

# Caleb J. Fulton

## CURRICULUM VITAE

Assistant Professor of Electrical and Computer Engineering  
The University of Oklahoma  
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(405) 325-4278

### Education

- 2011 Ph.D.** in Electrical and Computer Engineering (Dec.) *Purdue University, W. Lafayette, IN*  
**Dissertation:** "Digital array radar calibration and performance monitoring techniques, including direct conversion and dual polarization architectures"  
**Advisor:** Dr. William J. Chappell
- 2006 B.S.** in Electrical and Computer Engineering (Dec.) *Purdue University, W. Lafayette, IN*  
Graduated with Highest Distinction

### Research Interests

- Digital array radar system integration
- Phased array polarization correction
- Digital beamforming architectures
- Array mutual coupling effects
- In-situ array performance monitoring
- Multi-function and cognitive radar architectures
- Phased array calibration and measurements
- Synchronization and clocking circuitry
- Panel integration of solid-state T/R MMICs
- Simultaneous transmit/receive functionality

### Prior Employment

**2007-2011 Graduate Research Assistant, Purdue University**

*Research Activities:*

- Primarily functioned as a lead graduate student on the Army DAR (digital array radar) project at Purdue's IDEAS Microwave Laboratory. This project, sponsored by CERDEC, focused on creating and demonstrating a 16-element, S-band phased array radar subarray featuring low-cost transceiver technology, digitization of signals at every element on both transmit and receive, and panelization of GaN-based T/R MMICs. Its multidisciplinary nature provided exposure to a wide variety of RF, analog, and digital design problems as well as the opportunity to interface with a diverse group of peers from other research groups. Additionally, it provided a hardware testbed for the dissertation work described in the appended abstract.
- Was a particularly active member of the overall research group, contributing ideas to multiple projects and often helping other students with both theory and measurements.

*Teaching Opportunities:*

- Provided laboratory support and instruction for both undergraduate- and graduate-level courses in electromagnetics and RF/microwave circuits in addition to occasional classroom lectures in the professor's absence.
- Acted as graduate student mentor for several undergraduate senior design sections that focused on various RF/microwave principles.

**2005/2006 Summer Engineering Intern, GE Healthcare**

- Designed and built a prototype for the RF transmitter of a wireless heart-monitoring telemetry unit that used a dual-input phase-locked loop technique for direct GFSK modulation.
- Gained valuable industry experience as a young engineer working for the first time on practical and real-world RF/microwave devices and equipment.

### Awards and Honors

- 2015** DARPA Young Faculty Award for Nonlinear Processing and Dynamic Range Extension in Digital Phased Array Systems
- 2011** First Place in Graduate Student Competition – Awarded at 2011 International Microwave Symposium.
- 2010** Meritorious Paper Award – Voted best paper at GOMACTech 2010 Conference.
- 2009** Eaton Alumni Award in Design Excellence – Awarded for design work on the Army DAR prototype.
- 2006** Eaton Award for Senior Design – Awarded for the best design work during ECE senior design.
- 2006** Management Award at GE Healthcare – Awarded for outstanding work during summer internship.
- 2003** Indiana Resident Top Scholar Award, Purdue University – Awarded a full tuition scholarship.

## Publications and Invited Talks

### Journal Papers

- B. L. Cheong, D. Bodine, C. Fulton, S. Torres, T. Maruyama, and R. Palmer, "A polarimetric radar time-series simulator for tornadic debris studies," *IEEE Transactions on Geoscience and Remote Sensing*, currently under review, November 2016.
- C. Fulton, J. Salazar, R. Zhang, G. Zhang, R. Kelley, J. Meier, M. McCord, D. Schmidt, A. Byrd, L. M. Bhowmik, S. Karimkashi, D. Zrnic, R. Doviak, A. Zahrai, M. Yeary, R. Palmer, "Cylindrical Polarimetric Phased Array Radar (CPPAR): Beamforming and Calibration for Weather Applications," *IEEE Transactions on Geoscience and Remote Sensing*, accepted for publication, January 2016.
- Y. Song, K. T. Wong, C. Fulton, S. Khan, and W. Tam, "Long' dipoles in a collocated/orthogonal triad – for direction finding or polarization estimation," *IEEE Transactions on Antennas and Propagation*, submitted for review, October 2016.
- Z. Dunn, M. Yeary, C. Fulton, and N. Goodman, "Wideband digital predistortion of solid-state radar amplifiers," *IEEE Transactions on Aerospace and Electronic Systems*, Vol. 52, No. 5, October 2016.
- C. Fulton, M. Yeary, D. Thompson, J. Lake, and A. Mitchell, "Digital phased array systems: challenges and opportunities," *Proceedings of the IEEE, Special Issue on Phased Arrays*, Vol. 104, Issue 3, Feb. 2016.
- D. Bodine, R. Palmer, T. Maruyama, C. Fulton, Y. Zhu, and B. L. Cheong, "Simulated frequency dependence of radar observations of tornadoes," *Journal of Atmospheric and Oceanic Technology*, Vol. 33, No. 9, Sept. 2016.
- D. Bodine, T. Maruyama, R. Palmer, C. Fulton, and H. Bluestein, "Sensitivity of tornado dynamics to debris loading," *Journal of Atmospheric Science*, Vol. 73, No. 7, July 2016.
- A. Mirkamali and C. Fulton, "A computer aided technique for the analysis of embedded element patterns of cylindrical arrays," *IEEE Antennas and Propagation Magazine*, Vol. 57, Issue 3, June 2015.
- D. Thompson, M. Yeary, C. Fulton, and B. McGuire, "Optimized beam-steering approach for improved sidelobes in phased array radars using a minimal number of control bits," *IEEE Transactions on Antennas and Propagation*, Vol. 63, Issue 1, Jan. 2015.
- T. Snow, C. Fulton, and W. Chappell, "Transmit-receive duplexing using digital beamforming system to cancel self-interference," *Microwave Theory and Techniques, the IEEE Transactions on*, Vol. 59, Issue 12, Dec. 2011.

### Peer-Reviewed Conference Papers

- Z. Dunn, M. Yeary, F. Uysal, and C. Fulton, "Low sidelobe pseudo-orthogonal code sets through particle swarm optimization," *Proceedings of the 2016 IEEE Radar Conference*, May 2016.
- T. Hoffman, C. Fulton, M. Yeary, D. Thompson, A. Saunders, B. Murmann, B. Chen, and A. Guo, "IMPACT – a common building block to enable next generation radar arrays," *Proceedings of the 2016 IEEE Radar Conference*, May 2016.
- B. L. Cheong, D. Bodine, Y. Zhu, C. Fulton, S. Torres, T. Maruyama, R. Palmer, R., "Emulating polarimetric radar signals from tornadic debris using a radar-cross-section library," *Proceedings of the 2015 European Radar Conference (EuRAD)*, Sept. 2015.
- B. James and C. Fulton, "Decorrelation and mitigation of spurious products in phased arrays with direct conversion transceivers," *Microwave Symposium Digest (MTT), 2015 IEEE MTT-S International*, May 2015.
- Z. Dunn, M. Yeary, C. Fulton, and N. Goodman, "Memory polynomial model for digital predistortion of broadband solid-state radar amplifiers," *Proceedings of the 2015 IEEE Radar Conference*, May 2015.
- B. L. Cheong, D. Bodine, Y. Zhu, C. Fulton, S. Torres, T. Maruyama and R. Palmer, "Understanding tornadic debris echoes using a radar time-series emulator," *Proceedings of the 2015 IEEE Radar Conference*, May 2015.
- B. L. Cheong, D. Bodine, T. Maruyama, C. Fulton, S. Torres, and R. Palmer, "A radar-cross-section database driven radar time-series simulator," *Proceedings of the 8th European Conference on Radar in Meteorology and Hydrology*, Sept. 2014.
- C. Fulton, G. Zhang, W. Bocangel, L. Lei, R. Kelley, and M. McCord, "Cylindrical Polarimetric Phased Array Radar: a multi-function demonstrator and its calibration," *Communications, Antennas and Electronic Systems, 2013 IEEE Intl. Conf. on*, Oct. 2013.
- T. Snow, C. Fulton, and W. Chappell, "Multi-antenna near field cancellation duplexing for concurrent transmit and receive," *Microwave Symposium Digest (MTT), 2011 IEEE MTT-S International*, June 2011.
- C. Fulton and W. Chappell, "Calibration of a digital phased array for polarimetric radar," *Microwave Symposium Digest (MTT), 2010 IEEE MTT-S International*, May 2010.

- C. Fulton, P. Clough, and W. Chappell, "A digital array radar with a hierarchical system architecture," *Microwave Symposium Digest (MTT), 2009 IEEE MTT-S International*, June 2009.
- A. Wegener, C. Fulton, J. Gregory, and W. Chappell, "Large area integration of embedded high power RF amplifiers in a thin organic panel," *Microwave Symposium Digest (MTT), 2009 IEEE MTT-S International*, June 2009.
- **Other Conference Papers and Presentations with Peer Selection**
  - L. M. Bhowmik and C. Fulton, "Analysis and measurement of grating lobe effects in infinite planar arrays of finite-sized subarrays," *2016 IEEE International Symposium on Phased Array Systems and Technology*, Oct. 2016.
  - D. Thompson, M. Yeary, and C. Fulton, "RF array system equalization and true time delay with FPGA hardware-in-the-loop," *2016 IEEE International Symposium on Phased Array Systems and Technology*, Oct. 2016.
  - T. Hoffman, C. Fulton, M. Yeary, A. Saunders, D. Thompson, B. Chen, and B. Murmann, "Measured performance of the IMPACT Common Module – a building block for next generation phased arrays," *2016 IEEE International Symposium on Phased Array Systems and Technology*, Oct. 2016.
  - R. Lebron, J. Salazar, S. Duthoit, D. Schmidt, C. Fulton, and R. Palmer, "A novel near-field robotic scanner for millimeter-wave active phased array antenna calibration that includes surface, thermal and RF characterization," *2016 IEEE International Symposium on Phased Array Systems and Technology*, Oct. 2016.
  - J. Diaz, J. Salazar, J. Ortiz, N. Aboserwal, C. Fulton, and R. Palmer, "A dual-polarized stacked patch antenna with wide-angle and low cross-polarization for fully digital multifunction phased array radars," *2016 IEEE International Symposium on Phased Array Systems and Technology*, Oct. 2016.
  - J. Salazar, N. Aboserwal, J. Diaz, J. Ortiz, and C. Fulton, "Edge diffractions impact on the cross polarization performance of active phased array antennas," *2016 IEEE International Symposium on Phased Array Systems and Technology*, Oct. 2016.
  - N. Aboserwal, J. Salazar, and C. Fulton, "Current polarization impact on cross polarization definitions for practical antenna elements," *2016 IEEE International Symposium on Phased Array Systems and Technology*, Oct. 2016.
  - N. Tahir, N. Aboserwal, and C. Fulton, "Optimization of feed positioning of a multi-beam reflectarray," *2016 Allerton Antenna Symposium*, Sept. 2016.
  - J. Lujan, B. L. Cheong, C. Fulton, and R. Palmer, "Polarimetric radar cross section modeling of tornadic debris (abstract/presentation)," *AMS Radar Meteorology Conference*, Sept. 2015.
  - David Bodine, R. Palmer, T. Maruyama, C. Fulton, Y. Zhu, and B. L. Cheong, "A GPU-accelerated polarimetric radar time-series emulator (abstract/presentation)," *AMS Radar Meteorology Conference*, Sept. 2015.
  - S. Karimkashi, B. McGuire, R. Irazoqui, M. McCord, N. Aboserwal, M. Teshiba, H. Sigmarsson, and C. Fulton, "Development of a low-cost, multi-beam, X-band reflectarray-based weather radar system (abstract/poster)," *AMS Radar Meteorology Conference*, Sept. 2015.
  - Z. Dunn, M. Yeary, C. Fulton, N. Goodman, and Rafael Rincon, "Effects of cross-correlated waveforms on polarimetric scattering parameter recovery (abstract/poster)," *AMS Radar Meteorology Conference*, Sept. 2015.
  - L. M. Bhowmik and C. Fulton, "Floquet modal analysis of grating lobe effects for finite planar subarrays," *2015 Allerton Antenna Symposium*, Sept. 2015.
  - C. Fulton, R. Palmer, J. Salazar, Y. Zhang, J. Meier, R. Kelley, M. McCord, and B. McGuire, "An all-digital polarimetric phased array for MPAR applications and beyond (abstract/presentation)," *2015 International Symposium on Earth-Science Challenges (ISEC)*, Sept. 2015.
  - L. Paulsen, T. Hoffmann, C. Fulton, M. Yeary, A. Saunders, D. Thompson, B. Chen, A. Guoc, B. Murmann, "IMPACT – a low cost, reconfigurable, digital beamforming common module building block for next generation phased arrays," *SPIE Defense and Commercial Sensing Conference*, April 2015.
  - P. Clough, A. Wegener, and C. Fulton, "Automated calibration and tuning of near-field resonators," *2015 Government Microcircuit Applications & Critical Technology (GOMACTech) Conference*, March 2015.
  - C. Fulton, J. Meier, R. Kelley, S. Karimkashi, M. McCord, I. Meier, G. Zhang, R. Palmer, A. Zahrai, D. Schmidt, R. Doviak, D. Zrnic, L. Bhowmik, and A. Byrd, "Cylindrical Polarimetric Phased Array Radar Demonstrator (abstract/presentation)," *31st Conference on Environmental Information Processing Technologies*, Jan. 2015.
  - J. Kurdzo, R. Palmer, B. L. Cheong, R. Kelley, and C. Fulton, "Adaptive waveform design applications for a multi-sector MPAR (abstract/presentation)," *31st Conference on Environmental Information Processing Technologies*, Jan. 2015.

- B. L. Cheong, D. Bodine, T. Maruyama, C. Fulton, S. Torres, and R. Palmer, "Emulation of polarimetric weather radar signals from tornadic debris (abstract/presentation)," *31st Conference on Environmental Information Processing Technologies*, Jan. 2015.
- D. Bodine, R. Palmer, T. Maruyama, C. Fulton, and B. L. Cheong, "Dual-frequency simulations of radar observations of tornadoes," *27th Conference on Severe Local Storms*, Nov. 2014.
- D. Bodine, T. Maruyama, R. Palmer, C. Fulton, and H. Bluestein, "Examination of debris loading effects on tornado dynamics using a Large-Eddy Simulation model and W-band mobile radar measurements," *27th Conference on Severe Local Storms*, Nov. 2014.
- A. Horton, C. Fulton, J. Ruyle, and K. Hatami, "Investigation of electrical properties of clay soil," *2014 Allerton Antenna Symposium*, Sept. 2014.
- C. Fulton, "Phase mode analysis of a cylindrical polarimetric phased array antenna," *2014 Allerton Antenna Symposium*, Sept. 2014.
- Z. Dunn, M. Yeary, and C. Fulton, "Frequency-dependent power amplifier modeling and correction for distortion in wideband radar transmissions," *57th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS)*, Aug. 2014.
- R. Lee, M. Yeary, and C. Fulton, "Initial measurements and results of a multi-channel, adaptive pre-distortion system for an airborne phased array radar," *International Instrumentation and Measurement Technology Conference*, May 2014.
- A. Mitchell, C. Fulton, P. Clough, and H. Diamond, "Power handling considerations for simultaneous Transmit/receive arrays that utilize tunable coupling paths," *2014 Government Microcircuit Applications & Critical Technology (GOMACTech) Conference*, March 2014.
- C. Fulton, J. Herd, S. Karimkashi, G. Zhang, and D. Zrnic, "Dual-polarization challenges in weather radar requirements for Multifunction Phased Array Radar," *2013 IEEE International Symposium on Phased Array Systems and Technology*, Oct. 2013.
- G. Zhang, S. Karimkashi, L. Lei, R. Kelley, J. Meier, R. Palmer, C. Fulton, R. Doviak, A. Zahrai, D. Zrnic, Y. Al-Rashid, "A Cylindrical Polarimetric Phased Array Radar concept – A path to multi-mission capability," *2013 IEEE International Symposium on Phased Array Systems and Technology*, Oct. 2013.
- P. Clough, C. Fulton, A. Wegener, and V. Pai, "Simultaneous transmit and receive with digital processing," *2013 Government Microcircuit Applications & Critical Technology (GOMACTech) Conference*, March 2013.
- P. Clough, M. Harger, V. Pai, C. Fulton, and T. Snow, "A low-cost digital array radar architecture," *2012 Government Microcircuit Applications & Critical Technology (GOMACTech) Conference*, March 2012.
- W. Bocangel, R. Palmer, G. Zhang, J. Meier, C. Fulton, M. Harger, and W. Chappell, "A test of cylindrical polarimetric array configuration using the Digital Array Radar," *28th Conf. on Interactive Information Processing Systems (IIPS)*, Jan. 2012.
- C. Fulton and W. Chappell, "A dual-polarized patch antenna for weather radar applications," *Microwaves, Communications, Antennas and Electronic Systems, 2011 IEEE Intl. Conf. on*, Nov. 2011.
- C. Fulton and W. Chappell, "Calibration of panelized polarimetric phased array radar antennas: a case study," *2010 IEEE International Symposium on Phased Array Systems and Technology*, Oct. 2010.
- C. Fulton and W. Chappell, "The Purdue Digital Array Radar testbed," *2010 Government Microcircuit Applications & Critical Technology (GOMACTech) Conference*, March 2010.
- C. Fulton, W. Chappell, "Calibration techniques for digital phased arrays," *Microwaves, Communications, Antennas and Electronic Systems, 2009 IEEE Intl. Conf. on*, Nov. 2009.
- D. Matcovich, M. Walsh, W. Chappell, C. Fulton, J. Kessler and J. Milligan, "Enabling technologies for a digital array radar," *Tri-Service Radar Symposium*, June, 2008.
- C. Fulton, W. Chappell, "Low-cost, panelized digital array radar antennas," *Microwaves, Communications, Antennas and Electronic Systems, 2008 IEEE Intl. Conf. on*, May 2008.
- **Patent Disclosures**
  - J. Salazar, D. Schmidt, C. Fulton, R. Palmer, R. Lebron, A. Mancini, S. Duthoit, M. McCord, J. Meier, and R. Kelley, "Radio Frequency (RF) Scanner Multi Degree of Freedom Antenna Calibration & Characterization Robot," Provisional #16NOR006, Dec. 2015.
- **Major Reports and Deliverables**
  - CPPAR Design Team (OU and NSSL, R. Palmer lead), "Conceptual design study for the Multi-Function Phased Array Radar program: the Cylindrical Polarimetric Phased Array Radar," *internal report for the OU Board of Regents*, March 2014.
- **Invited Talks and Tutorial Sessions**
  - C. Fulton, "Digital phased array systems: challenges and opportunities," part of the *Future of Phased Array Technologies* webinar presented by the IEEE in Oct. 2016.

- C. Fulton, "Fourier series-based analysis and advanced pattern synthesis of radiation from the cylindrical polarimetric phased array radar," *OU Applied Math Seminar*, Sept. 2016.
- C. Fulton, "Tradeoffs in the use of cylindrical vs. planar arrays for future multifunction radar systems," *Invited talk given at the 2015 IEEE COMCAS conference*, Nov. 2015.
- C. Fulton and J. Salazar, "Short course on dual-polarized phased array antennas for weather radars," *AMS Radar Meteorology Conference*, September 2015.
- C. Fulton, "Digital Array Radar (DAR)," *Invited talk for the IEEE Phoenix Section Life Member Affinity Group*, Phoenix, AZ, May 2015.
- C. Fulton, "Digital phased arrays: beamforming, calibration, and future concepts," *Invited talk for a tutorial session at the 2015 Government Microelectronics & Critical Technologies (GOMACTech) Conference*, March 2015.
- C. Fulton, et al, "Cylindrical Polarimetric Phased Array Radar: a multi-function demonstrator and its calibration," *presentation to the Office of the Federal Coordinator for Meteorological Services and Supporting Research*, Sept. 2014.
- C. Fulton, et al, "Dual-polarization challenges in weather radar requirements for Multifunction Phased Array Radar: overview and current demonstrators," *invited talk at Elta Systems*, Ashdod, Israel, Oct. 2013.
- C. Fulton and R. Kelley, "An adaptable, low-cost ku-band hardware solution," *invited talk at National Weather Center by request of Weathernews Inc.*, Sept. 2013.
- C. Fulton, "Digital Array Radar research at OU/PU," *invited talk at Sandia National Laboratories*, November 2012.
- C. Fulton, "Low-cost digital phased arrays: challenges and opportunities," *invited talk at the Purdue University IDI Defense Spectrum Workshop*, May 2012.
- C. Fulton, "Enabling low-cost digital apertures for multi-function radar," *invited talk at the National Center for Atmospheric Research (NCAR)*, Boulder Colorado, July 2011.
- C. Fulton, "Digital array radar," *invited talk, 2010 RF Alliance Conference*, Purdue, April 2010.
- C. Fulton, "Purdue Digital Array Radar project," *invited talk at Elta Systems*, Ashdod, Israel, Nov. 2009.

### **Outreach, Service, and Leadership Activities**

- 2016** **Co-Chair**, *Special Session on Weather Radar Applications at the 2016 IEEE Phased Array Systems and Technology Conference.*
- 2016-** **Delegate**, *OU Advanced Radar Research Center Student Recruiting Trips to Georgia Tech.*
- 2015-** **Member**, *Government Engineering Team in support of the MPAR Advanced Technology Demonstrator's calibration - Supporting the overall calibration effort, and leading plans for calibration research in FY17-19.*
- 2015** **Major Reviewer**, *IEEE Special Issue on Phased Arrays*
- 2014-** **Member**, *OU ECE Undergraduate Studies Committee*
- Panelist**, *Academic panel session for the International Microwave Symposium (IMS) Connect Program (2014, 2016)*
- 2014-2015** **Co-Chair**, *Technical Program Co-Chair for the 2015 IEEE COMCAS Conference in Tel Aviv, Israel*
- Member**, *Technical Review Committee, 2015 IEEE Radar Conference*
- Member**, *OU ECE Committee to review policies regarding tenure and promotion*
- Member**, *OU Advanced Radar Research Center Director Search Committee*
- Volunteer**, *Girls Learning and Applying Math and Science: Engineering Event (October 2014) – Assisted Dr. Ruyle with a homopolar motor design/build event for local middle school girls*
- Delegate**, *OU Advanced Radar Research Center Student Recruiting Trips to Georgia Tech, Purdue University, and Texas A&M*
- Reviewer**, *NSF, IEEE Transactions on Very Large Scale Integration*
- 2013** **Member**, *Technical Program Committee for the 2013 IEEE COMCAS Conference in Tel Aviv, Israel (October, 2013) – Organizing and chairing a special session on phased array calibration*
- Member**, *Technical Review Committee, 2014 IEEE Radar Conference*
- Paper Reviewer**, *Multidimensional Systems and Signal Processing Journal*
- 2012-** **Honors Coordinator and Undergraduate Advisor**, *The University of Oklahoma School of ECE*
- Adopt-A-Prof Mentor**, *Lambda Phi Epsilon Fraternity at OU*

- Host, Shell High School Girls Day** – Represented the school of ECE during a visit from a group of high school girls, demonstrating a simple radar system and discussing the field of ECE in general
- 2012-2013 Adopt-A-Prof Mentor, Phi Kappa Psi Fraternity at OU**
- 2012 Contributor**, Wireless Spectrum Research and Development Group meeting in Boulder, CO
- Leader**, Team for Analysis of Current and Future R&D Trends in Radar at OU Radar Retreat
- Judge**, Moore Norman Technology Center Pre-Engineering Program Senior Capstone Projects
- 2011- Member, IEEE Microwave Theory and Techniques Society Education Committee** – Active participant in committee activities, administering the 2012 and 2013 MTT-S Video Competitions and the 2012 and 2013 Graduate Student Challenges and serving as a Student Paper Award judge at the 2013 International Microwave Symposium
- Paper Reviewer, IEEE Transactions on Communications, Transactions on Aerospace and Electronic Systems, and Transactions on Signal Processing.**
- 2010-2011 President/Chair, Purdue University IEEE MTT-S Student Chapter Branch**
- 2003-2005 Technical Advisor (2003, 2004) and Coordinator (2005), Purdue FIRST Programs**

### Teaching Assignments

- Spring, 2017:** ECE 3613 – Electric and Magnetic Fields  
Freshman Year Research Experience (FYRE; two students)
- Fall, 2016:** ECE 4703/5703 – Electromagnetic Fields and Wave Propagation
- Spring, 2016:** ECE 3613 – Electric and Magnetic Fields  
Freshman Year Research Experience (FYRE; two students)
- Fall, 2015:** ECE 4703/5703 – Electromagnetic Fields and Wave Propagation
- Spring, 2015:** ECE 3613 – Electric and Magnetic Fields  
Honors Engineering Research Experience (one student)
- Fall, 2014:** ECE 4703/5703 – Electromagnetic Fields and Wave Propagation
- Spring, 2014:** ECE 3613 – Electric and Magnetic Fields  
Honors Engineering Research Experience (two students)
- Fall, 2013:** ECE 4973/5973 – Electromagnetic Fields and Wave Propagation  
ENGR 1411 – Freshman Engineering Experience
- Spring, 2013:** ECE 3613 – Electric and Magnetic Fields  
Honors Engineering Research Experience (two sections/four students)
- Fall, 2012:** ECE 4973/5973 – Microwave Systems and Components

### Students Mentored or Advised

- **Current:**
  - **Yuanxi Chao**, *Dissertation Committee Outside Member (Spring 2016-)*
  - **Kristin Sperzel**, *Dissertation Committee Chair (Fall 2015-)*
  - **Shajid Islam**, *Dissertation Committee Chair (Fall 2015-)*
  - **Blake James**, *Dissertation Committee Chair (Fall 2015-)*
  - **William Dower**, *Dissertation Committee Member (Fall 2015-)*
  - **Robin Irazoqui**, *Dissertation Committee Chair (Spring 2015-)*
  - **Ivan Hurd**, *Dissertation Committee Outside Member (Spring 2015-)*
  - **David Lucking**, *Dissertation Committee Member (Fall 2015-)*
  - **William Bonner**, *Dissertation Committee Member (Fall 2015-)*
  - **J. R. Lievsay**, *Dissertation Committee Member (Fall 2015-)*
  - **Lal Mohan Showmik**, *Dissertation Committee Chair (Fall 2014-)*
  - **SM Shazzus Sharif**, *Dissertation Committee Member (Fall 2014-)*
  - **Alexander Moreno**, *Dissertation Committee Member (Fall 2014-)*
  - **Daniel Thompson**, *Dissertation Committee Member (Fall 2013-)*
  - **Lucasz Szolc**, *Dissertation Committee Member (Fall 2012-)*
  - **Andrew Meyer**, *Undergraduate Research Assistant (Fall 2016-)*
  - **Nick Peccarelli**, *Undergraduate Research Assistant (Summer 2016-)*
  - **Zach Rush**, *Undergraduate Research Assistant (Summer 2016-)*
  - **Carl Fratus**, *Undergraduate Research Assistant (Summer 2015-)*
  - **Zach Potts**, *Undergraduate Research Assistant (Summer 2015-)*
  - **Paulius Velesko**, *Undergraduate Research Assistant (Summer 2013-Fall 2015)*
- **Graduated (or otherwise competed):**
  - **Zachary Dunn**, *Dissertation Committee Member (Spring 2013-Spring 2015)*

- **Ye Zhu**, *Dissertation Committee Member (Spring 2015)*
- **Hernan Suarez**, *Dissertation Committee Member (Fall 2012-Fall 2015)*
- **Shahrokh Saeedi**, *Dissertation Committee Member (Fall 2012-Fall 2015)*
- **Andrius Lietuvninkas**, *Master's Thesis Committee Member (Fall 2015-Fall 2016)*
- **Javier Lujan**, *Master's Thesis Committee Chair (Fall 2014-Fall 2016)*
- **Arturo Umeyama**, *Master's Thesis Committee Member (Spring 2015-Fall 2016)*
- **Dakota Bengel**, *Master's Thesis Committee Member (Spring 2015-Spring 2016)*
- **C. J. Smith**, *Master's Thesis Committee Member (Fall 2014-Spring 2016)*
- **Arin Little**, *Master's Thesis Committee Member (Fall 2015-Spring 2015)*
- **Paul Winniford**, *Master's Thesis Committee Member (Fall 2014-Fall 2015)*
- **Patrick Kenworthy**, *Master's Thesis Committee Member (Spring 2014-Fall 2015)*
- **Alexander Moreno**, *Master's Thesis Committee Member (Spring 2014-Fall 2015)*
- **Robert (Austin) Lee**, *Master's Thesis Committee Member (Fall 2013-Spring 2014)*
- **Blake James**, *Master's Thesis Advisor (Fall 2013-Summer 2015)*
- **Adam Mitchell**, *Master's Thesis Advisor (Spring 2013-Summer 2014)*
- **Robin Irazoqui**, *Master's Thesis Advisor (Fall 2012-Fall 2014)*
- **Blake McGuire**, *Master's Thesis Advisor (Fall 2012-Summer 2014)*
- **David White**, *Master's Thesis Advisor (Fall 2012-Spring 2014)*
- **Zaidi Zhu**, *Master's Thesis Committee Member (Fall 2012-Spring 2014)*
- **Matthew Granato**, *Master's Thesis Committee Member (Fall 2012-Spring 2014)*
- **SM Shazzad Sharif**, *Master's Thesis Committee Member (Fall 2012-Fall 2013)*
- **Christian Boyer**, *NSF REU student from Millersville Univ. (Summer 2016)*
- **Russell Kenney and Nick Morris**, *Honors Engineering Research Experience, Spring 2016*
- **Connor McBryde**, *Undergraduate Research Assistant (Spring 2015-Fall 2015)*
- **Sarah Davis**, *Undergraduate Research Assistant (Spring 2014-Fall 2015)*
- **David Mitchell and Carey McCachern** *Honors Engineering Research Experience, Spring 2014*
- **Joshua Smart**, *Undergraduate Research Assistant (Summer 2013-Spring 2014)*
- **Alec Kyle, Blake Riojas, John Wood, Kreg Flowers**, *Honors Engineering Research Experience, Spring 2013*
- **Thomas Carlisle**, *Undergraduate Research Assistant (Spring 2012-Spring 2015)*
- **Wascar Bocangel**, *Master's Thesis Committee Member (Spring 2012-Spring 2013)*
- **Kevin Marlow**, *Undergraduate Research Assistant (Fall 2012-Spring 2013)*

### **Professional Society Memberships and Honors**

- 2016: Elevated to IEEE Senior Member by the IEEE Admissions and Advancement Committee in recognition of sustained, significant scientific and engineering performance
- Member: IEEE Microwave Theory and Techniques Society
- Member: IEEE Antennas and Propagation Society
- Member: IEEE Aerospace and Electronic Systems Society

### **Research Expenditures**

- **Total:** \$1,901,541.20
- **FY16:** \$1,069,286.13
- **FY15:** \$480,058.51
- **FY14:** \$303,374.32
- **FY13:** \$48,822.24