

Tyrone L. Roach

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Executive Summary

Ph.D. in Electrical Engineering, IEEE member, with over four years professional engineering experience in applied research and development. U.S. citizen, active security clearance. Demonstrated growth and expertise in phased array antenna design, electromagnetic modeling and simulation, and analysis and characterization of foreign threat radar systems. Contributed technically to over 15 sponsored programs which have led to multiple key delivered products, numerous written final reports and presentations to the customer. Held leadership roles in several of those programs. Authored two refereed journal papers, over ten conference proceedings, and recipient of numerous fellowships, assistantships, and awards during tenure as a graduate student. Demonstrated abilities in project leadership by becoming task lead on two major projects. Taught courses in electromagnetic theory and antennas at the graduate and professional level. Recognized externally and internally for contributions and accomplishments via awards in professional career. Commitment to service and representation by recruiting, participating in on-campus committees and groups, and holding mentoring roles throughout career. Served as a paper reviewer for select IEEE journal and international conference publications.

Education

Ph.D., Electrical and Computer Engineering, University of Illinois at Urbana-Champaign (Professor Jennifer T. Bernhard), May 2010, Urbana, IL, *Dissertation Title*: “Antenna Element Reconfigurability in Adaptive Arrays”, GPA: 3.84/4.00. Vodafone-Illinois, DFI, and GEM fellow, research/teaching assistant.

M.S.E.E., University of Illinois at Urbana-Champaign (Professor Jennifer T. Bernhard), May 2005, Urbana, IL, *Thesis Title*: “A Comparative Study of Diversity Gain and Spatial Coverage: Fixed vs. Reconfigurable Antennas for Portable Devices”, GPA: 3.80/4.00. SURGE and J.M Henderson fellow, research/teaching assistant.

B.S.E.E., University of Nevada-Las Vegas, Dec 2001 Las Vegas, NV, *Magna cum Laude*, Emphasis in electromagnetics, GPA: 3.87/4.00. Harold J. and Mayme Stocker and MEP Scholar.

Research Interests

- Applied electromagnetics
- Creating novel ways to increase functionality at the front-end of RF communication systems that utilize multiple antennas
- Platform and system level integration of phased array antenna systems with adaptive and multifunctional characteristics
- Expanding small array functionality in wireless sensor networks and smart sensor technology requiring interference mitigation through spatial means (e.g., cognitive radio and radar systems).
- Antenna array reconfigurability, arrays synthesis, beamforming, phased arrays

Publications

Refereed Journals:

1. **T.L. Roach** and J.T. Bernhard, “Exploration of amplitude tapering in linear phased arrays with pattern reconfigurable elements,” *Electromagnetics*, vol. 29, No. 5, pp. 384–392, 2009
2. **T.L. Roach**, G.H. Huff and J.T. Bernhard, “A comparative study of diversity gain and spatial coverage: fixed vs. reconfigurable antennas for portable devices,” *Microwave Opt Tech Lett*, vol 49, pp. 535–539, March 2007

Conference Proceedings (* presenter):

1. **T.L. Roach*** and J.T. Bernhard, “Utilizing radiation properties of pattern reconfigurable antennas in adaptive arrays,” in *Proc. 2009 Antenna App. Symp.*, Monticello, IL, pp. 245–257, September 2009

2. **T.L. Roach*** and J.T. Bernhard, "Antenna element pattern reconfigurability in adaptive arrays," in *Proc. 2008 Antenna App. Symp.*, Monticello, IL, pp. 86–103, September 2008
3. J. Graham*, D. Hibbard, D. Martin, S. Yencer, D. Novotny, C. Grosvenor, N. Canales, R. Johnk, L. Nagy, and **T. Roach**, "Outdoor vehicular test range turntable impact on electric-field uniformity study," *IEEE Intl. Symp. on Electromagnetic Compatibility (EMC)*, Detroit, MI, pp. 1–6, August 2008
4. *Invited Special Session: T.L. Roach**, G.H. Huff and J.T. Bernhard, "On the application for a radiation reconfigurable antenna," *Second NASA/ESA conference in Adaptive Hardware and Systems (AHS)*, Edinburgh, Scotland, United Kingdom, pp. 7–13, August 2007
5. *Invited Special Session: T.L. Roach** and J.T. Bernhard, "Exploration of amplitude tapering in phased arrays with pattern reconfigurable elements," *International Symposium on Electromagnetic Theory (EMTS)*, Ottawa, ON, Canada, July 2007
6. **T.L. Roach*** and J.T. Bernhard, "Investigation of sidelobe level performance in phased arrays with pattern reconfigurable elements," *IEEE AP-S Intl. Symp.*, Honolulu, HI, pp. 105–108, June 2007
7. H.K. Pan*, G. Huff, **T. Roach**, Y. Palaskas, S. Pellerano, P. Seddighrad, V.K. Nair, D. Choudhury, B. Bangerter, and J.T. Bernhard, "Increasing channel capacity on MIMO systems employing adaptive pattern/polarization reconfigurable antenna," *IEEE AP-S Intl. Symp.*, Honolulu, HI, pp. 481–484, June 2007
8. G.H. Huff* and **T.L. Roach**, "Stripline-based spiral antennas with integrated feed structure, impedance transformer, and dyson-style balun," *IEEE AP-S Intl. Symp.*, Honolulu, HI, pp. 2698–2701, June 2007
9. **T.L. Roach***, G.H. Huff and J.T. Bernhard, "Enabling high performance wireless communications systems using reconfigurable antennas," *Military Communications Conference (MILCOM)*, Washington, DC, pp. 1–6, Oct. 2006

Conference Abstracts (* presenter):

1. **T.L. Roach***, "Radiation reconfigurability in adaptive arrays for use in radar systems," *Emerging and Enabling Technology Conference*, Redstone Arsenal, AL, July 2011
2. **T.L. Roach*** and J.T. Bernhard, "Modeling pattern reconfigurable antennas for use in adaptive arrays," *USNC-URSI National Radio Science Meeting*, Boulder, CO, January 2010
3. **T.L. Roach*** and J.T. Bernhard, "Investigating pattern reconfigurable antennas for use in adaptive arrays," *USNC-URSI National Radio Science Meeting*, Boulder, CO, January 2009
4. **T.L. Roach*** and J.T. Bernhard, "A comparative study of diversity gain and spatial coverage: fixed vs. reconfigurable antennas for portable devices," *USNC-URSI National Radio Science Meeting*, Boulder, CO, January 2005

Professional Experience

Assistant Professor, 08/2015-present

*School of Electrical and Computer Engineering and Advanced Radar Research Center.
University of Oklahoma, Norman, OK.*

Research Engineer II, Electromagnetics Division, 10/2010-05/2015

Advanced Concepts Laboratory, Georgia Tech Research Institute, Atlanta, GA.

Experience Summary: Dr. Roach applies his expertise in electromagnetics and antennas to develop solutions for a variety of applied research problems. He has held leadership roles in several of the programs and has contributed significantly to a variety of projects in several different technical areas. The result of his efforts led to key delivered products, several final reports and presentations, and recognition externally and internally via awards and praises from senior researchers. The abbreviated listing below detail Dr. Roach's experiences with sponsored-based programs.

1. Task lead for the antenna array radiator development for an advanced anti-aircraft threat simulator requiring the production of a 2D space-fed phased-array radar antenna
2. Task lead for antenna design and development of passive multi-static radar system which supports increasing future capabilities to detect targets in real time with advanced beamforming techniques.

3. Lead system analyst for a Pre-Integrated Technical Evaluation and Analysis of Multiple Sources (ITEAMS) effort on a foreign threat air surveillance radar system
4. Investigated methods using electromagnetic simulation software to model the direct lightning effects on critical system components on an OH-58 model helicopter aircraft
5. Designed an electromagnetic scattering model utilizing simulation software representative of a phased array radar antenna in the presence of an electrically large RF obstruction
6. Characterized polarization and gain loss versus scan angle to establish the achievable upper bounds on array RF performance for a long range discrimination radar
7. Evaluated the performance of a radar's auxiliary antenna in the presence of the full electrically large antenna structure via modeling and simulation by integrating measured data taken from the isolated auxiliary antenna in order to assess its operational survivability against electronic attack.
8. Key contributor in an ITEAMS effort on a foreign-based phased-array radar: Designed and analyzed the phased-array's antenna element response and researched foreign electronic counter measure (ECM) techniques to assist in assessing system capabilities and limitations of the radar
9. Designed and simulated a complex radar scenario for multiple projects using an Adaptive Sensor Prototyping ENvironment (ASPENTM) tool to help assess the impact of multi-path effects and multi-path radar-to-target engagement scenario effects on radar performance
10. Designed and analyzed an alternative antenna element solution for use in wideband, counter-advanced threat phased-array radar system

Awards and Honors

Nominee for GTRI Innovative Research Award (Project Team), Apr 2013 • Northrop Grumman Information Systems Annual Supplier Excellence Award, Nov 2012 • GTRI Star Performer Award (Bonus) for outstanding employee contributions and commitment to GTRI core values: Oct 2013, Jan 2013, and Jun 2012 • Raj Mittra Outstanding Research Award, UIUC ECE Dept., 2010 • Olesen Award Nominee for excellence in undergrad instruction, ECE Dept., 2010 • National Science Foundation (NSF) Graduate Fellowship Honorable Mention, 2004 • Vodafone-Illinois Graduate Fellow, 2007 • DFI, GEM, and SURGE Fellow, UIUC, 2004.

Teaching Experience

Instructor, Georgia Institute of Technology - Distance Learning and Professional Education (DLPE), 01/2011-03/2011

NUIG EE432 - Antennas and RF Engineering Electromagnetics (13 students)

Co-instructed a new course with colleagues via video conference to students at the National University of Ireland-Galway, EE dept. • Co-developed and prepared course material, topics taught included antenna array theory, phased-arrays concepts, and applications of phased arrays.

Visiting Lecturer/Instructor, University of Illinois, ECE Dept., 01/2010-05/2010

ECE 329 - Introduction to Electromagnetic Fields (40 students)

Prepared and lectured a three-credit hour undergraduate introductory electromagnetic course. Topics included: Static electric and magnetic fields, Maxwell's equations, time-varying fields, plane waves, and transmission lines • Held office hours semiweekly, assisted students in course related electromagnetic problems, managed course TAs.

Teaching Assistant, University of Illinois, ECE Dept., 06/2010-07/2010 & 08/2009-12/2009

ECE 450 - Lines, Fields, and Waves Held office hours, discussed and solved course related electromagnetic problems with students • Lectured class sessions in the absence of the course instructors

Related Research & Work Experience

Technical Intern, Delphi Research Labs, Summer 2004

Shelby Township, MI (Louis Nagy)

Modeled and simulated the electromagnetic characteristics of the General Motors MPG Antenna Range
 • Analyzed electromagnetic effects of vehicle mounting on the performance of wire/planar antennas.

Research Assistant, University of Illinois, 01/2004-05/2004

Urbana-Champaign, IL (Jennifer Bernhard)

Developed programs to compare diversity metrics between pattern reconfigurable and pattern fixed antennas

- Characterized the packaging effects of pattern reconfigurable antennas on model portable device in a diversity environment
- Led a small interdisciplinary team in the measurement aspects of a pilot study to characterize the movement of granular materials via electromagnetic and signal processing techniques.

Research Intern, Summer Undergraduate Research Experience (SURE), Summer 2001

Georgia Institute of Technology, ECE Dept., Atlanta GA (Paul Steffes, Gary May)

Participated in applied research on electromagnetics and communications • Assembled and operated an Earth-Moon-Earth communication terminal using microwave components and measurement equipment.

Research Intern, Research Experience Undergraduate (REU), Summer 2000

University of Minnesota-Twin Cities, ECE Dept., Minneapolis, MN (Mohamed-Slim Alouni, Douglas Ernie)

Participated in general research on wireless communications theory • Analyzed probability relationships for mobile channels, results published in the *IEEE Trans. On Vehicular Technology*.

Service and Representation

Professional Career

Member IEEE and IEEE Antennas and Propagation Society • Reviewer for select IEEE international Conferences • Member: Academic Research Leadership (ARL) Network - a network committed to supporting underrepresented groups interested in and currently working in academic faculty or Ph.D.-level research careers • Served on committees, peer review groups for prospective candidates seeking employment with GTRI, and as a mentor for new hires.

Academic Career

Served as a paper reviewer for select IEEE journal publications • Supported faculty by providing substitute lectures for upper-level undergraduate electromagnetic courses in antennas, microwave devices and circuits, and sensor and instrumentation lab • Led tours and demonstrated usage of laboratory facilities to sponsored outreach group events • Graduate student representative for electromagnetics: ECE advising fair, 2005 & 2007, and program volunteer for multiple campus diversity and inclusion initiatives, 2003–2008 • Tutored students in science and mathematics at undergraduate institutions (Spring 2002).

Acquired Experiences and Capabilities

Professional

Familiarity with principles of EM and antenna theory, RF circuit principles, and system engineering aspects of radar systems • Proficient in electromagnetic modeling and simulation of complex structures • Expertise in antenna and phased-array design, modeling, and analysis of applied systems • Knowledge in utilizing computer-based EM simulation and software tools (e.g., HFSS and FEKO) • Written and contributed to several research reports and technical documentation for a variety of sponsored-based projects • Composed and presented briefings at numerous final review, interim review, and technical interchange meetings to the sponsoring agencies • Led and collaborated with team members across a wide range of research and development projects spanning across many areas of expertise.

Collegiate

Principal Investigator for a research proposal submitted in part of the postdoctoral research associateship program (RAP) to the Air Force Research Lab – Sensors Directorate, Dayton OH, June 2010 (not funded) • Employed specialized microwave equipment (e.g., network analyzer, spectrum analyzer, far-field anechoic chamber) to test and measure the performance of microwave devices and antennas • Utilized milling machine and layout software to fabricate prototype planar microwave antenna designs • Led efforts in completing the renovation of a measurement laboratory, including equipment set-up/layout for a new anechoic chamber.