

# Shantanu Chakrabartty

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Washington University in St. Louis.  
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## RESEARCH INTERESTS

Analog computing and Analog integrated circuits with focus on: (a) Energy scavenging and self-powered sensors, circuits and systems; (b) biomedical and implantable circuits and systems; (c) neuromorphic engineering; (d) neuromorphic systems; (e) floating-gate circuits and systems.

## EDUCATION

**The Johns Hopkins University**, Baltimore, MD

*Ph.D., Electrical and Computer Engineering, 2004.*

*Dissertation:* Design and Implementation of Ultra-low-power Pattern Recognizers and Sequence Decoders;

*Advisor:* Gert Cauwenberghs

**The Johns Hopkins University**, Baltimore MD

*M.S., Electrical and Computer Engineering, 2001.*

**Indian Institute of Technology**, New Delhi

*B.Tech, Electrical Engineering, 1996.*

## PROFESSIONAL EXPERIENCE

**Washington University**, St. Louis, MO

**7/2015 – Present**

*Professor, Department of Electrical and Systems Engineering*

*Professor (by courtesy), Department of Biomedical Engineering*

*Professor (by courtesy), Department of Computer Science and Engineering*

**Michigan State University**, East Lansing, MI

**7/2010 – 6/2015**

*Associate Professor, Department of Electrical and Computer Engineering*

**Michigan State University**, East Lansing, MI

**1/2012 – 6/2015**

*Adjunct Professor, Department of Biosystems Engineering*

**Piezonix LLC.**, East Lansing, MI

**5/2013 – Present**

*Co-founder and Chief Scientific Officer*

**Data Guild Inc.**, Palo Alto, California

**7/2013 – Present**

*Affiliate*

**Michigan State University**, East Lansing, MI

**8/2004 – 6/2010**

*Assistant Professor, Department of Electrical and Computer Engineering*

**The Johns Hopkins University**, Baltimore, MD

**5/1999 – 8/2004**

*Research Assistant, Electrical and Computer Engineering*

**University of Tokyo**, Tokyo, Japan

**9/2002 - 12/2002**

*Visiting Researcher, Department of Informatics*

**Qualcomm Incorporated**, San Diego, CA

**1/1996 – 5/1999**

*Engineer, Network and Switching Subsystem Group*

## **AWARDS AND HONORS**

- *MSU Innovation of the Year Award, 2012.*
- *NSF CAREER Award, 2010.*
- *MSU Teacher-Scholar Award, 2011.*
- *Alumni, U.S. National Academy Frontiers of Engineering.*
- *Honorary Mention, Best Paper Award, IEEE ISCAS 2015.*
- *Best Paper Award in Sensory Systems, IEEE ISCAS 2014.*
- *Best Paper Award in Sensory Systems, IEEE ISCAS 2013.*
- *Honorary Mention, Best Paper Award, IEEE ISCAS 2012.*
- *Honorary Mention, Best Paper Award, IEEE ISCAS 2011.*
- *Invited Member, Defense Science Research Council, USA, 2006.*
- *Catalyst Foundation Fellow, 1999-2004.*
- *Academic Frontiers Student Exchange Scholarship (Japanese Govt.), 2002.*
- *Best Undergraduate Thesis, IIT Delhi, 1996.*
- *National Talent Search Scholarship Recipient, India, 1990.*
- *Junior Talent Search Scholarship Recipient, India, 1989.*

## **TEACHING**

*Courses:*

- *Analog Integrated Circuits, Spring 2009, Spring 2010, 2012, 2014.*
- *Introduction to Mixed-signal Integrated Circuits, Fall 2007,2008,2009,2010,2011,2012,2014.*
- *Biomedical Instrumentation, Fall 2007.*
- *Low-power analog and mixed-signal VLSI systems, Michigan State University, Fall 2004, Spring 2006, Spring 2007. Spring 2008*
- *Mixed-signal Prototyping and Testing, Michigan State University, Spring 2005.*
- *Algorithms of Circuit Design, Michigan State University, Fall 2005, Fall 2006.*
- *Introduction to Electronic Instrumentation, Washington University, Spring 2016.*
- *Analog Integrated Circuits, Washington University, Fall 2015, Fall 2016.*

## **INVITED PRESENTATIONS AND TUTORIALS**

- *Expeditions in Self-powered Sensing, Tutorial at IEEE Sensors, Orlando, 2016.*
- *Zero-power Dynamic Signature for Trust Verification of Passive Sensors and Tags, Global Research Consortium, Bangalore, India, Jan. 2016 (Host: William Joyner Jr.).*

- *Expeditions in Self-powered Sensing, Computing and Imaging*, Department of Biomedical Engineering, Washington University in St. Louis, MO, Nov. 2015 (Host: Prof. Baranidharan Raman).
- *Expeditions in Floating-gate Circuits and Systems: Self-powered sensing and computing*, Department of Electrical and Computer Engineering, Stony Brook University, NY, Dec. 2013 (Host: Prof. Milutin Stanacevic).
- *Expeditions in Floating-gate Circuits and Systems: Self-powered sensing and computing*, Department of Electrical and Computer Engineering, Tufts University, MA, Nov. 2013 (Host: Prof. Valencia Koomson).
- *Expeditions in Floating-gate Circuits and Systems: From Self-powered sensors to nano-watt analog processors*, Department of Electrical and Computer Engineering, University of Toronto, Canada, Nov. 2013 (Host: Prof. Roman Genov).
- *Expeditions in Floating-gate Circuits and Systems: From Self-powered sensors to nano-watt analog processors*, Department of Computer Science and Engineering, Washington University, St. Louis, Oct. 2013 (Host: Prof. Viktor Gruev).
- *Approaching limits of sensing using neuromorphic noise-exploitation principles*, SPIE, San Diego, Mar. 2013 (Host: Prof. R.J. Martin-Palma)
- *Reproducing Kernel-based Methods for Extracting and Identifying Noise-robust Speech Features*, IEEE Asilomar Conference on Signal, Systems and Computers, Nov. 2012. (Host: Ghassan Alregib)
- *Noise-exploitation and Adaptation in Neuromorphic Sensors*, SPIE, San Diego, Mar. 2012 (Host: Prof. Akhlesh Lakhtakia).
- *Grand Challenge: Sensing-to-learn and Learning-to-sense – Exploiting biological symbiosis of sensing, computing, memory and adaptation for designing the next-generation of smart sensors*, NSF sponsored US-Japan Joint Workshop on Bioinspired Sensing and Actuation, Berkeley, Nov 12-13, 2011.
- *Morphing, Synthesis and Monitoring: Exploring the trinity of Hybrid Analog Integrated Circuits*, Department of Engineering Mechanics, Penn State University, Apr. 2011 (Host: Prof. Akhlesh Lakhtakia).
- *CMOS Integrated Circuits for Energy Scavenging and Self-powered Sensors*, IEEE Biomedical Circuits and Systems Conference, Paphos, Cyprus, Nov, 2010 (Host: Dr. Jennifer Blain)
- *Designing Microsystems that Learn: Algorithms and Hardware, Pattern Recognition and Machine Intelligence (PReMI09)*, Indian Institute of Technology, Delhi, Dec. 2009 (Host: Prof. Jayadeva).
- *Forward error-correcting biosensors: Hybrid bio-CMOS circuits and systems*, CMOS Emerging Technologies Workshop, Sep. 2009 (Host: Dr. Kris Iniweski).
- *Design of Neuromorphic Data Converters*, Telluride Neuromorphic and Cognitive Workshop, Telluride, Colorado, Jul. 2009 (Host: Prof. John G. Harris).
- *Sigma-Delta Learning: Bridging the gap between neuromorphic systems, machine learning and mixed-signal processing*, Department of Informatics, University of Tokyo, Japan, June

2009 (Host: Prof. Toshihiko Yamasaki).

- *Sensors and Processors for Structural Health Monitoring*, VDEC, University of Tokyo, Japan, June 2009 (Host: Prof. Tadashi Shibata).
- *Operating below the sub-microwatt barrier – Explorations in Analog Computing*, Invited Presentation, Wireless Integrated Microsystems (WIMS), University of Michigan, Ann Arbor, April 2009 (Host: Prof. Jerome K. Lynch).
- *CMOS Circuits for Biomechanical Implants*, Invited Presentation, CMOS Emerging Technologies Workshop, Vancouver, August 2008 (Host: Dr. Kris Inieweski).
- *Sub-microwatt Sensors for Structural Health Monitoring of Biomechanical Implants*, Invited Presentation, Department of Bioengineering, University of California, San Diego, August 2008 (Host: Prof. Gert Cauwenberghs).
- *Towards Reliable Multi-pathogen Biosensors using High-dimensional Encoding and Decoding Techniques*, Invited Presentation, SPIE Symposium on NanoScience+Engineering, CA 2008 (Host: Prof. Gert Cauwenberghs, UCSD) .
- *High-dimensional Encoding-Decoding Techniques for Reliable Pathogen Detection*, Invited Presentation, Hunter College, City University of New York, Feb 2008 (Host: Prof. Hiroshi Matsui).
- *Mixed-signal data mining on microphone array hearing aids*, Invited Presentation, Radio-Frequency Integrated Circuits Symposium, Atlanta Georgia, July, 2008 (Host: Sudipto Chakraborty, Texas Instruments).
- *Trainable Mixed-signal Interfaces*, Invited Presentation, Defense Science Research Council (DSRC) Adaptive Electronics Workshop, Arlington VA, Nov 28<sup>th</sup> 2006 (Host: Prof. Peter Asbeck, UCSD).
- *Micro-power Speaker Verification System-on-chip*, Invited Presentation, Applied Physics Laboratory, Laurel, MD, July 2005 (Host: Dr. Chris P. Diehl).
- *Sequence Learning and Decoding in Margin Propagation Networks*, Invited Presentation, Snowbird Learning Workshop, Snowbird, Utah, April 2005 (Host: Dr. Yoshua Bengio).
- *Hardware-Algorithm Tradeoffs in Implementing Support Vector Machines in Silicon*, PRIP Seminar Series, Michigan State University, 2004 (Host: Prof. Anil Jain).
- *Design of a floating-gate CMOS kernel machine for speech recognition*, Tutorial on Floating Gate Technology, IEEE International Symposium on Circuits and Systems, Phoenix AZ, 2002 (Host: Prof. Paul Hasler, Georgia Tech).
- *A hybrid HMM/SVM speech recognition system*, IEEE Midwest Symposium on Circuits and Systems, Lansing MI, 2000.

## RESEARCH GRANTS AND CONTRACTS

### Current Grants and Contracts

- [G1] Principal Investigator and Project Lead, CPS:TTP Option: Synergy: Collaborative Research: Internet of Self-powered Sensors - Towards a Scalable Long-term Condition-based Monitoring and Maintenance of Civil Infrastructure, **National Science Foundation**,

09/01/2016-08/31/2020, \$1,100,000.

- [G2] Co-Principal Investigator, *Hybrid Chemical Sensing with bio-electronic nose*, **Office of Naval Research**, 06/01/2016-05/31/2019, \$750,000 (Credit: 30%).
- [G3] Principal Investigator and Project Lead, *STARSS: Small: Collaborative: Zero-Power Dynamic Signature for Trust Verification of Passive Sensors and Tags*, **National Science Foundation / Semiconductor Research Corporation**, 8/16/2015 - 8/15/2018, \$450,000.
- [G4] Principal Investigator, *Scavenging Thermal-noise Energy and Quantum Fluctuations for Self-powered Time-stamping and Sensing*, **National Science Foundation**, 8/16/2015 - 8/15/2018, \$344,387.
- [G5] Co-Principal Investigator, *CSR: Medium: Self-organizing Cyber Substrates: Exploring a Modular Computing and Communications Architecture for Structural Health Monitoring*, **National Science Foundation**, 08/01/14-07/30/18, \$1,000,000 (Credit 30%).
- [G6] Co-Principal Investigator, *Ultra-low Power Wireless Sensing System for Multi-metric Self-Powered Monitoring of Bridge Components*, **United States Department of Transportation**, 08/01/13-07/30/17, \$937,135 (Credit 30%).
- [G7] Principal Investigator, *SHF:FAST: A Simulation and Analysis Framework for Designing Large-Scale Biomolecular-Silicon Hybrid Circuits*, **National Science Foundation**, 09/01/11-08/30/16, \$386,602.
- [G8] Principal Investigator, *CAREER: Integrated Research and Education in Self-powered Microsensing for Embedded and Implantable Structural Health Monitoring*, 04/01/10-03/31/16, **National Science Foundation**, CMMI:0954752, \$406,000.

### **Completed Grants and Contracts**

- [G9] Principal Investigator, *Motion Artifact Cancelling MIMO method for Ambulatory Respiratory-rate Monitoring*, National Institute of Health/General Electrical Global Research, 08/01/13-07/31/16, \$164,000.
- [G10] Principal Investigator, *Trusted Verification of CMOS Integrated Circuits using Zero-power Timers and Synchronization Circuits*, **Defense Advanced Research Projects Agency (DARPA)**, 9/1/2014 - 8/31/2015, 133,564.
- [G11] Senior Personnel, *Mechanically-Equivalent Response Amplifiers and Frequency Modulators for Energy-harvesting Devices*, **National Science Foundation**, 8/16/2014 - 8/15/2017, \$324,309.00 (Credit 10%)
- [G12] Principal Investigator, *STTR Phase I: Health Monitoring of Orthopedic Implants using Self-powered Piezo-floating-gate Sensing Technology*, **Piezonix LLC/National Science Foundation**, 07/01/14-12/31/14, \$72,253.
- [G13] Principal Investigator, *Self-powered RFID Sensing for Monitoring Complex Product Supply-chain*, **Midland Research Institute for Value Chain Creation**, 05/20/14-05/19/17, \$300,000.
- [G14] Principal Investigator, *Design and Evaluation of Self-powered Time-stamped Event-logger*, **Johns Hopkins Applied Physics Laboratory/US Department of Navy**, 04/01/14-09/30/14, \$68,000.
- [G15] Co-Principal Investigator, *Smart Pavement Monitoring System*, **Federal Highway Administration** (Contract: DTFH61-13-C-00015), 08/15/13-08/14/16, \$444,944 (Credit

25%).

- [G16] Co-Principal Investigator, *Center for Cyber-enabled Cognitive Structures*, **Strategic Partnership Grant, Michigan State University**, 08/01/13-07/31/16, \$481,000 (Credit 35%).
- [G17] Principal Investigator, *Development of Self-powered Age-monitoring Sensor*, **Targeted Support Grant for Technology Development (TSGTD)**, MSU Foundation, 09/01/12-08/01/13, \$60,000.
- [G18] Principal Investigator, *Fabrication and Testing of Gen-II Age-monitoring Sensors*, **Johns Hopkins Applied Physics Laboratory**, 03/01/12-08/30/12, \$47,574.
- [G19] Principal Investigator, *AIR: Development and Evaluation of Self-Powered Piezo-Floating-Gate Sensor Chipsets for Embedded and Implantable Structural Health Monitoring*, **National Science Foundation**, 08/01/11-07/31/14, \$258,000.
- [G20] Principal Investigator, *Self-powered Age Monitoring Sensors*, **Johns Hopkins Applied Physics Laboratory**, 04/15/11-08/30/11, \$65,000.
- [G21] Principal Investigator, *Low-power Speaker Identification System (LPSIS)*, **Johns Hopkins Applied Physics Laboratory** (sub-contract through MSU Foundation), 10/01/09-07/30/11, \$286,046.
- [G22] Co-Principal Investigator, *Smart Pavement Monitoring System*, **Federal Highway Administration**, Contract: DTFH61-08-C-00015, 08/15/08-08/14/11, \$375,000 (Credit 25%)
- [G23] Principal Investigator, *SGER: Cooperative Learning-Unlearning Algorithms for Identifying Noise Robust Auditory Manifolds*, **National Science Foundation**, IIS: 0836278, 08/01/08-07/31/09, \$62,010.
- [G24] Principal Investigator, Investigation into *non-conventional analog decoders for low-density parity check codes*, **National Science Foundation**, CCF: 0728996, 01/01/07-09/30/10, \$250,000.
- [G25] Principal Investigator, *A sub-microwatt self-powered fatigue sensor*, CMMI: 0700632, **National Science Foundation**, 05/01/07-04/30/10 \$295,999.
- [G26] Principal Investigator, *Development of forward error-correcting biosensor based on molecular biowires*, **National Science Foundation**, ECCS: 0622056, 09/01/06-08/30/10 \$270,000.
- [G27] Principal Investigator, *Development of micro-power VLSI devices*, **Johns Hopkins Applied Physics Laboratory** (sub-contract through MBI International), Contract No: 0905899, 04/01/08-03/31/09, \$75,300.
- [G28] Co-Principal Investigator, *Advanced Microsystems for Neural Information Processing*, **National Institute of Health**, 04/01/06-03/31/08 \$375,000 (Credit 25%).
- [G29] Principal Investigator, *Micropower speaker verification systems*, **Johns Hopkins Applied Physics Laboratory** (sub-contract through MBI), Contract No: 0939031, 12/01/2005-11/30/2006, \$75,000.
- [G30] Principal Investigator, *Development of ultra-low power acoustic sensors*, **Intramural Research Grant Program**, Michigan State University, 12/01/2005-12/14/2007, \$50,000.

## PATENTS

- [P1] S. Chakrabartty, ``*Temperature Compensation Method for High-density Floating-gate Memory*`, US patent: 9,437,602, 09/06/2016
- [P2] S. Chakrabartty, ``*Self-powered Strain-gauge*`, US patent: 9,331,265, Issued: 05/03/2016.
- [P3] S. Chakrabartty, ``*Self-powered Timer Apparatus*`, US patent: 8,963,647 , Issued Feb. 24, 2015.
- [P4] S. Chakrabartty, ``*Margin Decoding Communication System*`, US patent: 8,060,810 , Issued Nov. 15, 2011.
- [P5] S. Chakrabartty, N. Lajnef, N. Elvin, A.Gore, ``*Self-powered Sensor*`, US Patent: 8,056,420, Issued Nov. 15, 2011.
- [P6] S. Chakrabartty, ``*Self-powered Strain-rate Sensor*`, US Patent: 7,757,565, Issued Jul. 20, 2010.
- [P7] S. Chakrabartty, ``*Multiple-input Multiple-output Analog-to-digital Converter*`, US Patent no: 7,479,911, Issued Jan. 20, 2009.
- [P8] S.Chakrabartty, Y. Liu, E.C. Alocilja, ``*A Co-detection Protocol for Trace Detection of Pathogens on a Forward-error Correcting Biosensor*`, Michigan State University Disclosure Reference Number TEC2009-0009, 2009.
- [P9] S. Chakrabartty, W.A. Qureshi, ``*Method and Apparatus for On-Chip Optical Spectroscopy*`, Michigan State University Disclosure Reference Number, TEC2011-0020, 2010.
- [P10] S. Chakrabartty, M.Gu, C.Huang, ``*Temperature Independent Floating-gate Current Memory and Analog Processor*`, US provisional patent: 61/566,251, Filed: 03/13/2012.
- [P11] A. Fazel, S. Chakrabartty, ``*Sparse Auditory Reproducing Kernel (SPARK) Features for Noise-robust Speech and Speaker Recognition*`, US provisional patent: 61/643,550, Filed: 05/07/2012.

## PROFESSIONAL ACTIVITIES

- *Senior Member*, IEEE
- *Member*, American Society for Engineering Education (ASEE)
- *Associate Editor*, IEEE Transactions of Biomedical Circuits and Systems.
- *Associate Editor*, Advances in artificial neural systems, Hindawi Publications.
- *Review Editor*, Frontiers in Neuromorphic Engineering.
- *Chair*, IEEE Circuits and Systems Society, Neural Systems and Applications Technical Committee.
- *Panelist* :
  - National Science Foundation, ECCS, 2006, 2008.
  - National Science Foundation, CISE, 2014, 2015, 2016.
  - National Science Foundation, CMMI, 2007, 2010, 2012.
  - National Science Foundation, IIP, 2011, 2012, 2013, 2014,2015.
- *Panelist* :
  - American Society of Engineering Education, SMART Scholarship, 2012.
  - American Society of Engineering Education, NDSEG Scholarship, 2012.

- *International Panel Reviewer* :
  - Natural Sciences and Engineering Research Council of Canada (NSERC), 2008.
  - Dutch Technology Foundation STW, 2009.
- *Keynote Panel*:
  - Pattern Recognition and Machine Intelligence (PReMI09), IIT Delhi, 2009.
- *Organizing Committee* :
  - IEEE Biomedical Circuits and Systems Conference, San Diego, 2011.
  - IEEE Electro-Information Technology Conference, East Lansing, MI, 2006.
- *Technical Committee Member* :
  - IEEE Circuits and Systems: Sensory Systems
  - IEEE Circuits and Systems: Biomedical circuits and systems
  - IEEE Circuits and Systems: Neural systems and applications.
- *Program Committee Member* :
  - 20th Symposium on Integrated Circuits and Systems Design, 2007.
  - 22nd Symposium on Integrated Circuits and Systems Design, 2009
  - IEEE Biomedical Circuits and Systems Conference, 2006-2011.
  - IEEE Statistical Signal Processing Workshop, Ann Arbor, 2012.
- *Session Chair/Co-chair*:
  - Neural Systems and Applications, ISCAS 2012, Seoul, Korea.
  - Analog Circuits and IC Technology, ISCAS 2009, Taipei, Taiwan.
  - Sensor Networks and Algorithms, ISCAS 2009, Taipei, Taiwan.
  - Image Sensors, ISCAS 2009, Taipei, Taiwan
  - Biomedical Instrumentation and Bioanalysis, BIOCAS 2008, Baltimore, MD, USA.
  - Sigma-Delta Modulators, ISCAS 2007, New Orleans, USA.
- *Reviewer*
  - IEEE Journal of Solid-State Circuits.
  - IEEE transactions on Circuits and Systems I and II (TCAS).
  - IEEE transactions on Signal Processing (TSP).
  - IEEE transactions on Very Large Scale Integration (TVLSI).
  - IEEE transactions on Neural Networks (TNN)
  - IEEE sensor journal
  - IEEE transactions on Biomedical Engineering (TBME)
  - IEEE transactions on Biomedical Circuits and Systems (TBioCAS)
  - IEEE transactions on Neural Systems and Rehabilitation Engineering
  - Pattern Recognition Journal
  - IEEE Communication Letters
  - Advances in fuzzy systems, Hindawi.
  - Fuzzy sets and systems, Elsevier.
  - Sensors and Actuators, Elsevier.
  - Analytical Chemistry
  - IEEE Int. Symp. On Circuits and Systems (ISCAS).

## INSTITUTIONAL SERVICES

- *Chair*, Graduate Studies Committee (Michigan State Univ.), 2011 – 2013
- *Publicity Chair*, (MSU Electrical and Computer Engineering), 2013 – 2015.



- *Member*, Department Advisory Committee (MSU Electrical and Computer Engineering), 2011-2013, 2014 – 2015.
- *Member*, Strategic Research Task force Committee (MSU Electrical and Computer Engineering), 2011- 2015.
- *Member*, College Graduate Studies Committee (Michigan State Univ.), 2011-2012.
- *Advisor*, Computer Engineering, 2015 - current

## GRADUATE ADVISEES

### *Past Graduate Advisees*

- Hassan Aqeel Khan, (Ph.D. Fall 2015) Currently Assistant Professor, National University of Sciences and Technology, Islamabad. (Thesis: Kernel Methods for Biosensing Applications).
- Ming Gu, (Ph.D. Spring 2012) Currently Principal Engineer, Fairchild Semiconductors, California. (Thesis: Theory, synthesis and implementation of current-mode CMOS piecewise-linear circuits using margin propagation).
- Pikul Sarkar, (M.S. Summer 2012). Currently Senior Engineer, LSI Corp., Bangalore, India (Thesis: Programmable and Reconfigurable Strain-powered Micro-data-loggers based on Linear Piezo-Floating-Gate Injectors).
- Amin Fazel, (Ph.D. 2012) Currently Research Staff, *CRS Inc., Auburn Hills, Michigan*. (Thesis: Robust Signal Processing Methods for Miniature Acoustic Sensing, Separation and Recognition).
- Chenling Huang, (Ph.D. 2011) Currently Staff Engineer, *Qualcomm Incorporated, San Diego*. (Thesis: Design and Implementation of Integrated Self-powered Sensors, Circuits and Systems).
- Ravi Shaga, (M.S. 2011) Currently Senior Engineer, *Apple., Cupertino, CA*. (Thesis: Noise-shaping Stochastic Optimization and Online Learning with Applications in Digitally-assisted Analog Circuits).
- Yang Liu, (Ph.D. 2010) Currently CEO and co-founder, *Piezonix LLC, East Lansing*. (Thesis: Forward Error-Correcting Biosensors: Design, Modeling and Fabrication).
- Amit Gore, (Ph.D. 2008) Currently Research Scientist, *General Electric Corporate Research, New York, USA*. (Thesis: Design of High-dimensional Oversampling Converters with On-chip Learning: Theory, Design and Hardware Realization).
- Nizar Lajnef, (Ph.D. 2008) Currently Associate Professor, *Department of Civil and Environmental Engineering, Michigan State University, East Lansing, MI, USA*. (Thesis: Self-powered sensing in structural health and usage monitoring)
- Paul Kucher, (M.S. 2007), Currently Research Scientist, *Johns Hopkins University, Applied Physics Laboratory, Laurel, MD, USA*. (Thesis: Design and evaluation of an automated test platform for large-scale analog floating-gate programming.)
- Cheong Kun, (M.S. 2006) Currently Senior Engineer, *Qualcomm Incorporated, San Diego, CA, USA*. (Thesis: Design, implementation and testing of hybrid algorithmic sigma-delta A/D converters).

### *Current Graduate Advisees*

- Tao Feng, *Ph.D. Candidate* (Expected Fall 2015)
- Kenji Aono, *Ph.D. Candidate* (Expected Fall 2017)
- Mingquan Yuan, *Ph.D. Candidate* (Expected Fall 2017)
- Liang Zhou, *Ph.D. Candidate* (Expected Fall 2017)
- Yarub Alazzawi, *Ph.D. Candidate* (Expected Fall 2017)
- Oindrila Chatterjee, *Ph.D. Candidate* (Expected Fall 2018)
- Ahana Gangopadhyay, *Ph.D. Candidate* (Expected Fall 2018)
- Sri Harsha Kondapalli, *Ph.D. Candidate* (Expected Fall 2018)
- Darshit Mehta, *Ph.D. Candidate* (Expected Fall 2019)

## **PUBLICATIONS**

### **Book Chapters**

- [B1] S.Chakrabartty, N. Lajnef, N.Elvin, A.Elvin, ``Toward Self-powered Sensors and Circuits for Biomechanical Implants'', *VLSI Circuits for Biomedical Applications*, eds. Krzysztof Iniewski, Artech House, 2008.
- [B2] S.Chakrabartty, E.C. Alocilja, Y.Liu, ``Integrated Nano-Bio-VLSI Approach for Designing Error-free Biosensors'', *Nano-biosensors*, eds. Sandro Carrara, Springer, 2010.
- [B3] T. Hindo, S. Chakrabartty, ``Noise-exploitation in Neuromorphic Sensors'', *Engineered Biomimicry: Bioinspiration, Biomimetics and Bioreplication*, eds. A. Lakhtakia, R.J. Martin-Palma, Elsevier, 2013.
- [B4] S. Chakrabartty, ``Asynchronous Self-powered Sensing, Computation and Data-logging'', *Advances in Energy Harvesting Methods*, eds. A. Ertuk, N. Elvin, Springer, 2013.

### **Journal Publications in Chronological order (\* denotes corresponding author)**

- [J1] S. Das\*, H. Salehi, R. Burgueno, S. Chakrabartty, S. Biswas, ``Towards Packet-less Ultrasonic Sensor Networks for Energy Harvesting Structures'', *Computer Communications*, 2017 (To appear).
- [J2] L. Zhou, S. Chakrabartty\*, ``Linearization of CMOS Hot-electron Injectors for Self-powered Monitoring of Biomechanical Strain Variations'', *IEEE Transactions of Biomedical Circuits and Systems*, 2016 (To appear).
- [J3] M. Yuan, K-K. Lu, S. Singamaneni, S. Chakrabartty\*, ``Self-powered Forward Error-correcting Biosensor based on Integration of Paper-based Microfluidics and Self-assembled Quick Response Codes'', *IEEE Transactions of Biomedical Circuits and Systems*, 2016 (To appear).
- [J4] L. Zhou, A. Abraham, S. Tang, S. Chakrabartty\*, ``A 5nW Quasi-linear CMOS Hot-electron Injector for Self-powered Monitoring of Biomechanical Strain Variations'', *IEEE Transactions of Biomedical Circuits and Systems*, 2016, DOI: 10.1109/TBCAS.2016.2523992.
- [J5] M. Yuan, E.C. Alocilja, S.Chakrabartty\*, Self-powered Wireless Affinity-based Biosensor based on Integration of Paper-based Microfluidics and Self-assembled RFID Antennas'', *IEEE Transactions of Biomedical Circuits and Systems*, 2016, DOI: 10.1109/TBCAS.2016.2535245.
- [J6] W. Borchani, K. Aono, N. Lajnef, S. Chakrabartty\*, ``Monitoring Of Post-Operative Bone Healing Using Smart Trauma-Fixation Device with Integrated Self-Powered Piezo-Floating-Gate Sensors'', *IEEE Transactions on Biomedical Engineering*, 2015, DOI:

- 10.1109/TBME.2015.2496237.
- [J7]H. Khan, S. Chakrabartty\*, ``On the Channel Capacity of High-Throughput Proteomic Microarrays'', *IEEE Transactions on Molecular, Biological and Multi-Scale Communications*, vol: 1, no: 1, 2015.
- [J8]M. Yuan, P. Chahal, E.C Alocilja, S. Chakrabartty\*, ``Wireless Biosensing Using Silver-Enhancement Based Self-assembled Antennas in Passive Radio Frequency Identification (RFID) Tags'', *IEEE Sensors Journal*, vol: 15, no: 8, pp. 4442-4450, 2015.
- [J9]T. Feng, K. Aono, T. Covassin, S. Chakrabartty\*, `` Self-powered Monitoring of Repeated Head Impacts using Time-dilation Energy Measurement Circuit'', *IEEE Transactions on Biomedical Circuits and Systems*, vol:9, no:2, pp. 217-226, 2015.
- [J10] T. Feng\*, N. Lajnef, S. Chakrabartty, ``Design of a CMOS System-on-Chip for Passive, Near-field Ultrasonic Energy Harvesting and Back-telemetry'', *IEEE Transactions on Very Large Scale Integration*, 2015, DOI: 10.1109/TVLSI.2015.2401037.
- [J11] N. Lajnef, W. Borchani, R. Burgueno, S. Chakrabartty\*, ``Self-powered Piezo-floating-gate Smart-gauges based on Quasi-static Mechanical Energy Concentrators and Triggers'', *IEEE Sensors Journal*, vol. 15, no: 2, pp.676-683, 2015.
- [J12] T. T. Nguyen\*, T. Feng, P. Häfliger, S. Chakrabartty, ``Hybrid CMOS Rectifier based on Synergistic RF-Piezoelectric Energy Scavenging'', *IEEE Transactions of Circuits and Systems – I*, vol. 61, no: 12, pp.3330-3338, 2014.
- [J13] M. Yuan, Alocilja E. C., S. Chakrabartty\*, ``A Novel Biosensor based on Silver-enhanced Self-assembled Radio-frequency Antennas'', *IEEE Sensors Letters*, vol. 14, no: 4, pp. 941-942, 2014.
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### **Refereed Conference Publications in Chronological Order**

- [C1] L. Zhou, A. Abraham, S. Tang, S. Chakrabartty ``Approaching the Limits of Piezoelectricity Driven Hot-Electron Injection for Self-Powered in-Vivo Monitoring of Micro-Strain Variations’’, IEEE Symposium of Circuits and Systems (ISCAS 2016), Montreal, Canada, 2016.
- [C2] Y. Alazzawi, S. Chakrabartty, ``Design of CMOS Telemetry Circuits for In-vivo Wireless Sonomicrometry’’, IEEE Symposium of Circuits and Systems (ISCAS 2016), Montreal, Canada, 2016.
- [C3] L. Zhou, S. Chakrabartty `` Self-powered Sensing and Time-stamping of Rare Events using CMOS Fowler-Nordheim Tunneling Timers’’, IEEE Symposium of Circuits and

Systems (ISCAS 2016), Montreal, Canada, 2016.

- [C4] K. Aono, N. Lajnef, F. Faridazar, S. Chakrabartty, "Infrastructure Health Monitoring Using Self-Powered Internet-of-Things", IEEE Symposium of Circuits and Systems (ISCAS 2016), Montreal, Canada, 2016.
- [C5] M. Yuan, E.C. Alocilja, S. Chakrabartty, "Self-powered Wireless Biosensing based on Integration of Paper-based Microfluidics with Self-assembling RFID Antennas", IEEE Conference on Biomedical Circuits and Systems (BioCAS 2015), Atlanta, USA, 2015.
- [C6] Y. Alazzawi, C. Qian, S. Chakrabartty, "Feasibility of Non-Contact Ultrasound Generation using Implanted Metallic Surfaces as Electromagnetic Acoustic Transducers", IEEE Conference on Biomedical Circuits and Systems (BioCAS 2015), Atlanta, USA, 2015.
- [C7] L. Zhou, S. Chakrabartty, "Design of Low-Gm Transconductors using Varactor-based Degeneration and Linearization Technique", IEEE Conference on Biomedical Circuits and Systems (BioCAS 2015), Atlanta, USA, 2015.
- [C8] M. Yuan, P. Chahal, E.C. Alocilja, S. Chakrabartty, "Sensing by Growing Antennas: A Novel Approach for Designing Passive RFID based Biosensors", IEEE Symposium on Circuits and Systems (ISCAS 2015), Lisbon, Portugal, 2015.
- [C9] L. Zhou, S. Chakrabartty, "A Continuous-time Varactor-based Temperature Compensation Circuit for Floating-gate Multipliers and Inner-product Circuits", IEEE Symposium on Circuits and Systems (ISCAS 2015), Lisbon, Portugal, 2015 (Honorary mention for best paper award).
- [C10] B. Fang, T. Feng, M. Zhang, S. Chakrabartty, "Feasibility of B-mode Diagnostic Ultrasound Energy Transfer and Telemetry to a  $\text{cm}^2$  sized Deep-tissue Implant", IEEE Symposium on Circuits and Systems (ISCAS 2015), Lisbon, Portugal, 2015.
- [C11] N. Lajnef, R. Burgueno, W. Borchani, S. Chakrabartty, "Sub-Hz Self-Powered Sensing Based on Mechanical-Buckling Driven Hot-Electron Injection", IEEE Symposium on Circuits and Systems (ISCAS 2014), Melbourne, Australia, 2014 (Best paper award).
- [C12] L. Zhou, S. Chakrabartty, "A 7-Transistor-Per-Cell, High-Density Analog Storage Array with  $500\mu\text{V}$  Update Accuracy and Greater Than 60dB Linearity", IEEE Symposium on Circuits and Systems (ISCAS 2014), Melbourne, Australia, 2014.
- [C13] M. Gu, S. Chakrabartty, "A Bias-Scalable Current-Mode Analog Support Vector Machine Based on Margin Propagation", IEEE Symposium on Circuits and Systems (ISCAS 2014), Melbourne, Australia, 2014.
- [C14] K. Aono, T. Covassin, S. Chakrabartty, "Monitoring of Repeated Head Impacts Using Time-Dilation Based Self-Powered Sensing", IEEE Symposium on Circuits and Systems (ISCAS 2014), Melbourne, Australia, 2014.
- [C15] N. Lajnef, S. Chakrabartty, R. Burgueno, W. Borchani, "Quasi-static self-powered sensing and data logging", Proceedings of SPIE NDE/Smart Structures, San Diego, USA, 2014.
- [C16] S. Chakrabartty, N. Lajnef, "Compressive Piezo-floating-gate sensors for self-powered sensing of wide-dynamic-range mechanical events", Proceedings of SPIE NDE/Smart Structures, San Diego, USA, 2014.
- [C17] M. Gu, S. Chakrabartty, "A 120dB Input Dynamic Range, Current-Input Current-Output CMOS Logarithmic Amplifier with 230ppm/K Temperature Sensitivity", IEEE Midwest

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- [C18] M. Gu, S. Chakrabartty, ``Bias-Scalable Inner-Product Approximation Circuit Using Analog Margin Propagation'', IEEE Midwest Symposium on Circuits and Systems (MWSCAS 2013), Columbus, Ohio, 2013.
- [C19] L. Zhou, P. Sarkar, S. Chakrabartty, ``Scavenging Thermal-Noise Energy for Implementing Long-Term Self-Powered CMOS Timers'', IEEE Symposium on Circuits and Systems (ISCAS 2013), Beijing, China, 2013.
- [C20] P. Sarkar, S. Chakrabartty, ``A Compressive Piezoelectric Front-End Circuit for Self-Powered Mechanical Impact Detectors'', IEEE Symposium on Circuits and Systems (ISCAS 2013), Beijing, China, 2013.
- [C21] S. Chakrabartty, ``Approaching limits of sensing using neuromorphic noise-exploitation principles'', SPIE Smart Structures and Materials + Nondestructive Evaluation and Health Monitoring, San Diego, California, 2013.
- [C22] S. Chakrabartty, T. Feng, K. Aono, ``Gen-2 RFID compatible, zero down-time, programmable mechanical strain-monitors and mechanical impact detectors'', SPIE Smart Structures and Materials + Nondestructive Evaluation and Health Monitoring, San Diego, California, 2013.
- [C23] S. Chakrabartty, ``Reproducing Kernel-based Methods for Extracting and Identifying Noise-robust Speech Features'', IEEE Asilomar Conference on Signal, Systems and Computers, Nov. 2012.
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- [C25] F. Tao, S. Chakrabartty, ``Analysis and Design of High-Efficiency Inductive Power-links Using a Novel Matching Strategy'', IEEE Proc. Of 55<sup>th</sup> International Midwest Symposium on Circuits and Systems, Boise, Idaho, 2012.
- [C26] M. Gu, S. Chakrabartty, ``Varactor-Driven Temperature Compensation of CMOS Floating-Gate Current Memory'', *Proc. of IEEE Symposium of Circuits and Systems (ISCAS 2012)*, Seoul, South Korea, 2012.
- [C27] P. Sarkar, S. Chakrabartty, ``A Self-Powered Static-Strain Sensor Based on Differential Linear Piezo-Floating-Gate Injectors'', *Proc. of IEEE Symposium of Circuits and Systems (ISCAS 2012)*, Seoul, South Korea, 2012.
- [C28] R. Shaga, S. Chakrabartty, ``Sigma-Delta Gradient-Descent Learning for Online Real-Time Calibration of Digitally-Assisted Analog Circuits'', *Proc. of IEEE Symposium of Circuits and Systems (ISCAS 2012)*, Seoul, South Korea, 2012.
- [C29] T. Hindo, S. Chakrabartty, ``Noise-exploitation in Neuromorphic Sensors'', Biomimetics, Bioreplication and Bioinspiration Conference, Proc. Of SPIE (2012), San Diego, 2012.
- [C30] A. Fazel, S. Chakrabartty, ``Sparse Kernel Cepstral Coefficients (SKCC): Inner-Product Based Features for Noise-Robust Speech Recognition'', *Proc. of IEEE Symposium of Circuits and Systems (ISCAS 2011)*, Rio de Janiero, 2011.
- [C31] C. Huang, S. Chakrabartty, ``A Hybrid Energy Scavenging Sensor for Long-Term Mechanical Strain Monitoring'', *Proc. of IEEE Symposium of Circuits and Systems*

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- [C35] C. Huang, S.Chakrabartty, ``A Temperature Compensated Array of CMOS Floating-Gate Analog Memory'', *Proc. of IEEE Symposium of Circuits and Systems (ISCAS 2010)*, Paris, 2010.
- [C36] M.Gu, Y. Liu, S.Chakrabartty, ``Fast: a Simulation Framework for Solving Large-Scale Probabilistic Inverse Problems in Nano-Biomolecular Circuits'', *Proc. of IEEE Symposium of Circuits and Systems (ISCAS 2010)*, Paris, 2010.
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