz, Patrick P. Mercier, and **Drew A. Hall**, "A 400 MHz 4.5 nW -63.8 dBm Sensitivity Wake-Up Receiver Employing an Active Pseudo-Balun Envelope Detector," *IEEE European Solid-State Circuits Conference (ESSCIRC)*, Leuven, Belgium, Sep. 12-14, 2017.
- C17. Alexander Sun, Enrique Alvarez, A. G. Venkatesh, Eliah Aronoff-Spencer, and **Drew A. Hall**, "A 64×64 High-Density Redox Amplified Coulostatic Discharge-Based Biosensor Array in 180nm CMOS," *IEEE European Solid-State Circuits Conference (ESSCIRC)*, Leuven, Belgium, Sep. 12-14, 2017.
- C16. Tom Phelps, Haowei Jiang, and **Drew A. Hall**, "Development of a Smartphone-Based Pulse Oximeter with Adaptive SNR/Power Balancing," *IEEE Engineering in Medicine and Biology Conference (EMBC)*, Jeju Island, Korea, July 11-15, 2017.
- C15. Somok Mondal and **Drew A. Hall**, "An ECG Chopper Amplifier Achieving 0.92 NEF and 0.85 PEF with AC-Coupled Inverter-Stacking for Noise Efficiency Enhancement," *International Symposium on Circuits and Systems (ISCAS)*, Baltimore, MD, May 29-31, 2017.
- C14. Somok Mondal, Chung-Lun Hsu, Roozbeh Jafari, and **Drew Hall**, "A Dynamically Reconfigurable ECG Analog Front-End with a 2.5× Data-Dependent Power Reduction," *Custom Integrated Circuits Conference (CICC)*, Austin, TX, May 1-3, 2017.
- C13. Haowei Jiang, Po-Han Peter Wang, Li Gao, Pinar Sen, Young-Han Kim, Gabriel M Rebeiz, **Drew A Hall**, and Patrick P Mercier, "A 4.5nW Wake-Up Radio with -69dBm Sensitivity," *International Solid State Circuits Conference (ISSCC)*, San Francisco, CA, February 6-8, 2017.
- C12. B. Hong, A. Sun, L. Pang, A. G. Venkatesh, **D. Hall**, and Y. Fainman, "Integrated biosensor for simultaneous detection by surface plasmon resonance and Faradaic electrochemical impedance spectroscopy," *Conference on Lasers and Electro-Optics*, San Jose, CA, June 10, 2016.
- C11. **Drew A. Hall**, Jonathan S. Daniels, Bibiche Geuskens, Nouredine Tayebi, Grace M. Credo, David J. Liu, Handong Li, Kai Wu, Xing Su, Madoo Varma, and Oguz H. Elibol, "A nanogap transducer array on 32 nm CMOS for electrochemical DNA sequencing," *International Solid State Circuit Conference (ISSCC)*, San Francisco, CA, January 31st – February 4th, 2016.
- C10. Chung-Lun Hsu, Tiantian Zhang, Yu-Hwa Lo, and **Drew A. Hall**, "A Low-Noise Gain-Enhanced Readout Amplifier for Induced Molecular Electronic Signal," *Biomedical Circuits and Systems Conference (BioCAS)*, Atlanta, Ga, October 22-24, 2015.
- C9. Alex Sun, Travis Wambach, A. G. Venkatesh, and **Drew A. Hall**, "A Multitechnique Reconfigurable Electrochemical Biosensor for Integration into Mobile Technologies," *Biomedical Circuits and Systems Conference (BioCAS)*, Atlanta, Ga, October 22-24, 2015.
- C8. Qingxue Zhang, **Drew A. Hall**, and Roozbeh Jafari, "An ECG Dataset Representing Real-world Signal Characteristics for Wearable Computers," *Biomedical Circuits and Systems Conference (BioCAS)*, Atlanta, Ga, October 22-24, 2015.
- C7. Alex Sun, Anthony Au, A. G. Venkatesh, Vikash Gilja, and Drew A. Hall, "A Scalable High-Density Electrochemical Biosensor Array for Parallelized Point-of-Care Diagnostics," *Biomedical Circuits and Systems Conference (BioCAS)*, Atlanta, Ga, October 22-24, 2015.
- C6. Chengyang Yao, Alexander Sun, and **Drew A. Hall**, "Efficient Power Harvesting from the Mobile Phone Audio Jack for mHealth Peripherals", *Global Humanitarian Technology Conference (GHTC)*, Seattle, WA, October 8-11, 2015.

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- C5. Chengzhi Zong, Somok Mondal, **Drew Hall**, and Roozbeh Jafari, "Digitally Assisted Analog Front-end Power Management Strategy via Dynamic Reconfigurability for Robust Heart Rate Monitoring," *7th Workshop on Adaptive and Reconfigurable Embedded Systems (APRES)*, Seattle, WA, April 13-17, 2015.
- C4. Chung-Lun Hsu, A. G. Venkatesh, Howie Jiang, and **Drew A. Hall**, "Hybrid Semi-Digital Transimpedance Amplifier for Nanopore-Based DNA Sequencing," *Biomedical Circuits and Systems Conference (BioCAS)*, Lausanne, Switzerland, October 22-24, 2014.
- C3. Alexander Sun, Travis Wambach, A. G. Venkatesh, and **Drew A. Hall**, "A Low-Cost Smartphone-Based Electrochemical Biosensor for Point-of-Care Diagnostics," *Biomedical Circuits and Systems Conference (BioCAS) 2014*, Lausanne, Switzerland, October 22-24, 2014. **Included live demonstration at BioCAS.*
- C2. **Drew A. Hall**, Richard S. Gaster, Sebastian J. Osterfeld, Kofi Makinwa, Shan X. Wang, Boris Murmann, "A 256 Channel Magnetoresistive Biosensor Microarray for Quantitative Proteomics," *Symp. VLSI Circuits Dig.*, Kyoto, Japan, July 15-17, 2011.
- C1. **Drew A. Hall**, Richard S. Gaster, Shan X. Wang, Boris Murmann, "Portable biomarker detection with magnetic nanotags," *IEEE International Symposium on Circuits and Systems (ISCAS)*, Paris, France, June 3rd, 2010.

Conference Talks

- CT5. **Drew A. Hall**, "Magnetoresistive Biosensors for Quantitative Proteomics," *CMOS ETR*, Grenoble, France, July 6-8, 2014.
- CT4. S.X. Wang, R.S. Gaster, **D.A. Hall**, "Wash-free multiplex protein assay based on magnetic nanotechnology and its applications in cancer research," *Digest of International Magnetism Conf.*, * Taipei, Taiwan, April 25-29, 2011. **Invited talk.*
- CT3. **Drew A. Hall**, Calvin Chu, Andrew Dotey, Jr., Richard S. Gaster, Kofi Makinwa, Boris Murmann, Shan X. Wang, "A GMR Spin-Valve Integrated into a Continuous Time $\Sigma\Delta$ Modulator for Quantitative, Real-Time Biosensing," *Digest of International Magnetism Conf.*, Taipei, Taiwan, April 25-29, 2011.
- CT2. **D. A. Hall**, R. S. Gaster, H. Yu, S. J. Osterfeld, B. Murmann, S. X. Wang, "Multiplexed GMR Biosensor Arrays," *Digest of International Magnetism Conf.*, Sacramento, CA, May 5-8, 2009.
- CT1. **Drew A. Hall**, Tondra De, "A New Approach to Maze Searching and Solving Techniques for Small Autonomous Mobile Robots," *IEEE Southwest Region Meeting*, * Los Angeles, CA, September 9-10, 2005. **Best Student Paper Award Winner.*

Books and Book Chapters

- B2. Richard S. Gaster, **Drew A. Hall**, and Shan X. Wang, "Magnetic Nanoparticle Diagnostic Chips," invited book chapter in *Point of Care Diagnostics on a Chip*, Springer (Edited by Robert Westervelt and David Issadore), 2013.
- B1. **Drew A. Hall**, Richard S. Gaster, and Shan X. Wang, "GMR Biosensors," invited book chapter in *Handbook of Spin Transport and Magnetism*, Taylor & Francis (Edited by Evgeny Tsybmal and Igor Žurić), 2011.

Patents

- P3. Oguz H Elibol, Grace M Credo, Xing Su, Madoo Varma, Jonathan S Daniels, **Drew Hall**, Handong Li, Nouredine Tayebi, Kai Wu, "High throughput biochemical detection using single molecule fingerprinting arrays," US Patent (Provisional Filed, US and International Pending).
- P2. **Drew A. Hall**, Richard Gaster, Sebastian J. Osterfeld, and Shan X. Wang, "Temperature and Drift Compensation in Magnetoresistive Sensors," US Utility Patent No. 8,405,385 (International Pending).
- P1. Richard Gaster, Shan X. Wang, and **Drew A. Hall**, "Wash-free Analyte Detection Assay," US Patent (Provisional Filed, US and International Pending).

PROFESSIONAL EXPERIENCE

Tau Beta Pi Faculty Mentor (2014-Present)

Served on NSF review panels (2015-Present)

Served on UCSD Academic Integrity Review Board (2013-2015)

Served on NSF CAREER review panel (2013-2017)

Served on UCSD ECE Undergraduate Affairs Committee (2012-2014)

Served as a student representative on Stanford's Faculty Search Committee (2010-2011)

Conducted paper reviews for: JSSC, InterMag, JAP, AnalChem, Biosensors, ISCAS, TBioCAS, Sensors, Biosensors and Bioelectronics, Lab on a Chip

Associate editor of IEEE Transactions on Biomedical Circuits and Systems (TBioCAS) (2015-Present)

Technical program committee member for the Custom Integrated Circuits Conference (CICC) (2017-Present)