

# David S. Ricketts

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## 1. EDUCATION

### Harvard University

Ph.D., 2006.  
Thesis: Electrical Soliton Modelocking.  
Advisor: Donhee Ham.

### Worcester Polytechnic Institute

M.S.E.E., 1997.  
Thesis: AD6509, A 622 MHz Frequency Synthesizer.  
Advisor: John A. McNeill

### Worcester Polytechnic Institute

B.S.E.E., 1995, with *High Distinction*.  
Thesis: Development methodology and control systems in a NASA GASCAN project.

## 2. REASEARCH INTERESTS

- High-speed Analog and RF circuits
- Nano-electronic devices and circuits
- Analog computation, control & neural networks
- Power electronics and conversion

## 3. AWARDS & FELLOWSHIPS

- NSF CAREER Award, 2011
- Wimmer Teaching Fellow, Carnegie Mellon University, 2009
- Frontiers of Engineering Education, NAE, 2009.
- George Tallman Ladd Research Award 2009
- DARPA Young Faculty Award, 2008
- McGraw-Hill Yearbook of Science and Technology, 2008
- Analog Devices Outstanding Student Designer Award, 2006
- Harvard University Innovation Fellow, 2004
- Analog Devices Fellowship, WPI, 1996
- Wilmer L. and Margaret Kranich Prize, WPI, 1994
- Charles O. Thompson Award, WPI, 1992

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## 4. PROFESSIONAL EXPERIENCE

**Assistant Professor of Electrical and Computer Engineering, Assistant Professor (Courtesy) of Materials Science and Engineering, Carnegie Mellon University 2006-**

Research in high-speed electronics and nanoelectronics devices, focusing on extending the boundaries of circuit design through the integration of new phenomena, materials and devices. My work has appeared in the *Proc. of IEEE, ISSCC, JSSC, TMTT* and *Nature*. I have also authored two texts on the fundamentals of jitter in oscillators and on electrical solitons. My current focus is on high-speed PA design (>45GHz), High-speed interleaved ADCs (> 40GS/s) and Tip-based Nanofabrication of tunneling devices. In the latter, I am the PI of a 15 member DARPA program on Tip-directed, Field-assisted Nanomanufacturing (TFAN) focused on fabricating nanoelectronic devices with parallel probe arrays. My research grants total \$5.941M to date. My work was selected the 2008 McGraw Hill Yearbook of Science and Technology and I received the George Tallman Ladd Research Award and the DARPA Young Faculty Award. I have also developed/redesigned four new courses at CMU in device physics, RF design and innovation in science. I am a 2008 Wimmer Teaching Fellow and an invited participant in the 2009 NAE, Frontiers of Engineering Education Symposium.

**Fellow, School of Engineering and Applied Science, Technology and Entrepreneurship Center, (non-resident appointment) Harvard University, 2011-**

Research with graduate students at the School of Engineering and Applied Science and the Harvard Business School on Innovation in Science and Creativity, specifically the role of the individual in the creation of new knowledge. This work supports both scholarly research in this area as well as the development of educational material for courses taught at Carnegie Mellon and Harvard.

**Research Assistant, Ham Group, Harvard University, 2003 – 2006.**

Doctoral research in Ultrafast electronics, nonlinear wave and soliton based electronics and nanowire based circuits. Developed the first electrical soliton modelocked oscillator and also the first chip-scale modelocked oscillator in any field. Through collaboration with the Lieber group, helped to develop the fastestd integrated nanowire circuit to date. Other projects included phase noise analysis and stochastic resonance.

**Advanced System Engineering Manager, ON Semiconductor, 2002-2003.**

Directed a highly skilled team of system engineers to develop next generation technology for multi-phase power management ICs for Intel and AMD microprocessors. Initiated 10 new products in first 12 months and generated eight new patent/IP disclosures in first 6 months. Responsible for the development of new IP for the product line and the investigation of emerging technologies for acquisition.

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## **Manager of New Product Development**, ON Semiconductor, 2000-2002.

Responsible for 6 product development teams consisting of technical members across design, test, application engineering and layout. Oversaw the development of over 20 power management ICs in bipolar, CMOS and BiCMOS technologies. Responsible for ensuring technical excellence in design and system engineering as well as mentoring engineering staff.

## **Principal Consultant**, Renaissance Design, Inc. 1999-2001.

Provided design and system engineering services for the power management semiconductor industry. Led the system architecture and transistor level design of a custom 2-stage dc-ac inverter. Used Verilog to develop an all-digital controller which enhanced controller functionality and robustness. Designed system supervisory circuitry and peripherals, including a 5V LDO, ac line sense, current sense and protection, etc. Other projects include: feasibility analysis of custom thermo-electric cooler (TEC) controllers for laser cooling applications, IP evaluation for an emerging battery management market and product development methodology analysis for improved development cycle-time.

## **IC Technology Unit Manager/Staff IC Designer**, APC, 1995-1999.

Responsible for the development of custom power management ICs for uninterruptible power supplies (UPS). Developed a custom controller for push-pull dc-ac inverters, an 8-bit A/D supervisory IC for sine wave inverters, and a next generation sine-wave inverter controller. Designs utilized bipolar, CMOS and BiCMOS technologies.

## **5. Consulting**

### **Cadence Corporation**, Porto Alegre, Brazil, August 2008-July 2009

Co-taught RF design course as part of technology infrastructure initiative by Brazilian government.

### **ALTRAN Corporation**, Paris, France, May 2006, May 2007

Lecturer for “Innovation in Science and Engineering”, course offered to consortium of top engineering schools in Paris vicinity (Ecole Polytechnique, SUPELEC, etc.).

### **Sparktronics, Inc.**, Torrance, CA, 2008

System design and modeling for Soliton/NLTL based EMP system development.

### **SigmaTel Corp**, Burlington MA, 2005

Consulting on the development of high power audio driver IC.

### **Apogee Technologies**, Norwood MA, 2004

Consulting on IC controller for DC-DC power conversion.

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## 6. Teaching and Education

U- undergraduate, G – graduate

### **Carnegie Mellon University (2006- )**

Across 10 semester courses, average CMU student evaluation of instructor 4.4/5.0

- 18-623 Analog Circuit Design (G)
- 18-310 Fund Devices Physics (U)
- 18-610 Modern CMOS Devices (G)
- 18-513 RF Circuits and Antennas for Wireless Systems (U - capstone)
- 18-605 Innovation in Science and Engineering: Theory (G - interdisciplinary)
- 18-606 Innovation in Science and Engineering: Application (G - interdisciplinary)

### **Educational Contributions**

#### **Applied Physics**

- Curriculum development of AP undergraduate and graduate courses with AP faculty.
- Introduced new graduate device physics course, 18-610, Modern Device Physics
- Redeveloped 18-310, Fundamentals of Semiconductor Devices, including development of 5 virtual labs for web deployment
- Development of discovery based learning tools in conjunction with J. Bain and Eberly center via Wimmer Fellow, “IEMFE: Intuitive Electromagnetic Fields Education”

#### **Circuits**

- Curriculum development for undergraduate courses with circuits faculty, including proposal for reorganizing 300 level circuits courses into 18-320 (introductory analog/digital), 18-422 (advanced digital) and 18-423 (advanced analog).
- Collaborated with D. Stancil to re-design 18-513 into an interdisciplinary, wireless course: Wireless System Design, to include RF circuit content, enabling an analog circuit’s capstone while broadening the AP antennas capstone.

#### **Interdisciplinary**

- Developed a new interdisciplinary/interdepartmental course between ECE and EPP: 18-605/6 & 19-685/6: Innovation in Science and Technology, which explores the role of scientists and engineers in developing technological innovations. These courses focus on the development of technical solutions to a variety of scientific/engineering problems.

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## Outreach

- Participated in Carnegie Science Museum Engineers Week symposium, demonstrating engineering and science concepts to children ages 3-18.
- International outreach:
  - Taught courses in innovation and discovery in science in France (2005-2008)
  - Taught RF electronics in Brazil as part of a governmental program to develop engineering talent and infrastructure in Brazil.

## **NSCAD - Instituto de Informática – UFRGS/ Cadence Design Systems, Porto Alegre, Brazil (July-August 2008)**

BA03 RF IC Design – Full time intense course (40 hrs/week) as part of Brazilian government initiative to increase high-tech infrastructure in Brazil.

## **Lecturer (2002-2006)**

- Teaching Fellow, ES139 Innovation in Science and Engineering , (G, U), Harvard University, 2004 & 2005
- Guest Lecturer, ES 272 RF and High Speed Circuits, (G), Harvard University, 2005
- Invited Lecturer, Innovation in Science & Technology (G, U), Paris University Consortium, Paris, France, 2005
- Guest Lecturer, EE2799 Electrical and Computer Engineering Design, (G) Worcester Polytechnic Institute (WPI), 2002
- Guest Lecturer, ELE535 BiCMOS Integrated Circuit Design, (G), University of Rhode Island, 2002.

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## 7. Students

### Ph.D. Students – [Dept. /Co-adviser] (graduation date, estimated)

- Emre Karagozler [ECE/S. Goldstein], “Claytronics: A Stress Driven MEMS Tubular Robot,” (2011)
- Michael Chen [ECE], “Nonlinear Circuits in High-speed ADCs,” (2012)
- Weihua Hu (Physics), “Tip Directed Nanofabrication,” (2012)
- Wei Tai [ECE/L. R. Carley], “4W, 45 GHz Power Amplifiers,” (2012)
- Darmindra Arumugan [ECE/D. Stancil], “Position & Orientation Tracking Using Magneto-Quasi-Static Fields,” (2013)
- Chongzhe Li [ECE] “Power Combining in High Speed Power Amplifiers,” (2015)
- Zacharias George, “RF AFM Metrology for Nanoscale Devices” (2015)

### Master’s Students [research project dates] (graduation date)

- Zacharias George, “RF AFM Probes,” (2010)
- Ashwath Krishnan “A Class E Oscillator for Position Location Systems,” [Summer, 2010]
- En Shi, “Electrical Soliton Systems and Soliton Oscillators,” (2010)
- Akshat Gupta “Resonant Wireless Power Transfer” [Fall, 2009]
- Michael Chen, “Nonlinear Oscillators for mm-Wave Circuits,” (2009)
- Qianyu Liu, “Thermal Characterization of CNT Aerogel,” (2009)
- Heer Ghandi, “Processor-less Tablet Computing,”[Fall 2007]

### Undergraduate Research Students

- Christopher Heidelberg, “Temperature Programmed Desorption,” NSF REU, Summer 2009
- Yue Lu, “Stochastic Magnetic Switches for Probabilistic Computation” & “Time-dependant Variable Capacitor Devices,” Summer, 2007
- Wei Wu, “Semiconductor Physics Applet Development in LabView,” Spring, 2007
- Chongzhe Li, “Magnetic Nano-particle Inductor Characterization,” Spring 2010

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## 8. Publications

### 8.1 Books

*Electrical Solitons: Theory, Design and Applications*, **D. S. Ricketts** and D. Ham, CRC Press, 2010.

*The Designers Guide to Jitter in Ring Oscillators*, J. A. McNeill and **D. S. Ricketts**, Springer Verlag, 2009.

### 8.2 Books Chapters/Sections

**D. S. Ricketts**, Xiaofeng Li, and Donhee Ham, "Soliton Electronics," in *Circuits for Emerging Technologies - CMOS and beyond*, CRC Press 2008.

X. Li, **D. S. Ricketts**, and D. Ham, "Solitons in electrical networks," *McGraw-Hill 2008 Yearbook of Science and Technology*, McGraw-Hill, 2008.

### 8.3 Archival Papers, Peer Reviewed Before Publication

M. Chen and **D. S. Ricketts**, "Electrical modlocked oscillators and design stability criteria," *IEEE J. of Solid State Circuits*, in preparation.

S. Tamaru, J. A. Bain, M. H. Kryder and **D. S. Ricketts**, "Theory for calculating the Green's function of magnetostatic surface waves and its application to the study of spatial diffraction patterns," *Physical Rev. B*, in preparation.

M. E. Korogozlar, S. Goldstein and **D. S. Ricketts**, "Analysis and modeling of capacitive power transfer," *Trans. Circuits and Sys.*, *submitted*.

D. Arumugam, D. Stancil and **D. S. Ricketts**, "Magnetoquasistatic Proximity Sensor for Position and Orientation Sensing" *IEEE Vehicular Technology Conf.*, Sept. 2011, *submitted*.

D. Arumugam, J. Griffin, **D. S. Ricketts**, D. Stancil, "2-Dimensional Position Tracking using Magnetoquasistatic Fields," *Int. Conf. on Electromagnetics in Advanced Applications*, **invited**, Sept. 2011, *submitted*.

D. Arumugam, J. Griffin, D. Stancil and **D. S. Ricketts**, "Higher Order Loop Corrections for Short Range Magnetoquasistatic Position Tracking," *IEEE Int. Symp. on Antennas & Propagation*, Jun. 2011, Accepted.

M. E. Karagozler, A. M. Thaker, S. Goldstein and **D. S. Ricketts**, "Electrostatic-actuation generation and control of micro robots in a post-processed HV SOI CMOS," *IEEE Int. Sym. on Circuits and Systems*, May, 2011.

**D. S. Ricketts**, J. A. Bain, Y. Luo, S. Blanton, K. Mai and G. K. Fedder, "Enhancing CMOS using nanoelectronic devices, a perspective on hybrid integrated systems," *Proc. of the IEEE (Invited)*, Nov. 2010.

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E. R. Evarts, L. Cao, **D. S. Ricketts**, N. D. Rizzo, J. A. Bain, and S. A. Majetich, "Characterization of conducting atomic force microscopy for use with magnetic tunnel junctions," *IEEE Trans. Magn.*, 46, 1741 (2010).

M. W. Chen and **D. S. Ricketts**, "An 8.6GHz 42ps Pulse-Width Electrical Mode-Locked Oscillator," *International Solid-State Circuits Conference (ISSCC)*, pp. 500-501, Feb. 2010.

E. R. Evarts, L. Cao, **D. S. Ricketts**, N. D. Rizzo, J. A. Bain, and S. A. Majetich, "Spin transfer torque switching of magnetic tunnel junctions using a conductive atomic force microscope," *Applied Physics Letters* 95, 132510 (2009).

O. O. Yildirim, **D. S. Ricketts**, and D. Ham, "Reflection soliton oscillator," *IEEE Transactions on Microwave Theory and Technique* , vol. 57, no. 10, pp. 2344-2353, Oct. 2009.

**D. S. Ricketts**, X. Li, N. Sun, K. Woo, and D. Ham, "On the self-generation of electrical soliton pulses," *IEEE J. Solid-State Circuits (JSSC)*, vol. 42, no. 8, pp. 1657-1668, Aug. 2007.

**D. S. Ricketts** and D. Ham, "A chip-scale electrical soliton modelocked oscillator," *IEEE International Solid-State Circuits Conference (ISSCC)*, pp. 432-433, Feb 2006.

W. F. Andress, **D. S. Ricketts**, X. Li, and D. Ham, "Passive & active control of regenerative standing & soliton waves," **(Invited)** *Proc. of the IEEE Custom Integrated Circuits Conference*, pp. 29-36, Sept. 2006.

**D. S. Ricketts**, X. Li and D. Ham, "Taming the electrical soliton: A new direction in picosecond electronics," **(Invited)** *IEEE Radio Frequency Integrated Circuit (RFIC) Symposium*, pp. 33-36, Jun. 2006.

**D. S. Ricketts**, X. Li, and D. Ham, "Electrical Soliton Oscillator," *IEEE Trans. on Microwave Theory and Tech.*, vol. 54, no. 1, pp. 373-382, Jan. 2006.

**D. S. Ricketts**, X. Li, M. DePetro, and D. Ham, "A self-sustained electrical soliton oscillator," *IEEE MTT-S Int. Microwave Symp. Dig.*, Jun. 2005.

R. S. Friedman, M. C. McAlpine, **D. S. Ricketts**, D. Ham, C. M. Lieber, "High-speed integrated nanowire circuits," *Nature*, vol. 434, p.1085, Apr. 2005.

## 8.4 Papers in Symposium or Conference Proceedings

W. Hu, S. Tamaru, J. A. Bain and **D. S. Ricketts**, "High Current Pulse Generation for Thermal Surface Modification using Standard STM," *Int. Conf. Electron, Ion, Photon Beam Technology and Nanofabrication*, May. 2011, *accepted*.

J. R. Smith, **D. S. Ricketts** and J. A. Bain, "Localized thermal modification of surfaces via pulsed electron bombardment from an STM tip," *Int. Conf. Electron, Ion, Photon Beam Technology and Nanofabrication*, May. 2011, *accepted*.



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D. Arumugam, J. Griffin, D. Stancil and **D. S. Ricketts**, “Long Range Magnetoquasistatic Position Tracking using a Simple Active RFID Tag,” *IEEE Int. Conf. RFID*, Apr. 2011.

S. Tamaru and **D. S. Ricketts**, “Influence of the bias field orientation on the interaction strength between two closely formed spin torque oscillators,” *Int. Magnetism Conf.*, Taiwan, Apr. 2011.

E.R. Evarts, R.A. Booth, L.R. Shah, Y. Tang, S. Tamaru, **D.S. Ricketts**, J.A. Bain, S.A. Majetich, “Sub-30 nm Magnetic Tunnel Junction and Spin Valve Nanopillar Analysis Using Conductive Atomic Force Microscopy,” *Int. Magnetism Conf.*, Taiwan, Apr 2011.

J. R. Smith, W. Hu, Y-Y Dang, O. Ozcan, M. Sitti, J. A. Bain, **D. S. Ricketts**, R. Davis, “Scanning Probe Nanomanufacturing on Si: Surface Characterization of the Process Technique,” *Materials Research Symposium*, paper G1.5, Nov. 2010

E. R. Evarts, M. Moneck, R. A. Booth, C. Hogg, **D. S. Ricketts**, J-G Zhu, J.A. Bain, and S. A. Majetich, “Spin Torque Switching of 26 nm Diameter Magnetic Tunnel Junction Using a Conductive Atomic Force Microscope,” *Conference on Magnetism and Magnetic Materials*, Atlanta, GA, paper FC-13, Nov. 2010.

E. R. Evarts, T.T. Farkas, B. Tsukerman, L. Cao, **D. S. Ricketts**, G. Markovich, J.A. Bain, and S.A. Majetich, “Noise Measurements on Magnetic Tunnel Junction Nanopillars using Conductive Atomic Force Microscopy,” *Conference on Magnetism and Magnetic Materials*, Atlanta, GA, paper CB-10, Nov. 2010.

**D. S. Ricketts**, T. Schlesinger, Y. Luo and J. Bain, “Materials and Devices for Hybrid CMOS Circuits: Expanding the Functionality of Nanoscale CMOS,” Nano-DDS Conference, Ft. Lauderdale, FL, Oct. 2009 (**Invited**).

**D. S. Ricketts** and S. Bruck, “Stochastic Logic”, NRI-MIND, Architectures for post-CMOS switches (**Invited**), Notre Dame, IN, Oct. 2009.

**D. S. Ricketts**, L. Cao and S. Tamaru, “Spin-torque oscillator arrays as a solution for line width reduction in RF applications”, *Conference on Magnetism and Magnetic Materials*, paper EY-01, Washington D.C., Dec. 2009.

J.R. Smith, W. Hu, Y.Y. Dang, O. Ozcan, M. Sitti, J. Bain, R. Davis and **D. S. Ricketts**, “Writing Si nanowires on Si (100) with an STM tip: surface preparation and initial results,” *MRS Symposium*, M11.50, Boston, MA, Nov. 2009

D. S. Ricketts, X. Li and D. Ham, “Soliton Electronics,” (Invited) CMOS Emerging Technology Workshop, Whistler, Canada, 2007.

D. Ham, X. Li, S. A. Denenberg, T. H. Lee, and D. S. Ricketts, “Ordered and chaotic electrical solitons: communication perspectives,” (**Invited**) *IEEE Communications Magazine*, vol. 44, no. 12, pp. 126-135, Dec. 2006.

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R. S. Friedman, M. C. McAlpine, **D. S. Ricketts**, D. Ham, C. M. Lieber, "Fully integrated high frequency nanowire ring oscillators," *Materials Research Symposium*, Mar. 2005.

D. Ham, W. Andress, and **D. S. Ricketts**, "Phase noise in oscillators," **(Invited)** *Int. Workshop on Sip/SoC Integration of MEMS and Passive Components with RF-ICs*, Mar. 2004.

**D. S. Ricketts**, "Current sensing and accuracy for CPU multi-phase DC-DC converters: the sub 20 mV challenge," IBM Power Delivery Symposium, 2002.

## 8.5 Discussion PI's Work

Nature, News & Views article by Thomas H. Lee, "Electrical solitons come of age," *Nature*, vol. 440, 36-37, Mar. 2006.

## 8.6 Patents

Ricketts, *et.al* U.S. Patent No. 7,339,440 "Nonlinear Pulse Oscillator Methods and Apparatus".

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## 9. Invited and Contributed Talks

- “RF PA’s and spin-torque oscillators for RF,” University of FL, Mar, 2011
- “Tip-directed, Field-assisted Nanofabrication,” NIST, Mar 2011.
- “Extending the boundaries of analog and RF electronics,” Brown Univ., Mar, 2011.
- “Nanoscale magnetics for integrated power conversion and RF,” ARL, Jan, 2011.
- “Ultimate limitation of conversion in conventional ADCs,” ONR Superconducting Electronics Program, San Diego, Jan. 2011.
- “Tip-assisted, field emission nanofabrication,” Zyvex Corp., Apr., 2010.
- “Tip-assisted Nanofabrication,” Worcester Polytechnic Institute, MA, Mar. 2010.
- “Spin Torque Oscillators for Agile RF,” DARPA YFA Program, Oct. 2009.
- “Perspectives on electrical oscillators,” IBM Research, NY, Apr., 2009
- “Electrical oscillators and phase noise,” NIST, Boulder, CO, Oct. 2008
- “New directions : soliton mode-locking and nanowire circuits,” CMU, Sept. 2006
- “Electrical soliton oscillators” University of Michigan, Mar, 2006
- “Electrical soliton oscillator and nanowire Circuits,” University of California, Berkeley, Apr. 2006
- “Electrical soliton oscillators,” Cornell University, Mar 2006.
- “Creativity in science and engineering,” Innovation in Science and Engineering, Harvard University, 2008
- “The Double Helix, a case study in scientific discovery,” Innovation in Science & Technology, Paris University Consortium, Paris France, 2008.
- “Creativity in science and engineering,” Innovation in Science & Technology, Paris University Consortium, Paris France, 2008.

## 10. Professional Activities

### Societies

- Member, Institute of Electrical and Electronic Engineers
- Solid-state Circuits Society
- Circuits and Systems Society
- Electron Devices Society

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## 11. Editorial Roles on Publications, Major Activities in Professional Meetings

- Session Chair, *Nanotechnology*, CMOS Emerging Technologies Conf., Banff, Canada 2009.
- Guest Editor for:
  - Journal of Solid State Circuits special issue of the JSSC on ISSCC 2009
- Reviewer for:
  - Journal of Solid State Circuits (IEEE)
  - Electron Device Letters (IEEE)
  - Transactions on Circuits and Systems (IEEE)
  - Proceedings of the National Academy of Sciences
  - MacArthur Foundation (Fellows program)
  - Nano Letters