DARMINDRA D. ARUMUGAM

University Address Roberts Engineering Hall 246, Electrical & Computer Engineering Carnegie Mellon University, Pittsburgh, PA 15213 Email: darumugam@cmu.edu • Cell: (817) 247-7171	Home Address 515 S. Aiken Ave., Apt. 109 Pittsburgh, PA 15232
EDUCATION	
Doctor of Philosophy, Electrical & Computer Engineering	
Carnegie Mellon University, Pittsburgh, PA	December 2011
Thesis - Position and Orientation Measurement using Magnetoquasistatic Fiel Advisors - David S. Ricketts & Daniel D. Stancil	ds

Master of Science, Electrical Engineering University of Texas at Arlington, Arlington, TX Thesis - Characterization of RF Propagation in Metal Pipes for Passive RFID Systems Advisor - Daniel W. Engels

Bachelor of Science, Electrical Engineering University of Texas at Arlington, Arlington, TX

RESEARCH EXPERIENCE

Electrical & Computer Engineering, Carnegie Mellon University, Pittsburgh, PA

- 1. Doctoral research in quasistatic electromagnetic field theory and propagation theory
- 2. Co-invented a long-range quasistatic position and orientation detection technique which is unimpeded by large groups of people or dielectric bodies and operates extremely well in non-line-of-sight environments, enabling use for accurate positioning in practical environments such as in sporting events (eg.: tracking an American football during game-play)
- 3. Experimentally demonstrated complex image theory
- 4. Co-invented a quasistatic proximity and orientation (roll, pitch) sensing technique for aerial vehicles and terrain-relative navigation
- 5. Experimentally demonstrated a technique for long-range communications of passive RFID transponders using HVAC ducts, and published the demonstration in the Proceedings of IEEE

Research Associate

Research Assistant

Disney Research Pittsburgh, Pittsburgh, PA

- 1. Research in magnetoquasistatic field theory and RF system design
- 2. Designed a low-frequency RF system to measure long-range magnetoquasistatic loop coupling to determine position, and an optical system for ground truth position measurement

Research Assistant

Electrical Engineering, University of Pittsburgh, Pittsburgh, PA

- 1. Research in antenna and propagation theory for passive RF communication systems
- 2. Studied RFIC and antenna interface for passive RF communications
- 3. Studied and constructed multiple antenna systems for passive RF transponders to obtain larger communication distances

Research Assistant

Electrical Engineering, University of Texas at Arlington, Arlington, TX

- 1. Graduate research in propagation theory for passive RF communication systems
- 2. Studied channel characteristics for passive RF communications in metallic environments (e.g.: within metal pipes and chambers), around groups of people, or when embedded in different media (e.g.: conducting liquids), for the purpose of characterizing the performance of passive RFID systems

September 2008 - December 2008

January 2007 - August 2008

January 2009 - Current

May - August 2010 & 2011

December 2007

May 2005

January 2007 - August 2007

- - 1. Built RF devices for active transponder to base station communications
 - 2. Built sensor fusion interface for GPS, RFID, barcode system, and multiple wireless monitoring sensors
 - 3. Co-invented a medical container for transporting live organs for transplant purposes with a built-in array of monitoring sensors for use in military environments

TEACHING EXPERIENCE

Teaching Assistant Electrical & Computer Engineering, Carnegie Mellon University, Pittsburgh, PA

- 1. RF Circuits and Antennas for Wireless Systems
- 2. Applied Electrodynamics

Teaching Assistant

Electrical & Computer Engineering, University of Pittsburgh, Pittsburgh, PA

1. Power Systems Engineering

Teaching Assistant

Electrical Engineering, University of Texas at Arlington, Arlington, TX

- 1. RF Identification Systems Engineering
- 2. Principles and Practices of RF Identification Systems
- 3. Digital Circuit Design

THESIS

- 1. Position and Orientation Measurement using Magnetoquasistatic Fields, Ph.D. Thesis, Carnegie Mellon University, December 2011.
- 2. Characterization of RF Propagation in Metal Pipes for Passive UHF RFID Systems, M.S.E.E Thesis, University of Texas at Arlington, November 2007.

PATENTS

- 1. System and Methods for Position Tracking using Magnetoquasistatic Fields, D.D. Arumugam, J.D. Griffin, and D.D. Stancil, Filed with the US Patent Office, June 2010.
- 2. Single Antenna Single Reader System and Method for Locating a Tag, D.D. Arumugam, V. Ambravaneswaran, A.A. Modi, and D.W. Engels, Filed with the US Patent Office, February 2009.

INVITED TALKS

- 1. Position and Orientation Sensing using Magnetoquasistatic Fields, September 15 2011, RADAR Science and Engineering, Jet Propulsion Lab (JPL), Pasadena, CA.
- 2. Position Tracking using Magnetoquasistatic Fields, April 6 2011, National Robotics Engineering Consortium (NREC), Pittsburgh, PA.
- 3. Characteristics of Passive RFID Systems in Metallic Environments, August 5 2008, University of Pittsburgh, Pittsburgh, PA.

INVITED PAPERS

- 1. D.D. Arumugam, D.D. Stancil, and D.S. Ricketts, Two-Dimensional Position Measurement using Magnetoquasistatic Fields, International Conference on Electromagnetics in Advanced Applications (ICEAA), 2011.
- 2. P.V. Nikitin, D.D. Arumugam, M.J. Chabalko, B.E. Henty, and D.D. Stancil, Long Range Passive UHF RFID System using HVAC Ducts, Proceedings of the IEEE, vol.98, no.9, pp.1629-1635, Sept. 2010.
- 3. D.D. Arumugam and D.W. Engels, Specific Absorption Rates in the Human Head and Shoulder for Passive UHF RFID Systems at 915MHz, XXIX General Assembly of the International Union of Radio Science (URSI), vol.d01, no.8, August 2008.

RF Engineer

SAVR Communications, Irving, TX

September - December 2008

August - December 2009

January - May 2009

January - May 2007

January - May 2006

August - December 2006

JOURNALS

- 1. **D.D. Arumugam**, J.D. Griffin, and D.D. Stancil, Experimental Demonstration of Complex Image Theory and Application to Position Measurement, IEEE Antennas and Wireless Propagation Letters, Vol.10, pp.282-285, 2011.
- 2. P.V. Nikitin, **D.D. Arumugam**, M. Chabalko, B.E. Henty, and D.D. Stancil, Long Range Passive UHF RFID System using HVAC Ducts, Proceedings of the IEEE, vol.98, no.9, pp.1629-1635, Sept. 2010.
- 3. **D.D. Arumugam**, D.W. Engels, and M.H. Mickle, The Effect of Curvature on the Performance and Readability of Passive UHF RFID Tags, Applied Computational Electromagnetic Society (ACES) Journal, Special Issue on Computational and Experimental Techniques for RFID Sys., vol.25, no.3, pp.206-217, Mar. 2010.
- 4. **D.D. Arumugam**, A. Gautham, G. Narayanaswamy, N. Ayer, and D.W. Engels, Impact of Human Presence on the Read Zones of Passive UHF RFID Systems, International Journal of Radio Frequency Identification Technology and Applications, Vol. 2, No. 1 2, 2009, pp. 46 64.
- 5. **D.D. Arumugam** and D.W. Engels, Specific Absorption Rates in the Human Head and Shoulder for Passive UHF RFID Systems at 915 MHz, International Journal of Radio Frequency Identification Technology and Applications, Vol. 2, No. 1 2, 2009, pp. 1 26.
- D.D. Arumugam, V. Ambravaneswaran, A.A. Modi, and D.W. Engels, 2D localization using SAWbased RFID Systems: A single antenna approach, International Journal of Radio Frequency Identification Technology and Applications, Vol. 1, No. 4, 2007, pp. 417 - 438.
- 7. **D.D. Arumugam** and D.W. Engels, Characterisation of RF propagation in rectangular metal pipes for passive RFID systems, International Journal of Radio Frequency Identification Technology and Applications, Vol. 1, No. 4, 2007, pp. 345 - 362.
- 8. **D.D. Arumugam** and D.W. Engels, Characterisation of RF propagation in metal pipes for passive RFID systems, International Journal of Radio Frequency Identification Technology and Applications, Vol. 1, No. 3, 2007, pp. 303 343.
- 9. **D.D. Arumugam**, A.A. Modi, D.W. Engels, Environmental and performance analysis of SAW-based RFID systems, International Journal of Radio Frequency Identification Technology and Applications, Vol. 1, No. 2, 2007, pp. 203 235.

CONFERENCES

- 1. **D.D. Arumugam**, J.D. Griffin, D.D. Stancil, and D.S. Ricketts, A Wireless Orientation Sensor using Magnetoquasistatic Fields and Complex Image Theory, IEEE Radio and Wireless Symp., *Accepted*.
- 2. **D.D. Arumugam**, J.D. Griffin, D.D. Stancil, and D.S. Ricketts, Two-dimensional Position Measurement using Magnetoquasistatic Fields, IEEE Conf. on Electromagnetics in Adv. App., *In publication*.
- 3. **D.D. Arumugam**, D.D. Stancil, and D.S. Ricketts, Proximity and Orientation Sensing using Magnetoquasistatic Fields and Complex Image Theory, IEEE 74th Vehicular Technology Conference, *In publication*.
- D.D. Arumugam, J.D. Griffin, D.D. Stancil, and D.S. Ricketts, Higher Order Loop Corrections for Short Range Magnetoquasistatic Position Tracking, IEEE Symposium on Antennas and Propagation, Vol. 1, No. 1, 2011, pp. 1755-1757.
- 5. **D.D. Arumugam** and D.W. Engels, The Utility of Negative Refractive Index Meta-materials as Passive UHF RFID Tag Inlays, IEEE Symposium on Antennas and Propagation, Vol. 1, No. 1, 2009, pp. 1-4.
- 6. **D.D. Arumugam** and D.W. Engels, Characteristics of Passive UHF RFID Tags on Liquids, IEEE Symposium on Antennas and Propagation, Vol. 1, No. 1, 2009, pp. 1-4.
- 7. **D.D. Arumugam** and D.W. Engels, Characterization of Passive UHF RFID Tags in Toroidal Metal Pipes, IEEE Symposium on Antennas and Propagation, Vol. 1, No. 1, 2009, pp. 1-4.
- 8. **D.D. Arumugam** and D.W. Engels, Characteristics of Passive UHF RFID Tags on Metal Slabs, IEEE Symposium on Antennas and Propagation, Vol. 1, No. 1, 2009, pp. 1-4.
- 9. **D.D. Arumugam**, D.W. Engels, and M.H. Mickle, The Use of Flare Structures in Increasing the Performance of Passive UHF RFID Tags within Metal Pipes, IEEE Radio and Wireless Symposium, Vol. 1, No.1, 2009, pp. 453-456.
- 10. **D.D. Arumugam**, D.W. Engels, and M.H. Mickle, Analysis of Orientation Dependence of Passive UHF RFID Tags in Wrist Straps for Use in the Identification of Human Beings, IEEE Radio and Wireless Symposium, Vol. 1, No.1, 2009, MO3A-4.

- D.D. Arumugam, D.W. Engels, and M.H. Mickle, Specific Absorption Rates in Muscle Tissues for Passive UHF RFID Tag Backscatter, IEEE Radio and Wireless Symposium, Vol. 1, No.1, 2009, pp. 445-448.
- 12. **D.D. Arumugam**, D.W. Engels, and M.H. Mickle, Method for the real-time localization of passive SAW-based RFID systems around corners, IEEE Conference on Military Communications, Vol. 1, No. 1, 2009, pp. 1-7.
- D.D. Arumugam and D.W. Engels, Specific Absorption Rates in the Human Head and Shoulder for Passive UHF RFID Systems at 915MHz, XXIX General Assembly of the International Union of Radio Science URSI, Chicago, Vol. 1, No. 1, 2008, pp. 21 - 25.
- 14. **D.D. Arumugam** and D.W. Engels, Specific Absorption Rates (SAR) in Muscle Tissues for UHF RFID Reader Systems, XXIX General Assembly of the International Union of Radio Science URSI, Chicago, Vol. 1, No. 1, 2008, pp. 17 21.
- 15. **D.D. Arumugam** and D.W. Engels, Characterization of RF Propagation in Muscle Tissue for Passive UHF RFID Tags, XXIX General Assembly of the International Union of Radio Science URSI, Chicago, Vol. 1, No. 1, 2008, pp. 12 16.
- D.D. Arumugam and D.W. Engels, Impacts of RF Radiation on the Human Body in a Passive RFID Environment, IEEE Symposium on Antennas and Propagation Society APS, Vol. 10, No. 1109, 2008, pp. 1 - 4.
- 17. **D.D. Arumugam** and D.W. Engels, Characterization of RF Propagation in Helical and Toroidal Metal Pipes for Passive RFID Systems, IEEE International Conference on Radio Frequency Identification RFID 2008, Vol. 2, No. 1, 2008, pp. 269 - 276.
- 18. **D.D. Arumugam**, A. Gautham, G. Narayanaswamy and D.W. Engels, Impacts of RF Radiation on the Human Body in a Passive Wireless Healthcare Environment, IEEE Conference on Ambient Persuasion in Pervasive Healthcare APiPH, Vol. 2, No. 1, 2008, pp. 181 182.

HONORS & AWARDS

IEEE International Conf. on RFID Best Poster Award (2011) • Hsu Chang Memorial Fellowship (Honorary) for ECE PhD Candidate (January 2009) • Carnegie Institute of Technology Dean's Doctoral Fellowship (January 2009) • Doctoral Teaching & Research Fellowship (August 2008) • Dean's Fellowship (January 2008) • STEM Fellowship (January 2008) • Various Graduate Assistantships from the University of Texas at Arlington • Eta Kappa Nu • Graduation Honors-Cum Laude (May 2005) • Dean's List (2001, 2002, 2003) • Honors List Award (Spring 2002, Fall 2002, Spring 2003, Fall 2003) • Freshman's Honors List Award (2002) • President's Merit Award (2001)

FEATURED RESEARCH

PhysOrg, Popular Science, U.S. News Science, R&D Mag., Insciences, Science News Daily • Articles featured the first demonstration of a long-range (theoretical maximum distance of 1000's of meters) passive RF system within HVAC ducts, capable of powering and communicating with passive wireless sensors through existing infrastructures within buildings (P.V. Nikitin, **D.D. Arumugam**, M.J. Chabalko, B.E. Henty, and D.D. Stancil, Proceedings of the IEEE)

SELECTED PROFESSIONAL ACTIVITIES

Technical Reviewer: [IEEE Vehicular Technology Conference 2012 • IEEE Magnetism and Magnetic Materials 2010 • IEEE International Conference on RFID 2007, 2008, 2009 • IEEE International RF and Microwave Conference 2008 • Inderscience International Journal on Radio Frequency Identification Technology 2008 • IEEE Transactions on Information Technology in BioMedicine 2008 • ARTECH HOUSE Publishers, Boston & London, Norwood, MA 02062] • **Session Chair**: [Navigation and Sensors, IEEE Vehicular Technology Conference 2011 • Embedding and De-embedding Electromagnetic Structures for RFID Systems, IEEE International Conference on RFID 2009 • Manufacturing Track, RFID Journal Live 2008]

REFERENCES

- 1. David S. Ricketts, Email: ricketts@ece.cmu.edu
- 2. Daniel D. Stancil, Email: ddstancil@ncsu.edu
- 3. Daniel W. Engels, Email: daniel.engels@reveresecurity.com
- 4. Stephen R. Gibbs, Email: sgibbs@uta.edu