

KISHORE SUNDARA-RAJAN

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Dept. of Electrical Engineering
University of Washington
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EDUCATION

Ph.D. in Electrical Engineering **Expected 2010**

University of Washington, Seattle

Topic: "Capacitive Sensors for Biomechanical force measurements"

M.S. in Electrical Engineering **2003**

University of Washington, Seattle

Thesis Title: "Moisture Measurement in Paper Pulp Using Fringing Field Dielectrometry"

B.Engg. in Electrical and Electronics Engineering **2001**

University of Madras, India

Areas of Concentration: Analog and Digital Circuits, Power Systems, Control Theory

Thesis: "Ground Fault Detection Relay"

RESEARCH EXPERIENCE

Sensors, Energy, and Automation Laboratory, Univ. of Washington **2002 – Present**

Graduate Research Assistant

- Designed, developed, and optimized sensors and circuits for dielectric and impedance spectroscopy systems.
- Developed multivariable algorithms in MATLAB to use the sensing systems to measure physical properties of materials in industrial settings, and biomedical applications.
- Have experience managing over 15 research projects targeting diverse industrial applications including, multimodal sensing mobile platform for diet monitoring, sensitive skin for prosthetic applications, 3D profiling of air flow, measurement of coating thickness of paints on composites, profiling moisture diffusion in composites, flow front measurement in resin transfer molding systems, monitoring of cure process in resin transfer molding systems, detection of active chemical agent in pharmaceuticals, layer thicknesses in multi-core pharmaceutical products, moisture distribution in food products, aging process in food products, monitoring meat curing process, estimating structural properties of multi-layer food products, moisture in paper pulp, and monitoring progress of chemical processes.
- Created LabView based test and data acquisition systems that integrated custom circuits and off the shelf equipments over RS232, GPIB, and custom feedback controls.
- Acquired extensive knowledge in selecting and characterizing electrical and mechanical properties of a variety of materials including ITO, stretchable conductors, carbon composites, and a variety of polymers.
- Lead feasibility studies for various applications including pharmaceutical products and plastics in direct collaboration with industry partners.
- Architected and oversaw numerous successful research proposals ranging from \$25,000 to \$4.7M targeting industrial collaborators, NIH, NSF, DARPA and industrial research consortiums.
- Supervised a team of 5 undergraduate researchers, 1 graduate student, and 2 visiting professors
- These efforts have lead to 17 technical publications, 4 invention disclosures and a startup.

Industrial Assessment Center, University of Washington **10/2006 – 10/2008**

Lead Student

- Department of Energy certified in industrial energy efficiency.
- Played the lead role in starting, structuring, staffing and operation of the center at UWEE

- Lead a team of 3 graduate and 5 undergraduate students
- Made significant contributions during the proposal writing phase
- Represented UW at the national meeting for the centers.

Design, Testing, and Reliability Laboratory, University of Washington **3/2002 – 8/2002**
Research Assistant

- Developed jitter measurement technique for PLLs as a part of a 3 member group
- Developed a charge pump for converting high frequency (2 GHz) digital pulses into analog signal
- Acquired the basics of mixed signal circuit design.

Institute for Micromanufacturing, Louisiana Tech University, Ruston, LA **2001 – 2002**
Research Assistant

- Designed, optimized, and implemented a testing system for micro pumps
- Designed a magnetic actuator, the associated control circuitry, and monitoring software
- Involved in the development of magnetic membranes, three dimensional chambers
- Worked extensively with plasma enhanced chemical vapor deposition, electron microscopy (SEM), diffusion, and etching (RIE) systems.

WORK EXPERIENCE

dTEC Systems LLC, Seattle, WA **6/2007 – 9/2007**
Graduate Technical Intern

- Developed impedance sensors and measurement systems for nondestructively sensing moisture in food products, thickness of layers, and identification of fillers in food.
- Co-wrote a successful NSF SBIR proposal for monitoring curing of meat using dielectric spectroscopy.
- Directly interacted with other industrial partners to explore opportunities for product development including visiting their sites for technology evaluation.

Intel Research, Seattle, WA **6/2004 – 12/2005**
Graduate Technical Intern

- Developed a MEMS based low power low-g accelerometer for embedding in RFID tags.
- Modeled the sensor's performance using advanced multiphysics finite element models
- Fabricated sensors using industry standard fabrication procedure, MUMPS, as well as custom fabrication flow using generic microfabrication techniques.
- This work resulted in two internal invention disclosures, and one USPTO patent.

TEACHING EXPERIENCE

Energy Systems **Spring 2008**
Laboratory Instructor and Teaching Assistant

- Oversaw the laboratory section of the course
- Contributed to development of assignments and examinations
- Delivered guest lectures.

Modeling of MEMS **Winter 2006**
Teaching Assistant

- Contributed to the development of class materials, assignments, and projects

- Oversaw the laboratory section of the course and taught the use of modeling tools to students.

Devices and Circuits II

Spring 2006

Laboratory Instructor and Teaching Assistant

- Responsible for two sections of the course with a total of about 30 students
- Taught the laboratory section of the course.
- Significantly contributed to the development of class materials, assignments, and projects

Engineering Design by Teams

Autumn 2006

Teaching Assistant

- Delivered 3 lectures to the class; Organized a field trip for 29 students
- Made some contribution to the course material
- Facilitated guest lectures; Assisted in evaluation of assignments.

ENTREPRENEURIAL EXPERIENCE

AP Metrics, LLC

2008 – 2010

Director

- Founding member of startup aimed at commercializing nascent technologies developed at Universities
- Responsible for technology identification and evaluation
- Directed product development
- Developed business plan

Janani Foods Pvt Ltd, India

2004 – Present

Executive Director

- One of the founding members of the organization aimed at leveraging technology for agricultural advancement
- Conceived and implemented fundraising initiatives
- Prepared project reports and proposals
- Responsible for technology evaluation
- Part of core strategy group

INTELLECTUAL PROPERTIES

1. J. R. Smith, J. Heck, and K. Sundara-Rajan, “Inertial switch using fully released and enclosed conductive contact bridge,” *U.S. Patent 7,633,025*, December 15 2009.
2. K. Sundara-Rajan, A. V. Mamishev, and A. R. Kristal, “Dietary Data Recording System,” Record of Invention No. 8514D filed with University of Washington, November 2009.
3. G. Rowe, A. V. Mamishev, K. Sundara-Rajan, G. Klute, and W. R. Ledoux, “Conformal Sensing Skin,” Record on Invention No. 8250D filed with University of Washington, December 2008.
4. K. Sundara-Rajan, M. Ovir, A. H. Martin, and A. V. Mamishev, “Air Velocity Sensor System,” Record of Invention No. 8145D filed with University of Washington, August 7, 2008.
5. K. Sundara-Rajan, A. Mathur, and A. V. Mamishev, “Spatial Deconvolution of Material Properties Using Fringing Electric Field Sensors,” Record of Invention filed No. 8036D with University of Washington, March 18, 2008.
6. K. Sundara-Rajan, and J. R. Smith, “Low Acceleration Radial Inertial Switch Using Fully Released and Enclosed Contact Bridge,” Disclosure filed with Intel Research, December 2005.

PUBLICATIONS AND TALKS

Book and Chapters

1. A. V. Mamishev, K. Sundara-Rajan, and M. Zahn, "Interdigital Sensors and Transducers," IEEE Press, In Preparation
2. K. Sundara-Rajan, A. V. Mamishev, and M. Zahn, "Fringing Electric and Magnetic Field Sensors," Encyclopedia of Sensors, v4, pp. 89-100, ISBN 1-58883-060-8, Oct 2005.

Peer Reviewed Publications

1. K. Sundara-Rajan, G. I. Rowe, A. J. Simon, G. K. Klute, W. R. Ledoux, and A. V. Mamishev, "Shear Sensor for Lower Limb Prosthetic Applications," 2009 First Annual ORNL Biomedical Science & Engineering Conference, Oak Ridge National Laboratory, Knoxville, TN, USA., 3-18-2009.
2. A. Mathur, K. Sundara-Rajan, G. Rowe, and A. V. Mamishev, "Dielectric Spectroscopy – Choosing the right approach," Pharmaceutical Technology, Vol. 9, no. 32, pp 82-93, Sep. 2008.
3. B. Jiang, J. R. Smith, M. Philipose, S. Roy, K. Sundara-Rajan, and A. V. Mamishev, "Energy Scavenging for Inductively Coupled Passive RFID Systems," Instrumentation and Measurement, IEEE Transactions on, vol. 56, no. 1, pp. 118-125, 2007.
4. J. R. Smith, B. Jiang, S. Roy, M. Philipose, K. Sundara-Rajan, and A. V. Mamishev, "ID Modulation: Embedding Sensor Data in an RFID Timeseries," Proceedings of Information Hiding 2005, LNCS 3727, pp. 234-246.
5. J. R. Smith, K. P. Fishkin, B. Jiang, A. Mamishev, M. Philipose, A. D. Rea, S. Roy, and K. Sundara-Rajan, "RFID-Based Techniques for Human-Activity Detection," Communications of the ACM, vol. 48, no. 9, pp. 39-44, 2005.
6. K. Sundara-Rajan, L. Byrd, and A. V. Mamishev, "Measuring Moisture, Fiber, and Titanium Dioxide in Pulp With Impedance Spectroscopy," TAPPI Journal, vol. 4, no. 2, pp. 23-27, Feb. 2005.
7. M. Philipose, J. Smith, B. Jiang, A. Mamishev, S. Roy, and K. Sundara-Rajan, "Battery-Free Wireless Identification and Sensing," IEEE Pervasive Computing, vol. 4, no. 1, pp. 37-45, 2005.
8. A. V. Mamishev, K. Sundara-Rajan, F. Yang, Y. Du, and M. Zahn, "Interdigital Sensors and Transducers," Proceedings of the IEEE, vol. 92, no. 5, pp. 808-845, 2004.
9. K. Sundara-Rajan, L. ByrdII, and A. V. Mamishev, "Moisture Content Estimation in Paper Pulp Using Fringing Field Impedance Spectroscopy," Sensors Journal, IEEE, vol. 4, no. 3, pp. 378-383, 2004.
10. K. Sundara-Rajan, L. Byrd, and A. V. Mamishev, "Estimation of Moisture Content in Paper Pulp Containing Calcium Carbonate Using Fringing Field Impedance Spectroscopy," Proceedings of 58th Appita Annual Conference, Canberra, Australia, vol. 2, 2004, pp. 413-419.

Abstract Refereed Publications

1. K. Sundara-Rajan, A. Mathur, and A. V. Mamishev, "Characterization of Plastic Packaging with Fringing Electric Field Sensors," SBMicro2008, Brazil, Sept. 2008.
2. J. R. Smith, B. Jiang, S. Roy, M. Philipose, K. Sundara-Rajan, and A. V. Mamishev, "Embedding sensor data in an RFID timeseries," 7th Information Hiding Workshop, Barcelona, Spain, 2005.
3. J. Bing, J. R. Smith, M. Philipose, S. Roy, K. Sundara-Rajan, and A. V. Mamishev, "Energy Scavenging for Inductively Coupled Passive RFID Systems," Proceedings of the IEEE Instrumentation and Measurement Technology Conference, vol. 2, 2005, pp. 984-989.
4. A. L. Pyayt, K. Sundara-Rajan, G. I. Rowe, and M. A. L. Enlund, "On-Chip Characterization of Fluids Using Microsurface Plasmon Resonance Sensors," Optical Trapping and Optical Micromanipulation, vol. 5514, no. 1, pp. 586-594, Oct. 2004.
5. K. Sundara-Rajan, X. Li, N. Semenyuk, and A. V. Mamishev, "Moisture Measurement in Paper Pulp Using Fringing Field Impedance Spectroscopy," IEEE Sensors Conference, Toronto, 2003.

Talks Delivered

1. K. Sundara-Rajan, “Current Trends in Electrical Engineering,” Invited Talk, Vel Tech University, Chennai, India, May 2009.
2. K. Sundara-Rajan, “Sensors for Industrial Applications,” Invited Talk, International Institute of Information Technology, Hyderabad, India, December 2007.
3. K. Sundara-Rajan, and A. V. Mamishev, “Autonomous Microsensors based on Fringing Electric Field Sensing,” Summer Institute 2007, Center for Process Analytical Chemistry, Seattle, July 2007.
4. K. Sundara-Rajan, and A. V. Mamishev, “Fringing Field Sensing and You,” Summer Institute 2006, Center for Process Analytical Chemistry, Seattle, July 2006.
5. K. Sundara-Rajan, L. Byrd, and A. V. Mamishev, “Estimation of Moisture Content in Paper Pulp Containing Calcium Carbonate Using Fringing Field Impedance Spectroscopy,” 58th Appita Annual Conference, Canberra, Australia, April 2004.
6. K. Sundara-Rajan, and A. V. Mamishev, “Monitoring Physical Properties of Pharmaceutical Products Using Fringing Field Dielectric Spectroscopy,” Eighteenth International Forum Process Analytical Chemistry, IFPAC 2004, Arlington, VA, January 2004.
7. K. Sundara-Rajan, and A. V. Mamishev, “Non-Invasive Measurement of Material Properties,” Center for Process Analytical Chemistry Fall Meeting, Seattle, November 2003.

AWARDS

- 3rd Place in UW Electric Energy Industrial Consortium’s Research Poster Award, Graduate Category, 2008
- 2nd Place in UW Electric Energy Industrial Consortium’s Research Poster Award, Graduate Category, 2006
- IEEE Dielectric and Electrical Insulations Society’s Graduate Fellowship, 2003
- Student grant to attend the Eighteenth International Forum Process Analytical Chemistry, 2004
- IEEE Travel Grant awarded to attend IEEE Sensors Conference, 2003
- Chairman’s special mention and Best student award, Vel Tech Engineering College, India, 2001
- “Diamond Ring” for consistent academic excellence, Vel Tech Engineering College, India, 2001
- 7 “Gold Rings” for academic excellence, Vel Tech Engineering College, India, 1997-2001

SYNERGETIC ACTIVITIES

- Officer of UW chapter of “Leadership Institute for Tomorrow” since 2004.
- Peer reviewer for IEEE Sensors Journal.
- Peer reviewer for IEEE Transactions on Dielectrics and Electrical Insulation.
- Peer reviewer for IEEE Transactions on Instrumentation and Measurement.
- Peer reviewer for EURASIP Journal on Applied Signal Processing
- Peer reviewer for Journal of Physics D: Applied Physics
- Peer reviewer for Journal of Physics: Condensed Matter
- Peer reviewer for Nanotechnology
- Member of IEEE, SPIE, and DEIS Societies

SKILLS

- **Programming Languages:** C/C++, Assembly, LabView, and VHDL/Verilog
- **Research Software:** MATLAB, Ansoft Maxwell electrostatics, COMSOL multiphysics, Tanner L-Edit, CoventorWare, LabView, SPICE, Mathematica, and Maple.
- **Communication Protocols:** USB, UART, RS232, GPIB, and TCP/IP
- **Clean Room:** Photolithography, wet chemistry, RIE, DRIE, sputtering, thermal evaporation, PECVD, soft lithography with PDMS, and metrology.