

Tyrone L. Roach

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Executive Summary

Ph.D. in Electrical Engineering with over six years of accumulative professional experience in academia as a tenure-tracked assistant professor and in applied R&D as a research engineer. U.S. citizen, held a security clearance. IEEE and NSBE member. Demonstrated growth and expertise in engineering solutions to complex problems in applied electromagnetics—including phased array antenna design, EM modeling & simulation, and analysis and characterization of radar systems. As a faculty member, served as co-principal investigator on a proposal effort awarded by the federal government. Participated in various other collaborative research proposal and solicitation efforts. While in research industry, contributed technically to over 15 government sponsored programs which led to multiple key delivered products, numerous written final reports and presentations to the customer. Demonstrated abilities in project leadership and supervision by becoming task lead on two major projects and lead system analyst for another. Recognized externally and internally for contributions and accomplishments via awards in professional career, including promotion to rank of Senior Research Engineer. Authored three refereed journal papers and over ten conference proceedings. Recipient of numerous fellowships, assistantships, and awards during tenure as a graduate student. Taught courses in core electrical engineering subjects, electromagnetic theory, and antennas at the graduate and professional level. Commitment to service and representation by recruiting, participating in on-campus committees, holding mentoring roles throughout career, and serving as a paper reviewer for select IEEE journal and conference publications.

Education

Ph.D., Electrical and Computer Engineering, University of Illinois at Urbana-Champaign (Professor Jennifer Bernhard), May 2010, Urbana, IL, *Dissertation Title*: “Antenna Element Reconfigurability in Adaptive Arrays”.

M.S.E.E., University of Illinois at Urbana-Champaign (Professor Jennifer Bernhard), May 2005, Urbana, IL, *Thesis Title*: “A Comparative Study of Diversity Gain and Spatial Coverage: Fixed vs. Reconfigurable Antennas for Portable Devices”.

B.S.E.E., University of Nevada-Las Vegas, Dec 2001 Las Vegas, NV, *Magna cum Laude*, Emphasis in electromagnetics.

A.E.S., Community College of Southern Nevada, Las Vegas, NV: Preparatory Coursework, 1995-1998.

Employment Activity, Fellowships, and Other Appointments

- **Assistant Professor**: School of Electrical and Computer Engineering, University of Oklahoma, Norman, OK, 2015-2017
- **Faculty Member**: Advanced Radar Research Center (ARRC), University of Oklahoma, Norman, OK, 2015-2017
- **Research Engineer**: Sensors and Electromagnetics Applications Laboratory (SEAL)/Advanced Concepts Laboratory (ACL), Georgia Tech Research Institute, Atlanta, GA, 2010-2015
- **Visiting Lecturer/Instructor**: ECE Dept., University of Illinois at Urbana-Champaign, Urbana, IL, 2010
- **Graduate Teaching Assistant**: ECE Dept., University of Illinois at Urbana-Champaign, Urbana, IL, 2009 & 2003
- **Vodafone-Illinois Graduate Fellowship**: College of Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, 2008-2009
- **Diversifying Higher Education Faculty in Illinois (DFI) Fellowship**: Graduate College, University of Illinois at Urbana-Champaign, Urbana, IL, 2005-2008
- **Technical Intern**: Delphi Research Labs, Shelby Township, MI, Summer 2004
- **Graduate Degrees for Minorities in Engineering and Science (GEM) Fellowship**: University of Illinois/The National GEM Consortium, Alexandria, VA, 2004-2005

- **Graduate Research Assistant:** Electromagnetics Laboratory, ECE Dept., University of Illinois at Urbana-Champaign, Urbana, IL, 2004
- **Support for Under-Represented Graduate Education (SURGE) Fellowship:** College of Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, 2002
- **Summer Undergraduate Research Experience (SURE):** ECE Dept., Georgia Institute of Technology, Atlanta GA, Summer 2001
- **Research Experience Undergraduate (REU):** ECE Dept., University of Minnesota-Twin Cities, Minneapolis, MN, Summer 2000

Research and Technical Interests

Applied electromagnetics • Creating novel ways to increase functionality at the front-end of communication systems that utilize multiple antennas • Platform and system level integration of phased array antenna systems with adaptive and multifunctional characteristics • Transforming array functionality into emerging and next-generation wireless communication technologies • Realizing multifunctional antenna/antenna array technologies with novel physical materials and manufacturing techniques • Antenna array reconfigurability, arrays synthesis, beamforming, phased arrays

Refereed Journal Papers

1. **T.L. Roach** and J.T. Bernhard, "Investigation of Desired Element Pattern Reconfigurability in Small Adaptive Arrays." *IEEE Trans. Antennas Propag.*, Vol. 64, No. 12, pp. 5441–5446, Dec. 2016
2. **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
3. **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 Papers, Symposia Proceedings, and Presentations (* presenter)

1. **T. L. Roach**, "Investigating Array Performance with Radiation Reconfigurable Antennas," *Future Faculty Career Exploration Program (FFCEP)*, Dept. of Electrical and Microelectronic Engineering, Rochester Institute of Technology, Rochester, NY, September 2016
2. **T. Roach***, M. Yearly, R. Palmer, D. Schmidt, J. Grimsley, P. Chilson, R. Huck, and M. Weber, "Low Cost Detect-and-Avoid Radar for Oklahoma's 3D-Mesonet," *2016 USA-OK Oklahoma UAS Summit*, National Weather Center, Norman, OK, August 2016
3. **T.L. Roach**, "Investigating Element Pattern Performance in Phased Arrays with Radiation Reconfigurable Antennas." *Academic Research Leadership Symposium (ARLS)*, National Society of Black Engineers Annual Convention, Anaheim, CA, March 2015
4. **T.L. Roach**, "Radiation Reconfigurability in Small Adaptive Arrays for Use in Wireless Communication Systems." *Academic Research Leadership Symposium (ARLS)*, National Society of Black Engineers Annual Convention, Nashville, TN, March 2014
5. **T.L. Roach**, "Radiation reconfigurability in adaptive arrays for use in radar systems," *Emerging and Enabling Technology Conference*, Redstone Arsenal, AL, July 2011
6. **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
7. **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
8. **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
9. **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
10. 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

11. *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
12. *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
13. **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
14. 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
15. 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
16. **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
17. **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 Membership

- *Member*: Institute of Electrical and Electronics Engineering (IEEE)
- *Member*: IEEE Antennas and Propagation Society (APS)
- *Member*: IEEE Microwave Theory and Techniques (MTT) Society
- *Member*: National Society of Black Engineers (NSBE)
- *Member*: Academic Research Leadership (ARL) Network

Awards, Honors, and Recognition

- *Maximum Impedance*: IEEE Student Chapter, ECE dept., OU, Apr 2016
- *Promotion to Senior Research Engineer*: Georgia Tech Research Institute, May 2015
- *GTRI Innovative Research Award (Nominee)*: Project Team, Georgia Tech Research Institute, Apr 2013
- *Annual Supplier Excellence Award*: Awarded by Northrop Grumman Information Systems, Georgia Tech Research Institute, Nov 2012
- *GTRI Star Performer Award*: Georgia Tech Research Institute, Oct 2013, Jan 2013, and Jun 2012
- *Raj Mitra Outstanding Research Award*: ECE dept., UIUC, 2010
- *Olesen Award Nominee for Excellence in Undergrad Instruction*: ECE dept., UIUC, 2010

Service Activities

- *Member*: ARRC Recruiting Committee, Advanced Radar Research Center, OU, 2016
- *Advisor*: Ryan Brown, MS degree expected Fall 2017, ECE Dept., OU
- *Member*: Graduate Student Committee Member, (5-PhD, 3-MS), ECE Dept., OU
- *Recruiter*: Engineering Career Fair - Texas A&M University, Sep 2015; University of Illinois, Sep 2014
- *Guest Speaker*: Outreach Event - "A Walk For Education", OU-NSBE student chapter, Feb 2016
- *Participating Member*: "National Weather Festival", The National Weather Center/ARRC, Oct 2015
- *Reviewer*: Int. J. of Numerical Modeling: Electronic Networks, Devices and Fields, 2016
- *Reviewer*: IEEE International Symposium of Phased Array Systems & Technology, 2013
- *Reviewer*: 75th IEEE Vehicular Technology Conference Antenna and Propagation Track, 2012
- *Member*: SEAL Promotion Committee, Georgia Tech Research Institute, 2013 and 2011
- *Serving Member*: Peer review groups for prospective candidates seeking employment with GTRI and as a mentor for new hires, 2011 - 2015
- *Program Volunteer*: Multiple campus diversity and inclusion initiatives, UIUC, 2003-2008

Acquired Experiences and Capabilities

Funding Roles

- *Co-Principal Investigator*; Title: "Electrically Small Antenna Research and Support: Literature Review of Circular, Linear, and Dual-Polarized Patch Antennas and Benefits Thereof"; Sponsor: U.S. Federal Government; Status: *Funded*; Award Amount: \$ 21,335; Award Period: 05/2016 - 08/2016, Credit Allocation: 75%
- *Principal Investigator - Non-lead organization*; Title: "EARS: Collaborative Research: Wireless Agility - A Key Component in Bridging Emerging Technologies, Autonomous Agents, and Spectrum Management"; Sponsor: NSF; Status: *Not Funded*; Amount Requested: \$ 239,855; Proposal Period: 09/2016 - 09/2019, Credit Allocation: 100%
- *Principal Investigator*; Title: "Modeling Pattern Reconfigurable Antennas for use in Adaptive Arrays"; Sponsor: Postdoctoral Research Associateship program (RAP), Air Force Research Lab – Sensors Directorate, Dayton OH, June 2010; Status: *Not Funded*

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 technical reports and documentation for sponsored-based projects • Composed and presented briefings at numerous review and technical interchange meetings to sponsoring agencies • Led and collaborated with team members across a wide range of R&D projects spanning across many areas of expertise

Collegiate

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

Related Work and Research Experience

Assistant Professor, Advanced Radar Research Center/ECE Dept., OU, 08/2015-01/2017

Antenna lead for the preliminary investigation on the design and development of a Geo-Fence radar for small UAS weather observations; Collaborative effort with National Severe Storms Lab (NSSL) • Participated in various other collaborative research proposal and solicitation efforts with colleagues

Research Engineer II, Georgia Tech Research Institute, 10/2010-05/2015

Task lead for antenna array radiator development for an advanced anti-craft threat simulator and a passive multi-static radar system • Lead system analyst for a Pre-Integrated Technical Evaluation and Analysis of Multiple Sources (ITEAMS) effort on a foreign threat air surveillance radar system • Investigated methods using electromagnetic simulation software to model the direct lightning effects on critical system components on an OH-58 model helicopter aircraft • Designed an electromagnetic scattering model utilizing simulation software representative of a phased array radar antenna in the presence of an electrically large RF obstruction • Characterized polarization and gain loss versus scan angle to establish the achievable upper bounds on array RF performance for a Long Range Discrimination Radar • Designed and simulated a complex radar scenario for multiple projects using an Adaptive Sensor Prototyping Environment (ASPENTM) tool • Designed and analyzed an alternative antenna element solution for use in wideband, counter-advanced threat radar system

Technical Intern, Delphi Research Labs, Summer 2004

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 • Advisor: Dr. Louis Nagy at Shelby Township, MI site

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

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
- Advisor: Dr. Jennifer Bernhard in ECE Dept.

Research Intern, Summer Undergraduate Research Experience (SURE - 2001), Georgia Tech

Participated in applied research on electromagnetics and communications

- Assembled and operated an Earth-Moon-Earth communication terminal using microwave components and measurement equipment
- Advisors: Drs. Paul Steffes and Gary May in ECE Dept.

Research Intern, Summer Research Experience Undergraduate (REU - 2000), U of Minnesota-Twin Cities

Participated in general research on wireless communications theory

- Analyzed probability relationships for mobile channels, results published in the *IEEE Trans. On Vehicular Technology*
- Advisors: Drs. Mohamed-Slim Alouni and Douglas Ernie in ECE Dept.

Teaching Experience

Assistant Professor, School of Electrical and Computer Engineering, University of Oklahoma

ECE-3613 - Electromagnetic Fields I (Fall 2016: 47 students)

Course objective: Build a firm understanding of electromagnetic field concepts, and to learn how to use Maxwell's equations and boundary conditions under static and time-varying conditions to solve complex electromagnetics problems that will appear in higher-level courses and in practice

- First-time course preparation
- Topics taught included vector analysis, electrostatics, magnetostatics, Maxwell's equations, time-varying fields, and propagation of uniform plane waves
- Incorporated interactive online tool (i.e., Top Hat) to foster a more effective learning environment

ECE-2713 - Electrical Circuit I (Spring 2016: 72 students)

Course objective: Provide students with the opportunity to learn and gain a solid understanding of the fundamental principles of electronic circuits; and enhance their analytical and engineering problem solving skills

- First-time course preparation
- Topics taught included Ohm's Law, Kirchhoff's Voltage and Current Law, Node Voltage and Mesh Current Analysis, Voltage and Current Dividers, Source Transformations, Thevenin and Norton Equivalents, Superposition, DC Response of Inductors and Capacitors, Phasors, Impedance, AC Circuit Analysis, and Complex Power
- Incorporated Top Hat interactive tool into course

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 and 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 EM problems with students

- Assisted in transmission lines and matching (Smith Chart), Reflection and transmission of plane waves, EM radiation from linear antennas, antenna arrays, rectangular waveguides and cavities
- Taught lectures in the absence of the course instructors