

CURRICULUM VITAE

Edward J. Rothwell

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Education

Ph.D. in Electrical Engineering, Michigan State University, 1985. Dissertation title: "Radar Target Discrimination Using the Extinction-Pulse Technique." Adviser: Kun-Mu Chen
Electrical Engineer, Stanford University, 1982. Thesis title: "A Study of Slow-wave Propagation in a Dielectric/ferrite-lined Waveguide." Adviser: Marvin Chodorow
M.S., Electrical Engineering, Stanford University, 1980
B.S., Electrical Engineering, Michigan Technological University, 1979
A.S., Grand Rapids Junior College, 1977

Professional Experience

Dennis P. Nyquist Professor Emeritus, 2020-present, Department of Electrical and Computer Engineering, Michigan State University.

Dennis P. Nyquist Endowed Professor of Electromagnetics, 2017-2020, Department of Electrical and Computer Engineering, Michigan State University.

Associate Chair for Undergraduate Studies, 2014-2017, Department of Electrical and Computer Engineering, Michigan State University.

Professor, 1998-2017, Department of Electrical and Computer Engineering, Michigan State University. Responsible for instructional and research activities in the academic area of electromagnetics.

Associate Professor, 1990-1998, Department of Electrical Engineering, Michigan State University. Responsible for instructional and research activities in the academic area of electromagnetics.

Assistant Professor, 1985-1990, Department of Electrical Engineering, Michigan State University. Responsible for instructional and research activities in the academic area of electromagnetics.

Staff Member, 1985, MIT Lincoln Laboratory. Evaluated techniques for the radar acquisition, tracking, and identification of orbiting space vehicles and satellites.

Graduate Research Assistant, 1982-1985, Department of Electrical Engineering, Michigan State University. Developed experimental techniques for the measurement of transient electromagnetic fields scattered by radar targets. Developed numerical techniques for parameter extraction from target transient fields. Performed theoretical and numerical analysis for computation of transient scattered field from simple bodies. Developed techniques for target identification and discrimination using transient scattered fields.

Assistant Engineer, 1979-1982, Raytheon Co., Microwave and Power Tube Division. Designed low-power travelling wave tubes. Developed theory for analyzing slow-wave cyclotron amplifier. Performed electron beam optimization using field/particle simulation programs.

Awards and Academic Honors

Named first Dennis P. Nyquist Endowed Professor of Electromagnetics, 2017

MSU Distinguished Faculty Award, 2013.

John D. Withrow Teaching Excellence Award. Won the first John D. Withrow award given by the College of Engineering, 1991. Won again in 1996, 2006, and 2012.

Sloan Foundation, recognized by the Sloan Foundation for mentoring of graduate students from under-represented groups, 2008.

Withrow Distinguished Scholar Award, 2007. Awarded by the College of Engineering to a senior researcher.

IEEE SE Michigan Section 2005 Outstanding Professional Award

Elected Fellow of the IEEE, January 1, 2005

Selected as the MSU nominee for the CASE Professor of the Year award, 2004

MSU Alumni Club of Mid-Michigan Quality in Undergraduate Teaching Award, 2003. Awarded by Michigan State University, and the Mid-Michigan MSU Alumni Club.

Antenna Measurement Techniques Association (AMTA) 2003 Best Technical Paper Award (Sean Dorey, Michael Havrilla, Lydell Frasch, Christopher Choi, and Edward Rothwell)

Antenna Measurement Techniques Association (AMTA) 2014 Best Technical Paper Award (A. Knisely, M. Havrilla, J. Allen, A. Bogle, P. Collins, M. Hyde and E. Rothwell)

Dean's Distinguished Fellowship, College of Engineering, 1982-1985. Three-year 1/2-time fellowship for academic excellence.

AFTER (Air Force Thermionics Engineering and Research) Scholarship, Stanford University and Raytheon Company, 1979-1982. Air Force sponsored scholarship providing full tuition and 1/2 salary for two years.

Horace H. Rackham Graduate Fellowship, University of Michigan, 1979 (declined).

Student Achievements

Most outstanding graduate student of the year, Electrical Engineering Department,
Michigan State University, 1984
Elected to Phi Kappa Phi (national honor society), 1979
Graduated with highest honors, Michigan Technological University, 1979
Dean's list, Michigan Technological University, 1977-1979
Dean's list, Grand Rapids Junior College, 1975-1977
State of Michigan Merit Scholarship, 1975-1979
National Merit Scholar runner-up, 1975

Technical and Professional Societies

Institute of Electrical and Electronics Engineers (Fellow)
Sigma Xi (scientific research society)
International Union of Radio Science (USNC Commission B)
American Geophysical Union
Applied Computational Electromagnetics Society

Patents

Edward J. Rothwell, "Self-Structuring Antenna System with a Switchable Antenna Array and an Optimizing Controller," U.S. patent no. 6,175,723, January 16, 2001.

Edward J. Rothwell and Lynn Greetis, "Variable Frequency Patch Antenna," U.S. patent no. 8,659,498 B2, February 5, 2014.

Edward J. Rothwell and Raoul O. Ouedraogo, "Reconfigurable Leaky-Wave Antenna," U.S. patent no. 8,836,594 B2, September 16, 2014.

Publications

Books

E.J. Rothwell and M.J. Cloud, Electromagnetics, CRC Press, Boca Raton, FL, 2001 (ISBN 0-8493-1397-X).

E.J. Rothwell and M.J. Cloud, Electromagnetics, 2nd edition, Taylor & Francis CRC Press, Boca Raton, FL, 2008 (ISBN 978-1-4200-6447-6).

E.J. Rothwell and M.J. Cloud, Solutions Manual for Electromagnetics, 2nd edition, Taylor & Francis CRC Press, Boca Raton, FL, 2008 (ISBN 978-1-4398-0817-7).

E.J. Rothwell and M.J. Cloud, Electromagnetics, 3rd edition, Taylor & Francis CRC Press, Boca Raton, FL, 2018 (ISBN 978-1-4987-9656-9).

E.J. Rothwell and M.J. Cloud, Solutions Manual for Electromagnetics, 3rd edition, Taylor & Francis CRC Press, Boca Raton, FL, 2018 (ISBN 978-1-4987-9657-6).

E.J. Rothwell and M.J. Cloud, Engineering Writing by Design: Creating Formal Documents of Lasting Value, Taylor & Francis CRC Press, Boca Raton, FL, 2014. (ISBN 978-1482234312).

E.J. Rothwell and M.J. Cloud, Solutions Manual for Engineering Writing by Design: Creating Formal Documents of Lasting Value, Taylor & Francis CRC Press, Boca Raton, FL, 2014. (ISBN 978-1482257878).

E.J. Rothwell and M.J. Cloud, Engineering Writing by Design: Creating Formal Documents of Lasting Value, 2nd edition, Taylor & Francis CRC Press, Boca Raton, FL, 2020. (Softcover: ISBN 978-0-367-34754-3; hardback: ISBN 978-0-367-89682-9).

E.J. Rothwell and M.J. Cloud, Engineering Speaking by Design: Delivering Technical Presentations with Real Impact, Taylor & Francis CRC Press, Boca Raton, FL, 2015. (ISBN 978-1-4987-0577-6.)

E.J. Rothwell and M.J. Cloud, Solutions Manual for Engineering Speaking by Design: Delivering Technical Presentations with Real Impact, Taylor & Francis CRC Press, Boca Raton, FL, 2015. (ISBN 978-1-4987-5109-4)

Chapters in books

1. E.J. Rothwell, contributor, CRC Dictionary of Pure and Applied Physics, CRC Press, Boca Raton, FL, 2000.

Refereed articles

Appearing in books – related to research

1. E. Rothwell, K.M. Chen, D.P. Nyquist, P. Ilavarasan, J. Ross, R. Bebermeyer, and Q. Li, "Radar Target Identification and Detection Using Short EM Pulses and the E-pulse

- Technique," in Henry L. Bertoni, Lawrence Carin and Leopold B. Felsen (ed.), Ultra-Wideband, Short-Pulse Electromagnetics, New York. Plenum, pp. 475-482, 1993.
2. Edward Rothwell, Kun-Mu Chen, Dennis Nyquist, John Ross and Robert Bebermeyer, "Measurement and processing of scattered ultrawide-band/short-pulse signals," Proceedings of the Society of Photo-Optical Instrumentation Engineers on Radar/Ladar Processing and Applications, William J. Miceli, Ed., vol. 2562, pp.138-149, July 1995.
 3. K.M. Chen, E. Rothwell, D.P. Nyquist, J. Ross, P. Ilavarasan, R. Bebermeyer, Q. Li, C.Y. Tsai and A. Norman, "Radar Identification and detection using ultra-wideband/short-pulse radars," in Lawrence Carin and Leopold B. Felsen (ed.), Ultra-Wideband, Short-Pulse Electromagnetics 2, New York. Plenum, pp. 535-542, 1995.
 4. Edward J. Rothwell, Kun Mu Chen, Dennis P. Nyquist, Adam Norman, G. Wallinga, and Y. Dai, "Target Detection and Identification Using a Stepped-Frequency, Ultrawideband Radar," Proceedings of the Society of Photo-Optical Instrumentation Engineers on Radar Processing, Technology, and Applications, William J. Miceli, Ed., vol. 2845, pp. 26-37, November 1996.
 5. E.J. Rothwell, K.M. Chen, D.P. Nyquist, A. Norman, G. Wallinga and Y. Dai, "Target detection and imaging using a stepped-frequency ultra-wideband radar," in Carl E. Baum, et. al. (ed.), Ultra-Wideband, Short-Pulse Electromagnetics 3, New York. Plenum, pp. 439-446, 1997.
 6. G.D. Dester and E.J. Rothwell, "Analysis of the Transient Field Scattered by a Line Source above a Grounded Dielectric Slab," Ultra-Wideband, Short-Pulse Electromagnetics 8, pp. 195-202, October 2007.
 7. B. Perry, S. Cossmann, L. Kempel, and E. Rothwell, "Application of the Method of Subregions to Measurement of Layered Materials," Ultra-Wideband, Short-Pulse Electromagnetics 8, pp. 211-218, October 2007.

Appearing in journals – related to instruction

8. E.J. Rothwell, "Using Transport Equations in the Teaching of Electromagnetics," IEEE Transactions on Education, vol. 47, no. 3, pp. 361-364, August 2004.
9. E.J. Rothwell, "The Transmission Line as a Simple Example for Introducing Integral Equations to Undergraduates," IEEE Transactions on Education, vol. 52, no. 4, pp. 459-469, November 2009.
10. Edward J. Rothwell and Michael J. Cloud, "Automatic Error Analysis Using Intervals," IEEE Transactions on Education, vol. 55, no. 1, pp. 9-15, February 2012.

Appearing in journals – related to research

11. E. J. Rothwell, "Analysis of loss to prevent oscillations in the slow-wave cyclotron amplifier," *International Journal of Electronics*, vol. 53, no. 6, pp. 715-727, Dec. 1982.
12. E. J. Rothwell, D. P. Nyquist, K. M. Chen, and B. Drachman, "Radar target discrimination using the extinction-pulse technique," *IEEE Transactions on Antennas and Propagation*, vol. AP-33, pp. 929-937, Sept. 1985.
13. B. Drachman and E. J. Rothwell, "A continuation method for the identification of the natural frequencies of an object using a measured response," *IEEE Transactions on Antennas and Propagation*, vol. AP-33, pp. 445-450, April 1985.
14. K. M. Chen, D. P. Nyquist, E. J. Rothwell, L. Webb, and B. Drachman, "Radar target discrimination by convolution of radar return with extinction-pulses and single mode extraction signals," *IEEE Transactions on Antennas and Propagation*, vol. AP-34, pp. 896-904, July 1986.
15. E. Rothwell, K. M. Chen, D. P. Nyquist, and W. M. Sun, "Frequency domain E-pulse synthesis and target discrimination," *IEEE Transactions on Antennas and Propagation*, vol. AP-35, pp. 426-434, April 1987.
16. E. Rothwell, K. M. Chen, and D. P. Nyquist, "Extraction of the natural frequencies of a radar target from a measured response using E-pulse techniques," *IEEE Transactions on Antennas and Propagation*, vol. AP-35, pp. 715-720, June 1987.
17. E. Rothwell and N. Gharsallah, "Determination of the natural frequencies of a thin wire elliptical loop," *IEEE Transactions on Antennas and Propagation*, vol. AP-35, pp. 1319-1324, November 1987.
18. E. J. Rothwell and L. L. Fransch, "Propagation characteristics of dielectric rod loaded waveguides," *IEEE Transactions on Microwave Theory and Techniques*, vol. 36, pp. 594-600, March 1988.
19. E. J. Rothwell and K. M. Chen, "A Hybrid E-pulse/Least Squares Technique for Natural Resonance Extraction," *Proceedings of the IEEE*, vol. 76, no. 3, pp. 296-298, March 1988.
20. M. A. Blischke, E. J. Rothwell, K. M. Chen, and J. L. Lin, "Receiving and scattering characteristics of circular patch antenna array," *Journal of Electromagnetic Waves and Applications*, Vol. 2, No. 3/4, pp. 353-378, 1988.
21. E. Rothwell and B. Drachman, "A Unified Approach to Solving Ill-conditioned Matrix Problems," *International Journal for Numerical Methods in Engineering*, Vol. 28, pp. 609-620, March 1989.

22. N. Gharsallah, E. Rothwell, K. M. Chen, and D. P. Nyquist, "Identification of the Natural Resonances of a Conducting Sphere from a Measured Response," *IEEE Transactions on Antennas and Propagation*, Vol. 38, pp. 141-143, January 1990.
23. W. M. Sun, K. M. Chen, D. P. Nyquist, and E. J. Rothwell, "The Natural Oscillations of an Infinitely Long Cylinder Coated With Lossy Material," *Radio Science*, Vol. 24, No. 3, pp. 369-380, May-June 1989.
24. W. M. Sun, K. M. Chen, D. P. Nyquist, and E. J. Rothwell, "Determination of the Natural Modes for a Rectangular Plate," *IEEE Transactions on Antennas and Propagation*, Vol. 38, pp. 643-652, May 1990.
25. E. J. Rothwell and W. M. Sun, "Time Domain Deconvolution of Transient Radar Data," *IEEE Transactions on Antennas and Propagation*, Vol. 38, pp. 470-475, April 1990.
26. J-P Bayard, D. H. Schaubert, E. J. Rothwell, K. M. Chen and D. P. Nyquist, "Optimization method versus E-pulse method in the context of target discrimination," *IEEE Transactions on Antennas and Propagation*, Vol. 39, pp. 11-115, January 1991.
27. C. E. Baum, E.J. Rothwell, K. M. Chen and D. P. Nyquist, "The singularity expansion method and its application to target identification," *Proceedings of the IEEE*, Vol. 79, pp. 1481-1492, October 1991.
28. E. J. Rothwell, M. J. Cloud and P. Ilavarasan, "Transient field produced by a travelling-wave wire antenna," *IEEE Transactions on Electromagnetic Compatibility*, Vol. 33, pp. 172-178, August 1991.
29. E. J. Rothwell, J. Baker, K. M. Chen and D. P. Nyquist, "Approximate natural response of an arbitrarily shaped thin wire scatterer," *IEEE Transactions on Antennas and Propagation*, Vol. 31, pp. 1457-1462, October 1991.
30. E. J. Rothwell and M. J. Cloud, "A Hallen-type integral equation for symmetric scattering from lossy circular disks," *IEEE Transactions on Antennas and Propagation*, Vol. 40, pp. 920-925, August 1992.
31. K. M. Chen, D. P. Nyquist, E. J. Rothwell and W. M. Sun, "New progress on E/S pulse techniques for noncooperative target recognition," *IEEE Transactions on Antennas and Propagation*, vol. 40, pp. 829-833, July 1992.
32. W. Gesang, E. Rothwell, K.M. Chen, K. Burket, W.P. Hansen and J.L. Lin, "Receiving and scattering characteristics of an imaged monopole beneath a lossy sheet," *IEEE Transactions on Antennas and Propagation*, vol. 41, pp. 287-294, March 1993.
33. P. Ilavarasan, J.E. Ross, E.J. Rothwell, K.M. Chen, and D.P. Nyquist, "Performance of an automated target discrimination scheme using E pulses and S pulses," *IEEE Transactions on Antennas and Propagation*, vol. 41, pp. 582-588, May 1993.

34. P. Ilavarasan, E. Rothwell, K.M. Chen and D. P. Nyquist, "Natural resonance extraction from multiple data sets using physical constraints," *Radio Science*, vol. 29, no. 1, pp. 1-7, January-February 1994.
35. E.J. Rothwell, K.M. Chen, D.P. Nyquist, J.E. Ross and R. Bebermeyer, "A radar target discrimination scheme using the discrete wavelet transform for reduced data storage," *IEEE Transactions on Antennas and Propagation*, vol. 42, pp. 1033-1037, July 1994.
36. John E. Ross, Edward J. Rothwell, Dennis P. Nyquist and Kun-Mu Chen, "Approximate integral-operator methods for estimating the natural frequencies of coupled objects," *Radio Science*, vol. 29, no. 2, pp. 677-684, July-August 1994.
37. J. Song, D.P. Nyquist, S. Ohnuki, K.M. Chen and E.J. Rothwell, "Scattering of TE-polarized EM waves by discontinuity in grounded dielectric layer," *IEEE Transactions on Microwave Theory and Techniques*, pp. 481-488, March 1994.
38. J.E. Ross, E.J. Rothwell, D.P. Nyquist and K.M. Chen, "Transient coupling analysis using the singularity expansion method," *IEEE Transactions on Electromagnetic Compatibility*, vol. 36, no. 4, pp. 358-364, November 1994.
39. Edward J. Rothwell, Kun-Mu Chen, Dennis P. Nyquist, Ponniah Ilavarasan, John E. Ross, Robert Bebermeyer, and Qing Li, "A general E-pulse scheme arising from the dual early-time/late-time behavior of radar scatters," *IEEE Transactions on Antennas and Propagation*, vol. 42, no. 9, pp. 1336-1341, September 1994.
40. E.J. Rothwell, K.M. Chen, D.P. Nyquist, and J.E. Ross, "Time-domain imaging of airborne targets using ultra-wideband or short-pulse radar," *IEEE Transactions on Antennas and Propagation*, vol. 43, no. 3, pp. 327-329, March 1995.
41. P. Ilavarasan, E.J. Rothwell, K.M. Chen, D.P. Nyquist and R. Bebermeyer, "Natural resonance extraction from multiple data sets using a genetic algorithm," *IEEE Transactions on Antennas and Propagation*, vol. 43, no. 8, pp. 900-904, August 1995.
42. C.Y. Tsai, E.J. Rothwell and K.M. Chen, "Target discrimination using neural networks with time domain or spectrum magnitude response," *Journal of Electromagnetic Waves and Applications*, vol. 10, no. 3, pp. 341-382, 1996.
43. E.J. Rothwell and M.J. Cloud, "On the natural frequencies of an annular ring above a conducting half space," *Journal of Electromagnetic Waves and Applications*, vol. 10, no. 2, pp. 155-179, 1996.
44. Q. Li, E.J. Rothwell, K.M. Chen and D.P. Nyquist, "Scattering center analysis of radar targets using fitting scheme and genetic algorithm," *IEEE Transactions on Antennas and Propagation*, vol. 44, no. 2, pp. 198-207, February 1996.

45. E.J. Rothwell and M.J. Cloud, "Transient plane wave scattering from an annular ring above a lossy half space," *Journal of Electromagnetic Waves and Applications*, vol. 10, no. 9, pp. 1287-1310, 1996.
46. A. Norman, D.P. Nyquist, E. Rothwell, K.M. Chen, J. Ross, and P. Ilavarasan, "Transient scattering of a short pulse from a conducting sinusoidal surface," *Journal of Electromagnetic Waves and Applications*, vol. 10, no. 4, pp. 461-487, 1996.
47. Q. Li, E.J. Rothwell, K.M. Chen, and D.P. Nyquist, "Radar target discrimination schemes using time-domain and frequency domain methods for reduced data storage," *IEEE Transactions on Antennas and Propagation*, vol. 45, no. 6, pp. 995-1000, June 1997.
48. Y. Dai, E.J. Rothwell, K.M. Chen, and D.P. Nyquist, "Time-domain imaging of radar targets using algorithms for reconstruction from projections," *IEEE Transactions on Antennas and Propagation*, vol. 45, no. 8, pp. 1227-1235, August 1997.
49. G.S. Wallinga, E.J. Rothwell, K.M. Chen and D.P. Nyquist, "Application of cepstral analysis to radar target discrimination using E-pulse cancellation," *Journal of Electromagnetic Waves and Applications*, vol. 12, no. 3, pp. 387-405, 1998.
50. Q. Li, P. Ilavarasan, J.E. Ross, E.J. Rothwell, K.M. Chen, and D.P. Nyquist, "Combination of early-time and late-time based E pulses to improve target identification," *IEEE Transaction on Antennas and Propagation*, vol. 46, no. 9, pp. 1272-1278, September 1998.
51. E.J. Rothwell, K.M. Chen and D.P. Nyquist, "An adaptive-window-width short-time Fourier transform for visualization of radar target substructure resonances," *IEEE Transactions on Antennas and Propagation*, vol. 46, no. 9, pp. 1393-1395, September 1998.
52. E.J. Rothwell and M.J. Cloud, "Natural frequencies of a conducting sphere with a circular aperture," *Journal of Electromagnetic Waves and Applications*, Vol. 13, pp. 729-755, 1999.
53. A. Kizilay and E. Rothwell, "Efficient computation of transient TM scattering from a cylinder above an infinite periodic surface," *Journal of Electromagnetic Waves and Applications*, Vol. 13, pp. 943-961, 1999.
54. G.S. Wallinga, E.J. Rothwell, K.M. Chen and D.P. Nyquist, "Efficient Computation of the 2-dimensional Periodic Green's Function," *IEEE Transactions on Antennas and Propagation*, Vol. 47, No. 5, pp. 895-897, May 1999.
55. Y. Dai, E.J. Rothwell, K.M. Chen, and D.P. Nyquist, "Time-domain imaging of radar targets using sinogram restoration for limited-view reconstruction," *IEEE Transactions on Antennas and Propagation*, Vol. 47. No. 8, pp. 1323-1329, August 1999.

56. C. Ohl, E.J. Rothwell, D. Nyquist, and K.M. Chen, "Use of minimum phase signals to establish the time reference in transient radar target identification schemes," *IEEE Transactions on Antennas and Propagation*, pp. 124-125, January 2000.
57. G. Chen, B.L. Upham, W. Sun, C.-C. Chang, E.J. Rothwell, K.M. Chen, H. Yamasaki, and J.E. Trosko, "Effect of electromagnetic field exposure on chemically-induced differentiation of Friend erythroleukemia cells," *Environmental Health Perspectives*, Volume 108, Number 10, pp. 967-972, October 2000.
58. G.S. Wallinga, E.J. Rothwell, K.M. Chen, and D.P. Nyquist, "Enhanced detection of a target in a sea clutter environment using stepped, ultra-wideband signal and E-pulse cancellation," *IEEE Transactions on Antennas and Propagation*, Vol. 49, No. 8, pp. 1166-1173, August 2001.
59. A. Kizilay and E.J. Rothwell, "Transient TE scattering from a cylinder above an infinite periodic surface using a decomposition method," *Journal of Electromagnetic Waves and Applications*, vol.15, no. 3, pp. 293-314, 2001.
60. M. Schacht, E.J. Rothwell, and C. Coleman, "Time-domain imaging of objects within enclosures," *IEEE Transactions on Antennas and Propagation*, pp. 895-898, June 2002.
61. C.M. Coleman, E.J. Rothwell, J.E. Ross, and L.L. Nagy, "Self-Structuring Antennas," *IEEE Antennas and Propagation Magazine*, vol. 44, no. 3, pp.11-22, June 2002 (invited paper).
62. J. Suk and E.J. Rothwell, "Transient Analysis of TE-Plane Wave Scattering in a Layered Medium," *Journal of Electromagnetic Waves and Applications*, Vol 16, No. 2, pp. 281-297, 2002.
63. Chi-Wei Wu, L.C. Kempel, and E.J. Rothwell, "Hybrid Finite Element-Boundary Integral Method for Cavities Recessed in an Elliptic Cylinder," *IEEE Transactions on Antennas and Propagation*, vol. 51, no. 8, pp. 1829-1836, August 2003.
64. J. Suk and E.J. Rothwell, "Transient Analysis of TM-Plane Wave Reflection from a Layered Medium," *Journal of Electromagnetic Waves and Applications*, Vol.16, No. 9, pp. 1195-1208, 2002.
65. Chi-Wei Wu, Leo C. Kempel, and Edward J. Rothwell, "Mutual Coupling Between Patch Antennas Recessed in an Elliptic Cylinder," *IEEE Transactions on Antennas and Propagation*, vol. 51, no. 8, pp. 2489-2492, September 2003.
66. In-Sik Choi, Dong-Kyu Seo, Jin-Kyu Bang, Hyo-Tae Kim and Edward Rothwell, "Radar Target Recognition Using One-dimensional Evolutionary Programming-Based CLEAN," *Journal of Electromagnetic Waves and Applications*, vol.17, no. 5, pp 763-784, 2003.
67. A. Kizilay and E.J. Rothwell, "Experimental Investigation of Transient Multipath for

- Objects above a Periodic Surface,” IEEE Transactions on Antennas and Propagation, vol. 51, no. 10, pp. 2968-2973, October 2003.
68. Jong Oh, Edward Rothwell, Dennis Nyquist, and Michael Havrilla, “Natural Resonance Representation of the Transient Field Reflected by a Conductor-Backed Lossy Layer,” Journal of Electromagnetic Waves and Applications, Vol. 17, No. 5, pp. 673-694, 2003.
 69. G. Stenholm, E.J. Rothwell, D.P. Nyquist, L.C. Kempel, and L.L. Frasch, “E-pulse diagnostics of simple layered materials,” IEEE Transactions on Antennas and Propagation, vol. 51, no. 12, pp. 3221-3227, December 2003.
 70. In-Sik Choi, Joon-Ho Lee, Hyo-Tae Kim and Edward J. Rothwell, “Natural Frequency Extraction Using Late-time Evolutionary Programming-Based CLEAN,” IEEE Transactions on Antennas and Propagation, vol. 51, no. 12, pp. 3285-3292, December 2003.
 71. Edward J. Rothwell and Jungwook Suk, “Efficient Computation of the Time-Domain TE Plane-Wave Reflection Coefficient,” IEEE Transactions on Antennas and Propagation, vol. 51, no. 12, pp. 3283-3285, December 2003.
 72. Ahmet Kizilay and E.J. Rothwell, “Transient multipath analysis of circular cylinders above sinusoidal surfaces using a ray tracing method,” Journal of Electromagnetic Waves and Applications, vol. 18, no. 1, pp. 41-60, 2004.
 73. C.M. Coleman, E.J. Rothwell, and J.E. Ross, “Investigation of Simulated Annealing, Ant-Colony Optimization, and Genetic Algorithms for Self-Structuring Antennas,” IEEE Transactions on Antennas and Propagation, vol. 52, no. 4, pp. 1007-1014, April 2004.
 74. Heike Vollmer and Edward J. Rothwell, “Resonance Series Representation of the Early-Time Field Scattered by a Coated Cylinder,” IEEE Transactions on Antennas and Propagation, vol. 52, no. 8, pp. 2186-2189, August 2004.
 75. J.C. Oh, E. Rothwell, B.T. Perry, and M.J. Havrilla, “Natural Resonance Representation of the Transient Field Reflected by a Conductor-Backed Layer of Debye Material,” Journal of Electromagnetic Waves and Applications, vol.18, no. 5, pp. 571-589, 2004.
 76. Sean P. Dorey, Michael J. Havrilla, Lydell L. Frasch, and Edward J. Rothwell, “Stepped-Waveguide Material Characterization Technique,” IEEE Antennas and Propagation Magazine, vol. 46, No. 1, pp. 170-175, February 2004 (invited paper).
 77. M.E. O’neal, D.A. Landis, E. Rothwell, L. Kempel, and D. Reinhard, “Tracking Insects with Harmonic Radar: a Case-Study,” American Entomologist, vol. 50, No. 4, pp. 212-218, Fall 2004.
 78. B.T. Perry, E.J. Rothwell, and L.L. Nagy, “Analysis of Switch Failure in a Self-Structuring Antenna System,” IEEE Antennas and Wireless Propagation Letters, vol. 4,

- pp. 68-70, 2005.
79. E. Rothwell, "Computation of the Logarithm of Bessel Functions of Complex Argument," *Communications in Numerical Methods in Engineering*, vol. 4, pp. 597-605, 2005.
 80. E.J. Rothwell, "Efficient Computation for the Time-Domain TM Plane-Wave Reflection Coefficient," *IEEE Transactions on Antennas and Propagation*, vol. 53, no. 10, pp. 3417-3419, October 2005.
 81. Andrew Bogle, Michael Havrilla, Dennis Nyquist, Leo Kempel, and Ed Rothwell, "Electromagnetic Material Characterization using a Partially-Filled Rectangular Waveguide," *Journal of Electromagnetic Waves and Applications*, vol. 19, no. 10, pp. 1291-1306, 2005.
 82. D. Love and E. Rothwell, "A Mode-Matching Approach to Determine the Shielding Properties of a Doubly-Periodic Array of Rectangular Apertures in a Thick Conducting Screen," *IEEE Transactions on Electromagnetic Compatibility*, vol. 48, no. 1, pp. 121-133, February 2006.
 83. E.J. Rothwell, L.C. Kempel, and L.L. Frasch, "E-pulse Discrimination of R-Cards in a Layered Environment," *IEEE Transactions on Antennas and Propagation*, vol. 54, no. 7, pp. 2175-2178, July 2006.
 84. S.M. Cossmann, E.J. Rothwell, and L.C. Kempel, "Transient reflection of TE-polarized plane waves from a Lorentz medium half space," *Journal of the Optical Society of America A*, vol. 23, no. 9, pp. 2320-2323, 2006.
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 242. B. Crowgey, O. Tuncer, E. Rothwell, B. Shanker, and L.C. Kempel, "Development of Numerical Techniques for Characterization of Anisotropic Materials," 28th International Review of Progress in Applied Computational Electromagnetics (ACES 2012), Columbus, OH, April 10-14, 2012.

243. Leo C. Kempel, B. Shanker, Edward J. Rothwell, and Prem Chahal, "Theoretical Analysis of Varactor-loaded Half-width Leaky-wave Antenna Arrays," 11th International Workshop on Finite Elements for Microwave Engineering, Estes Park, CO, June 4-6, 2012.
244. Michael Havrilla, Andrew Bogle, Milo Hyde, and Edward Rothwell, "Electromagnetic Material Characterization of Curved Conductor-Backed Media using an NDE Microstrip Probe," 17th International Workshop on Electromagnetic Nondestructive Evaluation, Rio de Janeiro, Brazil, June 17-20, 2012.
245. Raenita Fenner and Edward Rothwell, "Deficiency in the Error Propagation Method for Sensitivity Analysis of Free Space Material Characterization Methods." 15th International Symposium of ANtenna Technology and applied ElectroMagnetics (ANTEM), Toulouse, France, 25-28 June, 2012.
246. Seung-Jae Lee, In-Sik Choi, and E. J. Rothwell, "E-Pulse and target classification using neural network study," Proceedings of the Korea Institute of Information Technology Summer Conference, May 2012, pp. 69-72.
247. Junyan Tang, Kazuko Fuchi, Edward J. Rothwell, Alejandro R. Diaz, and Raoul O. Ouedraogo, "An Origami Inspired Tunable Metamaterial," IEEE AP-S International Symposium and URSI Radio Science Meeting, Chicago, IL, July 8-14, 2012.
248. Benjamin R. Crowgey, Ozgur Tuncer, Edward J. Rothwell, B. Shanker, Leo C. Kempel and M. Havrilla, "Characterization of Gyromagnetic Material Using a Reduced Aperture Waveguide," IEEE AP-S International Symposium and URSI Radio Science Meeting, Chicago, IL, July 8-14, 2012.
249. Michael T. Corwin, Robert P. Penno, Stephen W. Schneider, E.J. Rothwell, B. Shanker, and Leo C. Kempel, "Radiation by an Inductively-loaded Half-width Leaky-wave Antenna," IEEE AP-S International Symposium and URSI Radio Science Meeting, Chicago, IL, July 8-14, 2012.
250. Korede Akinlabi-Oladimeji, Junyan Tang, Andrew Temme, Edward Rothwell, Prem Chahal, Leo Kempel, and Raoul Ouedraogo, "A Center-Fed Half-Width Microstrip Leaky-Wave Antenna with an Adjustable Principal Beam," IEEE AP-S International Symposium and URSI Radio Science Meeting, Chicago, IL, July 8-14, 2012.
251. Seung-Jae Lee, In-Sik Choi, and E. J. Rothwell, "A Study of Target Classification using E-pulse and Neural Network," Next Generation Data Technology for the Big Data Era, Korea Institute of Science & Technology Information, Seoul, Korea, Proceedings pp. 69-72 (4-5), 2012.
252. Junyan Tang, Benjamin Crowgey, Ozgur Tuncer, Edward Rothwell, Balasubramaniam Shanker, Leo Kempel, and Michael Havrilla, "Characterization of Biaxial Materials

- using a Partially Filled Rectangular Waveguide,” AMTA 2012 Antenna Measurement Techniques Association Symposium, Bellevue, WA, October 21-26, 2012.
253. Fayadh Hussein, Bayez al-Sulaifanie, Benjamin Crowgey, Edward Rothwell, B. Shanker, and Leo Kempel, “Radiation of a Circular-polarized Microstrip Antenna Through an Uniaxial Superstrate: A Preliminary Study,” 2012 Loughborough Antennas & Propagation Conference, Loughborough, UK, 12-13 November, 2012.
 254. Benjamin Crowgey, Ozgur Tuncer, Junyan Tang, Leo Kempel, Edward Rothwell, and Balasubramaniam Shanker, “Measurement of Anisotropic Material Properties for Antenna Applications,” 2012 Loughborough Antennas & Propagation Conference, Loughborough, UK, 12-13 November, 2012.
 255. “Integration of Piezoelectric Energy Harvesting and Antenna Elements on a Common Substrate,” Joshua C. Myers, Nophadon Wiwatcharagoses, Edward J. Rothwell, and Premjeet Chahal, Electronic Components and Technology Conference (ECTC), Las Vegas, NV, May 28-31, 2013.
 256. Sung-Jun Lee, In-Sik Choi, Seung-Jae Lee, and Edward J. Rothwell, “Extraction of Optimum Classification Angle Using Arch-range Measured Data for Scale-model Targets,” IEEE AP-S International Symposium and URSI Radio Science Meeting, Orlando, FL, July 7-13, 2013.
 257. Junyan Tang, Benjamin Crowgey, Ozgur Tuncer, Edward J. Rothwell, Balasubramaniam Shanker, Leo Kempel, and Michael Havrilla, “Characterization of Gyromagnetic Materials Using a Partially-Filled Waveguide Technique,” IEEE AP-S International Symposium and URSI Radio Science Meeting, Orlando, FL, July 7-13, 2013.
 258. Joshua Myers, Premjeet Chahal, and Edward J. Rothwell, “A Multi-layered Metamaterial Inspired Dynamically Tunable Antenna,” IEEE AP-S International Symposium and URSI Radio Science Meeting, Orlando, FL, July 7-13, 2013.
 259. Li-Yuan Fang, Yen-Sheng Chen, Yao-Chia Chan, and Edward J. Rothwell, “Self-Structuring Electromagnetic Scatterer Using a Conductor-Backed Template,” IEEE AP-S International Symposium and URSI Radio Science Meeting, Orlando, FL, July 7-13, 2013.
 260. Korede Akinlabi-Oladimeji, Junyan Tang, Edward J. Rothwell, Benjamin Crowgey, and Raoul Ouedraogo, “Experimental Investigation of the Beam-Scanning Capabilities of a Stub-Loaded Half-width Microstrip Leaky-Wave Antenna,” IEEE AP-S International Symposium and URSI Radio Science Meeting, Orlando, FL, July 7-13, 2013.
 261. Benjamin Crowgey, Korede Akinlabi-Oladimeji, and Edward J. Rothwell, “Measurement of the Electromagnetic Properties of a Conductor-Backed Material Using a Waveguide-Iris Technique,” IEEE AP-S International Symposium and URSI Radio Science Meeting, Orlando, FL, July 7-13, 2013.

262. Junyan Tang, Raoul Ouedraogo, Edward J. Rothwell, Alejandro Diaz, and Kazuko Fuchi, "Experimental Validation of a Tunable Metamaterial Inspired Miniaturized Patch Antenna," IEEE AP-S International Symposium and URSI Radio Science Meeting, Orlando, FL, July 7-13, 2013.
263. Benjamin Crowgey, Korede Akinlabi-Oladimeji, Edward Rothwell, Michael Havrilla, and Lydell Frasch, "A Triaxial Applicator for the Characterization of Conductor-Backed Absorbing Materials," 35th Annual Meeting & Symposium of the Antenna Measurement Techniques Association (AMTA), Columbus, OH, October 6 - 11, 2013.
264. Ki-Young Lee, Yun-Hee Lee, Jeong-Joon Kim, Gyoo-Seok Choi, Kyeong-Su Jang, Sung-Jai Choi, Sun-Jin Oh, Edward J. Rothwell, and Jeong-Jin Kang, "A Study on the Ontology for Semantic Web," The 1st International Conference on Contents, Platform, Network and Device (ICCPND 2014), Pusan, Korea, July 10 - 13, 2014.
265. Joosuk Kim, Taehyun Jeon, and Edward J. Rothwell, "Design of Patch Antenna for Wide Band Communication," The 1st International Conference on Contents, Platform, Network and Device (ICCPND 2014), Pusan, Korea, July 10 - 13, 2014.
266. Jonathan L. Frasch, Edward J. Rothwell, and Benjamin R. Crowgey, "Stepped-Waveguide Technique for the Extraction of the Electromagnetic Parameters of Conductor-Backed Absorbers," IEEE AP-S International Symposium and URSI Radio Science Meeting, Memphis, TN, July 6-11, 2014.
267. Korede Akinlabi-Oladimeji, Edward J. Rothwell, and Prem Chahal, "Free-Space Characterization of Conductor-Backed Absorbing Materials Using an Aperture Screen," IEEE AP-S International Symposium and URSI Radio Science Meeting, Memphis, TN, July 6-11, 2014.
268. Junyan Tang, Benjamin R. Crowgey, Edward J. Rothwell, B. Shanker, Leo C. Kempel, and M. Havrilla, "Gyromagnetic Material Characterization and Error Analysis Using a Partially-Filled Waveguide Technique," IEEE AP-S International Symposium and URSI Radio Science Meeting, Memphis, TN, July 6-11, 2014.
269. Junyan Tang, Raoul O. Ouedraogo, Edward J. Rothwell, Alejandro R. Diaz, and Kazuko Fuchi, "A Tunable Dual-Band Miniaturized Monopole Antenna," IEEE AP-S International Symposium and URSI Radio Science Meeting, Memphis, TN, July 6-11, 2014.
270. Junyan Tang, Amin Tayebi, Satish Udpa, Edward J. Rothwell, and Andrew Temme, "A Dual-Band Tunable Reflectarray," IEEE AP-S International Symposium and URSI Radio Science Meeting, Memphis, TN, July 6-11, 2014.
271. Andrew K. Temme and Edward J. Rothwell, "Material Characterization using a Two-Wire Transmission Line," IEEE AP-S International Symposium and URSI Radio Science

Meeting, Memphis, TN, July 6-11, 2014.

272. A. Knisely, M. Havrilla, J. Allen, A. Bogle, P. Collins, M. Hyde and E. Rothwell, "Biaxial Anisotropic Material Characterization using Rectangular to Square Waveguide," AMTA 2014 Antenna Measurement Techniques Association Symposium, Tucson, AZ, October 12-17, 2014. (Winner of best student paper award and best technical paper award).
273. Andrew K. Temme and Edward J. Rothwell, "Evaluation of Material Characterization Setups Which Utilize a Two-Wire Transmission Line," IEEE AP-S International Symposium and URSI Radio Science Meeting, Vancouver, BC, July 19-24, 2015, p. 3.
274. Jonathan L. Frasch, Sean Ellison, and Edward J. Rothwell, "A Stepped Waveguide Technique for the Characterization of Conductor-Backed Absorbing Materials," IEEE AP-S International Symposium and URSI Radio Science Meeting, Vancouver, BC, July 19-24, 2015, p. 4.
275. Jonathan L. Frasch, and Edward J. Rothwell, "A Three Dimensional Extension of the Self-Structuring Antenna to Improve Beam Steering," IEEE AP-S International Symposium and URSI Radio Science Meeting, Vancouver, BC, July 19-24, 2015, p. 172.
276. Korede Oladimeji, Jonathan Frasch, Edward Rothwell, and Leo Kempel, "Longitudinal Groove Loading of a Half-Width Microstrip Leaky-Wave Antenna," IEEE AP-S International Symposium and URSI Radio Science Meeting, Vancouver, BC, July 19-24, 2015, p. 40.
277. Tayfun Özdemir, Yuriy M. Goykhman, Andrew R. Brown, Benjamin Crowgey, Edward J. Rothwell and Prem Chahal, "Frequency Tunable Antenna for LTE (4G) Handsets Operating in the 2.3-2.7GHz Global Roaming Band," IEEE AP-S International Symposium and URSI Radio Science Meeting, Vancouver, BC, July 19-24, 2015, pp. 1134-1135.
278. Jonathan L. Frasch and Edward J. Rothwell, "A new waveguide verification standard for the characterization of magnetic materials," USNC-URSI National Radio Science Meeting, Boulder, CO, January 6-9, 2016.
279. Edward J. Rothwell, Jonathan L. Frasch, Sean Ellison, and Prem Chahal, "Computation of the scattering parameters of a system of waveguide sections using a recursion technique," USNC-URSI National Radio Science Meeting, Boulder, CO, January 6-9, 2016.
280. Raenita Fenner, Jonathan Frasch, and Edward Rothwell, "Characterization of RF Magnetic Media with Free Space Methods and Genetic Algorithms", European Conference on Antennas and Propagation (EuCAP), Davos, Switzerland 10-15 April 2016.

281. R.A. Fenner, J. Frasc, and E.J. Rothwell, "Free Space Material Characterization with Genetic Algorithms and Multiple Objective Cost Functions," IEEE AP-S International Symposium and URSI Radio Science Meeting, Fajardo, Puerto Rico, June 26-Jul 1, 2016.
282. Jonathan L. Frasc and Edward J. Rothwell, "Optimization of Stepped-Waveguide Applicators for the Characterization of Conductor-Backed Absorbing Materials," USNC-URSI National Radio Science Meeting, Boulder, CO, January 4-7, 2017. (Invited presentation)
283. Saptarshi Mukherjee, Yiming Deng, Lalita Udpa, Satish Udpa, Prem Chahal, Edward Rothwell, "Microwave time reversal mirror for breast tumor detection," IEEE AP-S International Symposium and URSI Radio Science Meeting, San Diego, CA, July 9-15, 2017.
284. Vincens Gjokaj, Premjeet Chahal, Leo Kempel, and Edward Rothwell, "A Novel 3D Printed Half-Width Microstrip Leaky-Wave Antenna," IEEE AP-S International Symposium and URSI Radio Science Meeting, San Diego, CA, July 9-15, 2017.
285. Edward J. Rothwell and Raenita Fenner, "Evaluation of Anisotropic Overlay Materials for Use in the Free-Space, TEM, or Waveguide Characterization of Conductor-Backed Absorbers" IEEE AP-S International Symposium and URSI Radio Science Meeting, San Diego, CA, July 9-15, 2017.
286. S. Karuppuswami, Jonathan Frasc, E.J. Rothwell, P. Chahal, and M.J. Havrilla, "Fabrication of a Triaxial Applicator for the Characterization of Conductor-Backed Absorbing Materials," IEEE AP-S International Symposium and URSI Radio Science Meeting, San Diego, CA, July 9-15, 2017.
287. E. J. Rothwell, "Partial Overlay Technique for the Waveguide Characterization of Conductor-Backed Absorbers," USNC-URSI National Radio Science Meeting, Boulder, CO, January 4-6, 2018. (Invited presentation)
288. Edward Rothwell, Saranraj Karuppuswami, and Premjeet Chahal, "Implementation of a Partial Overlay Technique for the Characterization of the Electromagnetic Properties of Conductor-Backed Materials," IEEE AP-S International Symposium and URSI Radio Science Meeting, Boston, MA, July 8-13, 2018.
289. Saikat Mondal, Edward J. Rothwell, and Prem Chahal, "A Wideband Antenna for Buried RFID Applications," IEEE AP-S International Symposium and URSI Radio Science Meeting, Boston, MA, July 8-13, 2018.
290. Edward J. Rothwell and S. Karuppuswami, "Characterization of Conductor-Backed Absorbing Materials Using a Bottom-Filled Rectangular Waveguide," URSI EM Theory Symposium, San Diego, CA, May 27-31, 2019.

- 291. John Doroshewitz, Saptarshi Mukherjee, Edward Rothwell, Lalita Udpa, and Jeffrey Nanzer, "Time-Reversal Microwave Tomography Using Frequency Domain Sampling," International Microwave Symposium, Boston, MA, June 2-5, 2019.
- 292. William Stevers and Edward Rothwell, "Suitability of Consumer Software-defined Radios for Precompliance Radiated Emissions Testing," IEEE AP-S International Symposium and URSI Radio Science Meeting, Boston, MA, July 7-12, 2019.

Non-refereed conference presentations and other talks

- 293. Alejandro Diaz, Edward J. Rothwell, Shih-Yuan Chen, and Raoul O. Ouedraogo, "Metamaterials and RF Device Design," Proceedings of the 2009 NSF Engineering Research and Innovation Conference, Honolulu, HA, June 22-25, 2009.
- 294. R. O. Ouedraogo, and E. J. Rothwell, "Miniaturization of antennas for reduced carbon footprint of mobile devices," NSF CMMI Research and Innovation Conference, Atlanta, Georgia, January 2011.
- 295. Benjamin R. Crowgey, Edward J. Rothwell, B. Shanker, Leo C. Kempel, O. Tuncer, and M. Havrilla, "Characterization of Gyromagnetic Material Using a Reduced Aperture Waveguide," Material Measurement Working Group Meeting, May 3, 2012.
- 296. Benjamin Crowgey, Ozgur Tuncer, Junyan Tang, Ed Rothwell, Shanker Balasubramaniam, and Leo Kempel, "Development of Rectangular Waveguide Techniques for Extracting the Electric and Magnetic Parameters of Anisotropic Materials," Tri-Services Metamaterial Review, Virginia Beach, VA, May 22-25, 2012.
- 297. Edward J. Rothwell, "A Review of Antenna Miniaturization with a Focus on Metamaterials," IBM Applied Electromagnetics and Signal Integrity Seminar Series, April 25, 2015. (Invited presentation, inaugural presentation.)

Journal papers in review

Srijan Datta, Edward Rothwell, Saptarshi Mukherjee, Xiaodong Shi, Mahmood Haq, Yiming Deng, and Lalita Udpa, "Design of a Negative Index Metamaterial Lens for Subwavelength Microwave Detection," submitted to the IEEE Sensors Journal, 31 March 2021.

Research reports

Written or co-written more than 200 annual, quarterly, and monthly research technical reports.

Research Grants and Contracts

Internal

1. **MSU Division of Engineering Research**, "Efficient Methods for the Analysis of Microwave and Millimeter-wave Guided Wave Structures," \$6078, 10/30/86-10/29/87, PI.
2. **Case Center, College of Engineering, MSU**, Management of Technology and Innovation Program, "Assessing the Commercial Potential for Using Self-Structuring Antennas in Televisions and FM Radios," Fall 1999, ¼-time graduate student support, PI.
3. **Michigan State University**, IRGP, "Functionally Graded Materials for Antenna Applications," \$75,000, 12/15/99-3/15/01, co-PI.

External

4. **Boeing Military Airplane Company**, "Electromagnetic Radiation and Scattering," \$50,000, 6/15/86-6/14/87, co-PI.
5. **Office of Naval Research**, "Radar Target Discrimination and Identification Using Extinction Pulses and Single Mode Extraction Signals," \$30,000, 10/1/86-9/30/87, co-PI.
6. **Office of Naval Research/DARPA**, "Radar Target Discrimination and Identification using Extinction-pulses and Single-mode Extraction Signals," \$120,000, 6/1/87-5/31/88, co-PI.
7. **Boeing Military Airplane Company**, "Electromagnetic Radiation and Scattering," \$50,000, 6/15/87-6/14/88, co-PI.
8. **Office of Naval Research/DARPA**, "Radar Target Discrimination and Identification using Extinction-pulses and Single-mode Extraction Signals," \$120,000, 6/1/88-5/31/89, co-PI.
9. **Boeing Military Airplane Company**, "Electromagnetic Radiation and Scattering," \$55,000, 9/1/88-11/30/89, co-PI.
10. **Defense Advanced Research Projects Agency**, "Radar Target Discrimination and Identification using Extinction-pulses and Single-mode Extraction Signals," \$120,000, 6/1/89-5/31/90, co-PI.
11. **Boeing Advanced Systems Company**, "Electromagnetic Radiation and Scattering," \$67,000, 12/1/89-11/30/90, co-PI.

12. **Office of Naval Technology**, "Non-cooperative Target Recognition by E/S Pulse Techniques," \$30,000, 7/1/90-12/31/90, co-PI.
13. **Boeing Advanced Systems Company**, "Electromagnetic Radiation, Scattering and Interactions," \$67,000, 1/1/90-12/31/90, co-PI.
14. **Boeing Military Airplane Company**, "Electromagnetic Radiation, Scattering and Interactions," \$75,000, 1/1/91-12/31/91, co-PI.
15. **Naval Ocean Systems Center**, "Non-cooperative target recognition by E/S Pulse Techniques," \$140,000, 8/1/91-6/15/92, co-PI.
16. **Thermo Electron Technologies Corporation**, "Non-cooperative Target Recognition Using Ultra-Wideband Radars," \$32,000, 9/3/91-6/30/92, co-PI.
17. **Naval Ocean Systems Center**, "Radar Target Detection Using Short EM Pulses and the E-Pulse Technique," \$147,762, 12/30/92-12/31/93, co-PI.
18. **Boeing Defense and Space Group**, "Electromagnetic Radiation, Scattering and Interactions," \$85,000, 1/1/92-12/31/92, co-PI.
19. **Office of Naval Research (AASERT)**, "Target Identification and Detection Using Impulse Radars or Ultra-wideband Radars," \$161,000, 9/1/93-8/31/96, co-PI.
20. **Office of Naval Research**, "Radar Detection in a Sea Clutter Environment Using Short EM Pulses and the E-pulse Technique," \$169,079, 3/1/94-8/31/96, co-PI.
21. **Electric Power Research Institute**, "Potential Role of Extremely Low-Frequency Electric and Magnetic Fields on Their Ability to Modulate Cell-cell Communication in Human Breast Epithelial Cells In-vitro," \$336,028, 5/16/96-8/31/98, co-PI.
22. **Electric Power Research Institute**, "Potential Role of Extremely Low-Frequency Electric and Magnetic Fields on Their Ability to Modulate Cell-cell Communication," \$20,000, 9/1/98-12/31/98, co-PI.
23. **Electric Power Research Institute**, "Potential Role of Extremely Low-Frequency Electric and Magnetic Fields on Their Ability to Modulate Cell-cell Communication In-vitro," \$170,000, 1/1/99-12/31/99, co-PI.
24. **The Boeing Company**, Multi-spectral Low Observable (LO) Nondestructive Evaluation (NDE) Research, \$99,955, 8/7/97-3/6/98, lead-PI.
25. **The Boeing Company**, Multi-spectral Low Observable (LO) Nondestructive Evaluation (NDE) Research, Phase II, \$49,797, 8/31/98-12/6/99, lead-PI.

26. **National Science Foundation**, "Acquisition of Instrumentation for Ultra-wide-band Short-Pulse Electromagnetic Interrogation of Targets and Materials," \$233,675, 10/1/97-9/30/98, lead-PI.
27. **Electric Power Research Institute**, "Potential Role of Extremely Low-Frequency Electric and Magnetic Fields on Their Ability to Modulate Cell-cell Communication In-vitro," \$170,000, 1/1/00-12/31/00, co-PI.
28. **Mission Research Corporation**, "Advanced Foam Support Technology," \$40,000, 8/15/00-3/31/01, co-PI.
29. **Dow Corporation**, "General Research," \$5,000, 2000-open, co-PI.
30. **Dow Corporation**, "Electromagnetics Material Research," \$50,000, 1/01/01-12/31/01, co-PI
31. **Delphi Research Labs**, "Self-Structuring Antenna Systems," \$50,000, 3/1/01-12/31/01, PI.
32. **Michigan Economic Development Corporation**, Construction of Prototype Self-Structuring Antennas, 1/1/01-6/30/03, \$40,000, PI.
33. **Dow Chemical Corporation**, "Electromagnetics Material Research II", \$15,000, 5/16/01-12/31/02, co-PI.
34. **Boeing Defense and Space Group**, "Simulation of Microwave Probes," \$35,000, 7/1/01-5/31/02, co-PI.
35. **Project GREEN**, "Use of Microelectronics to Develop an Advanced Harmonic Radar System for Tracking Insects in Michigan Agroecosystems," 02/12/01-02/11/02, \$43,529, co-PI.
36. **NASA**, A Proposal for Fellowship Support for Jonathan Lopez-Morrell and Derik C. Love, 8/15/01-8/14/04, \$132,000. co-PI.
37. **Boeing Defense and Space Group**, Multi-Spectral Low Observable (LO) Nondestructive Evaluation Research, \$50,000, 8/31/01-5/31/02, PI.
38. **Delphi Research Labs**, "Self-Structuring Antenna Systems," 3/1/02-12/31/02, \$50,000, PI.
39. **Dow Chemical Company**, Harmonic Radar Tag Research, 1/02-12/04, \$45,000, co-PI.
40. **Dow Chemical Company**, Electromagnetic Materials Research, Year 2, 1/2/02-2/28/03, \$50,000, co-PI.

41. **NASA**, The Grounding of Composite Materials and the Impact on EMC, training grant, \$24,000, 8/15/2002-8/1/2003, co-PI (Pierre lead-PI).
42. **Delphi Research Labs**, Self-Structuring Antenna Systems, \$50,000, 3/1/03-12/31/03, lead-PI (Kempel co-PI).
43. **Universal Technology Corporation**, Time-Domain Electromagnetic Field Reflectometry, \$60,000, 8/15/03-11/30/04, PI.
44. **Boeing Company**, Characterization of Sources of Error in Materials Measurements Systems, \$47,473, 4/1/03-5/31/04, PI.
45. **NSF**, MATLAB Antenna Toolbox, NSF, 1/03-12/04, \$100,000, Co-PI (Kempel lead-PI).
46. **Dow Chemical Company**, Harmonic Radar Tag Research II, \$60,000, 10/01/03-12/31/04, Co-PI (Kempel lead-PI).
47. **Prescutti and Associates**, Low Profile Wideband Self-Structuring Antenna, \$21,450, 7/1/03-2/1/04, PI. (SBIR: Prime contractor U.S. Navy).
48. **Delphi Research Labs**, Self-Structuring Antenna Systems, \$50,000, 3/1/04-12/31/04, lead-PI (Kempel co-PI).
49. **Prescutti and Associates**, Compact Conformal Arrays, 10/1/04-4/30/05, \$49,990, PI. (STTR: Prime contractor U.S. Navy).
50. **Mission Research Corporation**, Applications of RF Polymers, 1/1/04-3/31/05, \$100,000, co-PI (Kempel lead-PI).
51. **Air Force Office of Scientific Research**, DURIP: RF Materials Measurement Equipment, 4/1/2005-12/31/2005, \$48,494, co-PI (Kempel lead-PI)
52. **Delphi Research Labs**, Modeling of Automotive Antennas in a Vehicle Environment, 5/1/2005-5/31/2006, \$50,000, lead-PI (Kempel co-PI).
53. **Universal Technology Corporation**, Novel Londe Waveguide Designs for in situ Measurement of Complex Materials, 5/9/2005-5/6/2006, \$60,000, PI. (Prime contractor: U.S. Air Force)
54. **Universal Technology Corporation**, Novel Londe Waveguide Designs for in situ Measurement of Complex Materials, 5/9/2005-5/6/2006, \$6,700, PI. (Prime contractor: U.S. Air Force)
55. **Dow Chemical Corporation**, Unrestricted Gift for Support of Research in Area of

Harmonic Radar Corrosion Detection, 4/11/2006-4/10/2007, \$40,000, co-PI (Kempel lead-PI).

56. **Universal Technology Corporation**, Londe Waveguide Designs for in situ Measurement of Complex Materials, 12/1/2006-7/31/2008, \$131,450, PI. (Prime contractor: U.S. Air Force)
57. **ITT Industries**, Short-Pulse Radar Enabling Technology (SPRET), 8/16/06-8/13/07, \$50,000, co-PI (Kempel lead-PI). (Prime contractor: U.S. Air Force)
58. **Clarkson Aerospace Corporation**, ASET: Aerospace Enabling Sensor Technologies, 9/8/06-4/8/08, \$225,000, lead-PI (Biswas, Chen Ramhuhalli co-PIs). (Prime contractor: U.S. Air Force)
59. **Dow Chemical Corporation**, Research Gift for Harmonic Radar Corrosion Detection, 12/21/2006-12/20/2007, \$40,000, co-PI (Kempel lead-PI).
60. **NSF**, A Methodology for Design of Metamaterials and Their Integration in Advanced RF Systems, 6/1/08-5/31/12, \$390,887 co-PI (Diaz lead-PI)
61. **NSF**, A Methodology for Design of Metamaterials and Their Integration in Advanced RF Systems (REU), 6/1/08-5/31/12, \$12,000 co-PI (Diaz lead-PI)
62. **ITT Industries**, Short-Pulse Radar Enabling Technology (SPRET) for 2008, 1/1/08-2/15/09, \$50,000, co-PI (Kempel PI).
63. **Clarkson Aerospace Corporation**, Sensors Technical Thrust Research, 1/1/08-8/15/08, \$35,000, PI.
64. **Boeing**, Nondestructive Evaluation Technology Initiative, 12/1/08-12/31/09, \$75,000, lead-PI (Kempel Co-PI). (prime contractor: AFRL)
65. **NSF**, A Methodology for Design of Metamaterials and Their Integration in Advanced RF Systems (REU), 6/1/08-5/31/12, \$6,000 co-PI (Diaz lead-PI).
66. **NSF**, NeTS: Small: Pulse Switching: An Ultra-light Multi-hop Network Paradigm without Packet Abstraction, 8/15/09-8/14/12, \$349,990 co-PI (Biswas lead-PI).
67. **AFRL**, Advanced Aperture Research, \$1,809,657, 5/16/09-5/31/14, co-PI (first year, Kempel lead-PI), lead-PI (subsequent years).
68. **AFOSR**, RF Polymers III, \$580,000, 4/1/09-5/15/14, co-PI (Shanker co-PI, Kempel lead-PI).
69. **Motorola**, Plastic Nano-Composites to Improve Antenna Performance, \$50,000,

6/1/2010-11/30/11, co-PI (Drzal lead-PI)

70. **Boeing**, Nondestructive Evaluation Technology Initiative, 6/1/10-3/31/11, \$75,000, lead-PI (Kempel Co-PI). (prime contractor: AFRL)
71. **General Electric Aviation**, Coating Electrical Property Characterization and CEM Development, 5/16/12-5/15/15, \$237,312, sole-PI.
72. **Virtual EM**, Efficient HF Transmit Antennas Utilizing Platform Coupling, 6/21/13-10/09/13, \$60,000, sole-PI. (STTR, prime contractor: U.S. Navy)
73. **Raytheon Company**, Reconfigurable Array Performance Improvement and Deployment (RAPID), 11/14/13-1/20/17, \$528,055, co-PI (Lee Harle lead PI, DARPA prime contractor)
74. **Universal Technology Corporation**, Free-Space Characterization and Advanced Apertures, 9/27/12-3/15/2015, \$207,000, lead-PI (Chahal Co-PI). (prime contractor: AFRL)
75. **Virtual EM**, Efficient HF Transmit Antennas Utilizing Platform Coupling and Reconfigurable Aperture, 1/29/14-2/1/18, \$181,921, sole-PI. (STTR, prime contractor: U.S. Navy)
76. **General Motors Corporation**, A Standard PD Reference for evaluating the performance of PD measuring instruments, 12/18/2015-11/15/2016, \$105,565, co-PI (Strangas lead PI).
77. **Virtual EM**, Wideband Efficient Dual Polarized HF Antenna, 12/16/16-4/13/17, \$45,000, sole-PI. (SBIR, prime contractor: U.S. Air Force)

Institutional Service

University Standing Committees

- Academic Governance Committee, 1997-98
- Committee on Academic Environment, 1997-98
- Committee on the Use of Human Subjects in Research, (substitute, 1987-88)
- Committee on Honors Programs 2001-2003
- Committee on Faculty Affairs, 2017-2019

University ad-hoc Committees

- Investigative Committee, 2006-2007, 2016-2017 (chairman)
- Inquiry Panel, 2015 (chairman)
- Faculty Grievance Jurisdictional Appeal Panel, 2017

Disciplinary Review Panel, 2019

College Standing Committees

Engineering Curriculum Committee 1989-93, 2001-2005, 2013-2017 (chairman 2013-2015)

Promotion and Tenure Committee (chairman of Instruction Subcommittee, 2000)

Faculty Rating Committee (P&T), 2007-2013, (chairman 2010-2013)

College ad-hoc Committees

Grievance Committee, 1987

Associate Dean Search Committee, 2000

Student Service Awards Committee, 2005

Space Committee, 2007-2008

Green Apple Awards Committee, 2016, 2017

Les Leone Cooperative Education Award Committee, 2017

Undergraduate Scholarships Committee, 2019

Department Standing Committees

Curriculum Committee (Undergraduate Studies Committee), 1987-present, (chairman 1991-93, 1998-2001, 2010-2014)

Advisory Committee, 1989-90, 1992-94, 1996-98, 2005-2007, 2012-2014 (chairman 2006-2007)

Graduate Studies Committee, 1994-95

Planning Committee, 1995-2001

Laboratory/Space Committee, 1987-89, 2003-2006

Awards Committee 2003-2006, 2012-2013

Assessment Committee (ABET) 2005-2006, 2007-2012

Promotion and Tenure Committee 2006-2009, 2011-present (chairman 2008-2009, 2012-2014, 2015-2016)

Department Area Committees

Electroscience Area Committee, 1987-present (chairman 1987-90, 2002-2009)

Department ad-hoc Committees

Recruiting Video Committee, 1990-92 (chairman)

ABET Visit Preparation Committee, 1991-93, 1997-2005

Faculty Search Committee, 1996-1998, 2015-2016

Promotion and Tenure Committee, 1996-97

World Wide Web Committee, 1996-1998

Graduate Program Review Committee, 2000

Laboratory Committee, 2001-2002

Academic Advisor Search Committee (chairman) 2001, 2002

ECE Technologist Search Committee (chairman) 2005-06

Other duties

Department Secretary, 1986-87

Department Honors College Advisor, 1987-2018
Editor, Electrical Engineering Department Newsletter, 1995-2000

Other Activities

Engineering Open House activities: EM lab demonstrations, discussions with parents and prospective students

Participated in Alumni Distinguished Scholarship recruiting activities: lunches, lectures, etc.

Writing and grading Electromagnetics Qualifying Exam, 1985-present

Reviewer of Engineering student cooperative education reports

Professional Service

Journal activities

Editorial Board, Journal of Electromagnetic Waves and Applications, 2000-present

Institute of Webcasting, Internet and Telecommunications (IWIT), 2011-present (Korea)

Reviewing activities

Journals

IEEE Transactions on Antennas and Propagation

IEEE Transactions on Microwave Theory and Techniques

IEEE Transactions on Electromagnetic Compatibility

Radio Science

Journal of Electromagnetic Waves and Applications

International Journal for Numerical Methods in Engineering

Electronics Letters

IEE Proceedings on Radar, Sonar and Navigation

IEEE Transactions on Education

IEEE Transactions on Signal Processing

International Journal of Applied Electromagnetics and Mechanics

IEEE Antennas and Wireless Propagation Letters

Journal of Applied Geophysics

IEEE Transactions on Aerospace and Electronic Systems

Progress in Electromagnetic Research

IEEE Antennas and Propagation Magazine

IEEE Microwave Magazine

Research in Non-Destructive Evaluation

Journal of the Optical Society of America B

Digital Signal Processing

International Journal of RF Technologies

IET Science, Measurement & Technology

Optics Letters

Journal of Non-Destructive Evaluation
Journal of Microwaves, Optoelectronics, and Microwave Applications
Journal of the Applied Computational Electromagnetics Society
Measurement
Applied Optics
IEEE Microwaves and Wireless Components Letters
Wave Motion
International Journal of Antennas and Propagation
Journal of the Optical Society of America A
Sensors
Journal of Alloys and Compounds
NDT&E International
IET Microwaves, Antennas & Propagation
IEEE Transactions on Industrial Informatics
IEEE Transactions on Terahertz Science and Technology
PLOS ONE
ACES Express
IEEE Transactions on Magnetics
Review of Scientific Instruments

Book Publishers

McGraw-Hill
Prentice Hall
West Educational Publishing
PWS Publishing
Oxford University Press
John Wiley & Sons
CRC Press/Taylor & Francis
Springer SBM

Proposals

National Science Foundation
U.S. Civilian Research and Development Foundation (CRDF)
MSU IRGP
MSU Honors Research Seminar
Foundation for Polish Science
MSU TSGTD

Promotion and Tenure

Clemson University, Department of Electrical Engineering, 1998
Pohang University of Technology, South Korea, Department of Electrical Engineering,
1999
University of Jordan, Amman, Jordan, College of Engineering, 2000
University of Kentucky, College of Engineering, 2001
University of Wisconsin-Milwaukee, 2008
National Central University, Taiwan, 2010

Catholic University of America, 2010
Oakland University, 2011
The Hashemite University, Amman, Jordan, 2011
The University of Colorado, Colorado Springs, 2013
Florida International University, 2014
Wright State University, 2015
University of Colorado, Denver, 2015
Pohang University of Science and Technology (POSTECH), 2016
Kuwait University, 2017
Florida International University, 2017

Conferences

IEEE Antennas and Propagation International Symposium
URSI North American Radio Science Meeting
European Conference on Antennas and Propagation (EuCAP)
IEEE International Conference on Circuits and Systems for Communications 2008
13th International Symposium on Applied Electromagnetics and Mechanics (ISEM), 2007
2008 IEEE International Geoscience and Remote Sensing Symposium
42nd Southeastern Symposium on System Theory, University of Texas at Tyler, 2010

Service to the IEEE

Session chairman for the 1989 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Secretary-Treasurer of the Trident group of the Southeastern Michigan Section of the IEEE, 1989-91.

Vice-President of the Trident group of the Southeastern Michigan Section of the IEEE, 1990-92.

President of the Trident group of the Southeastern Michigan Section of the IEEE, 1992-94.

Session chairman for the 1993 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 1998 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 1999 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2000 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2002 IEEE Antennas and Propagation Society International

Symposium/National Radio Science Meeting.

Session chairman for the 2003 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2005 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2006 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2008 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2009 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2010 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

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Session chairman for the 2013 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2014 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2015 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2017 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Session chairman for the 2018 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 1993 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 1995 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2008 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of the reviewing Committee for the 2008 IEEE International Conference on Circuits and Systems for Communications

Member of the reviewing Committee for the 13th International Symposium on Applied Electromagnetics and Mechanics (ISEM), 2007

Member of the reviewing Committee for the 2008 IEEE International Geoscience and Remote Sensing Symposium

Member of the reviewing Committee for the 2009 International Symposium on Electromagnetic Compatibility, Kyoto, Japan.

Member of reviewing Committee for the 2009 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2010 Southeastern Symposium on Systems Theory

Member of reviewing Committee for the 2010 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2011 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2013 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of the Technical Program Committee for the 2011 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2012 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of the Technical Program Committee for the 2012 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2012 IEEE International Conference on Wireless Information Technology and Systems (ICWITS).

Member of the Technical Program Committee for the 2013 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2014 IEEE Antennas and Propagation Society

International Symposium/National Radio Science Meeting.

Member of the Technical Program Committee for the 2014 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2015 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of the Technical Program Committee for the 2016 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2016 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of the Technical Program Committee for the 2017 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2017 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of the 2017 IEEE Antennas and Propagation Society Best Paper Awards Committee.

Member of reviewing Committee for the 2018 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Member of reviewing Committee for the 2019 IEEE Antennas and Propagation Society International Symposium/National Radio Science Meeting.

Other

United States National Committee for The International Union of Radio Science (URSI USNC) Commission B membership Committee 2010-present, (chair, 2010-2020).

Associate chair of the Technical Program Committee for the 2001 ACES Conference.

Organizing Committee, 13th International Symposium on Applied Electromagnetics and Mechanics (ISEM), 2007.

Session chairman for ISEM 2007.

Session chairman for the 2007 URSI North American Radio Science Meeting.

Session chairman for the 2011 URSI North American Radio Science Meeting.

Session chairman for the 2012 URSI North American Radio Science Meeting.

Session chairman for the 2016 URSI North American Radio Science Meeting.

Member of the Reviewing Committee for the 9th European Conference on Antennas and Propagation (EuCAP), 2015.

Organized the 2016 meeting of the Materials Measurement Working Group at Michigan State University. Approximately 60 attendees from government and industry.

Member of the Reviewing Committee for the 11th European Conference on Antennas and Propagation (EuCAP), 2017.

Organized a special session on “Advanced Analysis, Design, and Applications of Waveguiding Structures” for the 2017 URSI North American Radio Science Meeting.

Session chairman for the 2017 URSI North American Radio Science Meeting.

Member of the Reviewing Committee for the 12th European Conference on Antennas and Propagation (EuCAP), 2018.

Member of the Reviewing Committee for the 2018 URSI North American Radio Science Meeting.

Organized a special session on “Advanced Analysis, Design, and Applications of Waveguiding Structures” for the 2018 URSI North American Radio Science Meeting.

Session chairman for the 2018 URSI North American Radio Science Meeting.

Member of reviewing Committee for the 2018 Applied Computational Electromagnetics Society (ACES) conference.

Member of the Reviewing Committee for the 13th European Conference on Antennas and Propagation (EuCAP), 2019.

Visiting Scholars Hosted

In-Sik Choi, Pohang University of Technology, South Korea, 2001-2002.

Dr. Jeong-Seog Lee, 2004-2008.

Prof. Jeong-Jin Kang, Dong Seoul College, South Korea, 2006-2009.

Prof. Shih-Yuan Chen, National Taiwan University, 2008-2009.

Prof. In-Sik Choi, Hannam University, South Korea, 2011.

Prof. Yao-Ching Kan, Yuan Ze University, Taiwan, 2011.

Prof. In-Sik Choi, Hannam University, South Korea, 2013-2015.

Teaching and Advising

Ph.D. Thesis Supervision

Michael Blischke, "Broadband Analysis of Radiating, Receiving, and Scattering Characteristics of Microstrip Antennas and Arrays," August 1989, co-advisor with Kun-Mu Chen.

John E. Ross, "Application of Transient Electromagnetic Fields to Radar Target Discrimination," August 1992.

Ponniah Ilavarasan, "Automated Radar Target Discrimination Using E-pulses and S-pulses," August 1992, co-advisor with Kun-Mu Chen.

Ying-Chen Dai, "Time-domain Imaging of Radar Targets Using Ultra-Wideband or Short Pulse Radars," August 1997, co-advisor with Kun-Mu Chen.

Qing Li, "Radar Target Discrimination Using Early-time Responses," August 1995, co-advisor with Kun-Mu Chen.

Chang-Ying Tsai, "Radar Target Discrimination Using Neural Networks," August 1995, co-advisor with Kun-Mu Chen.

Glen Wallinga, "Application of E-pulse and Cepstral Analysis to Radar Target Detection and Discrimination," August 1997.

Ahmet Kizilay, "A Perturbation Method for Transient Multipath Analysis of Electromagnetic Scattering from Targets above Periodic Surfaces," August 2000.

Jung-Wook Suk, "Transient Analysis of Plane-Wave Scattering in a Layered Medium," December 2000.

Chi-Wi Wu, "Coupling between Cavity-Backed Antennas on an Elliptic Cylinder," December, 2001, co-advisor with Leo Kempel.

Christopher Coleman, “Self-Structuring Antennas,” May 2002.

Jong Chan Oh, “Natural Resonance Representation of the Transient Field Reflected by a Planar Layered Lossy Dielectric,” December 2002.

Derik Love, “A Mode-Matching Approach to Determine the Shielding Effectiveness of a Doubly-Periodic Array of Apertures in a Thick Conducting Screen,” December 2004.

Bradley Perry, “Natural Resonance Representation of the Transient Field Reflected from a Multi-layered Material,” August 2005.

Gary Dester, “Electromagnetic Material Characterization of a Conductor-backed Material Using the Two Layer, Two Thickness, and Two Iris Waveguide Probe Methods: Error Analysis, Simulation, and Experimental Results,” August 2008.

Raenita Fenner, “Error Analysis of Reflection-Only Material Characterization Methods,” May 2011.

Raoul Ouedraogo, “Topology Optimization of Metamaterials and Their Applications to RF Component Design,” August 2011.

Ben Crowgey, “Rectangular Waveguide Material Characterization: Anisotropic Property Extraction and Measurement Validation,” December 2013.

Junyan Tang, “Characterization of Anisotropic Materials Using a Partially Filled Rectangular Waveguide,” May 2015.

Andrew Temme, “Experimental Studies of Microwave Propagation Through Fires for Through-Wall, Search-and-Rescue Radar in Firefighting,” December 2015.

Jonathan Frasch, “Application of Evolutionary Algorithms to Electromagnetic Materials Characterization and Design Problems,” May 2017.

Korede Akinlabi-Oladimeji, 2012-2018 (joined Aerospace Corporation 2017), expected graduation 2021.

Ph.D. Thesis Supervision (did not finish)

Robert Bebermeyer, 1993-1995 (joined U.S. Navy)

Fayyadh Hussein, Iraq Linkage Program, 2014-2016 (University of Duhok, program cancelled)

Master's Thesis Supervision

Stephen Reichel, "A Time Domain Bistatic Inverse Scattering Identity Using Physical Optics Approximation," October 1994. (Kaiserslautern program/Studienarbeit.)

Christoph Ohl, "Target Discrimination using the Extinction-Pulse Technique and Wavelet Transforms with Cepstral Analysis," October 1997. (Kaiserslautern program/Studienarbeit.)

Mirko Schacht, "Radar Target Identification of Hidden Objects using Direct Time Domain Measurements," January 1999. (Kaiserslautern program/Diplomarbeit.)

Christopher Coleman, "Analysis of Daimler-Chrysler/CISPR 25 Radiated Emission Testing setup for modules," July 1999.

Mathew Feusse, "Modeling Conducted Emission Transients due to DC Motor Switching in Automotive Applications," May 2001, co-advisor with Dennis Nyquist.

Garrett J. Stenholm, "Nondestructive Evaluation of Layered Materials using the E-pulse Technique," May 2002.

Bradley Perry, "A Self-Structuring Antenna Prototype," August 2002.

Michael Markey, "Comparison of Measurement to Simulation for an antenna on a vehicle," May 2003, co-advisor with Leo Kempel.

Heike Vollmer, "Natural Mode Analysis of the Early-Time Response of a Dielectric Coated Cylinder," May 2003. (Kaiserslautern program/Studienarbeit.)

Jason Meeussen, "Error analysis in a waveguide materials property measurement," May 2004.

Lanwu Zhao, "Analysis and Synthesis of Broadband Travelling Wave Antennas," August 2004.

Jonathan Wierzba, "Scattering from a Coated Curved Surface of Varying Thickness with Application to Nondestructive Evaluation," May 2005.

Joachim Jessberger, "Investigation of the Near-Field Properties of the Self-Structuring Antenna," October 2005. (Kaiserslautern program/Studienarbeit.)

Steve Cossmann, "Transient Reflection of Plane Waves from a Lorentz-Medium Half-Space," May 2006, co-advisor with Leo Kempel.

Timm Zweitash, "Transient Reflection of Plane Waves from a Plasma Half-Space," November 2006. (Kaiserslautern program/Studienarbeit.)

Raenita Fenner, "Bandwidth Extension of a Body Worn Antenna Vest," August 2007.

Lynn Greetis, "A Self-Structuring Patch Antenna," May 2008.

Raoul Ouedraogo, “A Self-Tuning Electromagnetic Shutter,” August 2008.

Michael Archbold, “Control of the Main Beam of a Half-Width Microstrip Leaky-Wave Antenna by Edge Loading Using the Transverse Resonance Method,” August 2008.

Ben Crowgey, “Comparison of UWB Short-Pulse and Stepped-Frequency Systems for Imaging Through Barriers,” August 2009.

Chad Gardner, “A Conformal Taguchi Optimized E-patch Antenna,” December 2010.

Andrew Temme, “A Self-Structuring Two-Port Network,” December 2011.

Korede Akinlabi-Oladimeji, “Self-Structuring Head-Worn Antenna”, May 2012.

William Stevers, “Suitability of the RSP2pro Software-defined Radio for Precompliance Radiated Emissions Testing,” May 2020.

External Master’s Thesis Supervision/Guidance Committee

Naim Shandi, Lawrence Technological University. Guidance Committee Member. Principal adviser: Prof. Michael J. Cloud. Expected graduation: Spring, 2022.

External Dissertation Evaluation

Hoi-Shun Antony Lui, Ph.D. The University of Queensland, May 2008.

Chad Hargrave, Ph.D. The University of Queensland, July 2014.

Jayaprakash Poojali, Ph.D., Indian Institute of Technology Madras, September 2017.

Honors College Advisees

Approximately 300 Honors College students advised, 1987-2019.

Other Advising

Academic adviser for approximately 30 Master's students, 1985-2018

Served on 100+ Ph.D. guidance committees (including as chairman), 1985-present

Served on 20+ Master's thesis committees, 1985-present

Served on 8 Master's oral exam committees, 1985-present

Courses taught 1985-present

ECE 280	Analytical Methods for Electrical Engineering
EE 300	Electric Circuits
EE 305	Electromagnetic Fields and Waves I
EE 306	Electromagnetic Fields and Waves II
EE 307	Electromagnetic Fields and Waves III
EE 308	Electromagnetic Fields and Waves Laboratory
ECE 381	Professionalism, Communications, and Ethics
ECE 405	Electromagnetic Fields and Waves II
ECE 407	Electromagnetic Compatibility
EE 435	Microwave Circuits and Systems (quarters, before 1992)
EE 435	Electromagnetic Waves and Applications (semesters, after 1992)
EE 436	Antenna Theory and Design
EE 438	Electromagnetics Laboratory
EE 491	Electromagnetic Compatibility
EE 495	Independent Study
EE 499	Independent Research
EE 801	Special Topics
EE 835	Electromagnetic Waves I
ECE 835	Electromagnetic Fields and Waves I (Online)
EE 836	Electromagnetic Waves II
EE 841	Fourier Optics
EE 926	Antenna Theory I
EE 927	Antenna Theory II
EE 929C	Geometrical Theory of Diffraction

Lab Coordination

Coordinator for the following labs, 1985-present:

EE 308 (quarters)
 EE 438 (quarters)
 ECE 306 (semesters)
 EE 307 (semesters)
 EE 435 (semesters)
 ECE 405 (semesters)
 ECE 407
 EE 841 (semesters)

Individualized Instruction

Independent study:

1986: 2 grad, 1 undergrad
 1987: 1 grad, 2 undergrad
 1988: 1 grad, 1 undergrad
 1989: 2 undergrad
 1990: 1 grad, 1 undergrad
 1992: 1 undergrad

1993: 1 grad, 1 undergrad
1995: 1 undergrad
1996: 2 undergrad
2000: 2 undergrad
2001: 1 grad, 4 undergrad
2002: 2 undergrad
2003: 2 undergrad, 1 PA
2004: 1 undergrad, 1 PA
2005: 2 undergrad, 1 PA
2006: 4 undergrad
2007: 1 undergrad, 1 grad, 1PA
2008: 1 PA
2009: 2 grad
2011: 1 grad, 1 undergrad
2012: 1 undergrad
2014: 2 undergrads
2015: 1 undergrad
2016: 1 undergrad

Approximately 50 honors options given to Honors College Students, 1985-present

Course Development

EE 929C, "Geometrical Theory of Diffraction." Three credit course developed first in 1988; taught six times.

ECE 407, "Electromagnetic Compatibility." Four credit course with laboratory. Developed with Dennis Nyquist. Sponsored by NSF GOALI grant.

EE 841 laboratory, "Fourier Optics." Developed one credit laboratory to be added to existing course. Wrote lab manual. Developed experiments in diffraction, spatial filtering and optical signal processing.

ECE 835, "Electromagnetic Fields and Waves I." Developed online version of ECE 835 in 2018.

Laboratory Development

EE 308/306/307/438/435 Oversaw the acquisition of new laboratory equipment for Electromagnetics teaching laboratory, 1989-90. Approximately \$400,000 of new equipment obtained through grant from Hewlett-Packard, from new building funds, and from University. Each lab station was equipped with a new SWR meter, slotted line, signal generator, vector voltmeter, power meter, digital oscilloscope, computer and printer.

EE 308/306/307 Completely rewrote laboratory manual. Implemented new experiments in numerical electromagnetics and radiation. Revised and updated experiments on transmission

lines. Designed new anechoic chamber and oversaw its construction. Wrote software for GPIB-based, computer controlled automated measurements using signal generator, power meter, vector voltmeter, and antenna platform. Wrote numerical analysis software.

EE 438/435 Completely rewrote laboratory manual. Implemented new experiments in S-parameter measurement, CAD-based microwave circuit design, antenna measurements, and network analyzer measurements. Wrote software for numerical computation of antenna patterns and impedance. Wrote software for GPIB-based, computer-controlled automated measurements using network analyzer.

ECE 407 Developed laboratory experiments for the teaching of the principles of electromagnetic compatibility (EMC), and for instruction in the techniques of EMC measurements. Incorporated new equipment including arbitrary waveform generator and combination spectrum/network/impedance analyzer.

Course and Laboratory Development Grants

Hewlett-Packard Company, "Development of a Microwave Laboratory," \$81,273, 1989, PI.

National Science Foundation, "GOALI: Electromagnetic Compatibility Educational Experiences: A Joint Effort Between Chrysler Corporation and Michigan State University," \$208,841, 6/15/97-5/31/00, co-PI.

Classroom Development

EE 300 Revised the introductory circuits class format. Established a lecture/recitation format where each section received individualized instruction from a TA or faculty member. Previous to this, the course was on television in a lecture-only format.

EE 307 Implemented an innovative evaluation format for the introductory electromagnetics laboratory. Students receive an indication of "acceptable" or "unacceptable" on each lab report. If the report is "unacceptable" the student is given two opportunities to make up the deficiency. By the end of the semester, all reports must be "acceptable." Therefore, all students must meet a minimum level of proficiency on all of their work.

Also implemented an oral report procedure wherein the lab class is asked to simulate a work environment. Lab groups give reports to a variety of simulated audiences including managers, lay groups, government agents, customers, etc.

EE 435 Established an innovative design experience for senior students requiring them to design, build, test, and deliver a working antenna system. The students are required to work in groups as the engineering team for a fictitious company. They begin by answering a call for proposals and establishing a work schedule. They must file progress reports and hold meetings with management during all phases of design, build and test. Finally, they must demonstrate the antenna system for the customer and provide a complete technical report.

ECE 407 Developed a new course in electromagnetic compatibility with Dennis Nyquist. Taught the course jointly with Daimler Chrysler while in development. Designed a set of laboratory experiments to demonstrate the principles of EMC and to expose the students to EMC measurements of radiated and conducted emissions.

Evidence of teaching and mentoring excellence

Ph.D. student advisee Andrew Temme awarded one of three IEEE Antennas and Propagation Society Doctoral Research Awards for 2013-2014.

Ph.D. student advisee Junyan Tang awarded second place for commercialization potential in the Engineering student research symposium, November 2012.

Supervisor for the design group “MSU_spartans” consisting of Andrew Temme, Don VanderLaan, and Steve Zajak. The group was awarded second place in the student design contest at the 2011 IEEE Antennas and Propagation International Symposium, Spokane, WA, for their low-cost antenna pattern measurement system. There were 13 entries, and 3 finalists chosen to demonstrate their system at the conference.

Ph.D. student advisee Raoul Ouedraogo awarded third place in the student paper competition at the 2010 IEEE Antennas and Propagation International Symposium, Toronto, ON. There were over 200 student entrants in the competition.

Undergraduate advisee Andrew Temme presented his research titled “A Self-Structuring Two-Port Network” at the 2010 MSU UURAF and the Graduate Academic Conference.

Undergraduate advisee Andrew Temme awarded NSF Graduate Fellowship, 2010.

Undergraduate advisee Andrew Temme chosen as a finalist for the MSU Featherstone Prize, 2010.

Recognized by students in MSU Department of Residence Life survey as a faculty member who has “stimulated them to think, reflect, connect ideas, explore knowledge, and become excited about learning,” April 2009.

Undergraduate research assistant Andrew Temme awarded one of three IEEE Antennas and Propagation Society Undergraduate Fellowships for 2009-2010.

M.S. Student Lynn Greetis chosen as runner-up in the 2008 IEEE Antennas and Propagation Symposium Student Paper Contest.

Ph.D. student Bradley Perry chosen most outstanding ECE graduate student by the College of Engineering, 2005.

MSU Alumni Association of Mid-Michigan Quality in Undergraduate Teaching Award, 2003.

Withrow Teaching Excellence Award, 1991, 1996, 2006, 2012.

Nominated by Michigan State University for the CASE National Professor of the Year Award, 2004.

Twice nominated by the College of Engineering for the Michigan State University "Teacher/Scholar Award."

One of seven finalists for the 1993 Michigan State University Senior Class Council "Outstanding Faculty Award."

Many Honors College Advisees given major scholarships (e.g., NSF and DoD Fellowships).

Master's student Adam Norman chosen most outstanding graduate student by the College of Engineering, 1992.

Chosen by academic award-winning undergraduate students to attend awards banquet as the teacher who had the most influence on their MSU experience: 1988, 1989 (2 students), 1990 (3 students), 1992, 1994, 1996, 1997.

Chosen by NSF Graduate Fellowship winner Brian Reynolds to attend the University Awards Banquet as the teacher who had the most influence on his MSU experience.

Consistently high, and considerably higher than average, Student Instructional Ratings (SIRS). Ranked by Department chairman third in undergraduate teaching in 1995-96, and first in 1996-98.

Student Ratings

Student Instructional Rating System (SIRS)

1985-1988: Two questions; average values shown below

Quarter/Course	Number of student responses	“Overall effectiveness as an instructor” (0-4)	“How much you feel you have learned” (0-10)
F '85 – EE 435	22	3.68	8.10
W '86 – EE 306	87	3.53	7.80
S '86 – EE 841	27	3.78	8.41
F '86 – EE 305	82	3.55	7.59
W '87 – EE 926	11	3.95	8.91
S '87 – EE 927	11	3.86	8.55

F '87 – EE 305	84	3.48	7.36
W '88 – EE 436	17	3.74	8.12
Average Score		3.70	8.11

1989-1993: 20 questions; average values of 3 selected questions shown below, along with Department averages for courses at same level (300/400/grad)

Quarter or Semester/ Course	No. of student responses	“Ability to stimulate student interest” (0-4)		“Attitude toward students” (0-4)		“Overall learning experience” (0-4)	
		Score	Dept ave	Score	Dept ave	Score	Dept ave
W '89 – EE 926	10	3.80	3.57	4.00	3.89	NA	NA
W '89 – EE 300	54	2.82	2.39	3.37	3.19	NA	NA
S '89 – EE 927	7	3.71	3.28	4.00	3.57	3.43	3.31
F '89 – EE 305	65	3.23	2.77	3.68	3.16	3.22	2.95
W '90 – EE 836	7	3.29	2.97	3.86	3.43	3.33	3.14
S '90 – EE 841	10	3.50	3.09	3.80	3.33	3.44	2.77
F '90 – EE 435	25	3.35	2.80	3.65	3.18	3.21	3.04
W '91 – EE 438	9 (lab)	3.33	2.85	3.89	3.34	3.56	2.79
W '91 – EE 436	20	3.15	2.74	3.70	3.04	3.16	2.79
S '91 – EE 308	10 (lab)	3.90	2.88	3.90	3.44	3.70	2.95
S '91 – EE 306	33	3.30	2.45	3.61	2.90	3.33	2.95
F '91 – EE 835	14	3.71	2.74	3.57	3.01	3.50	2.62
W '92 – EE 436	12	3.64	2.70	3.91	3.12	3.60	2.76
W '92 – EE 438	6 (lab)	3.67	2.69	3.67	3.21	3.20	2.73
W '92 – EE 438	5 (lab)	3.20	2.69	3.60	3.21	3.40	2.73
S '92 – EE 306	23	3.10	2.26	3.57	2.73	3.00	2.37
F '92 – EE 435	23	3.77	2.74	3.91	3.25	3.73	2.88
S '93 – EE 306	67	3.48	2.69	3.82	3.13	3.25	2.75
S '93 – EE 306	11 (lab)	3.64	2.61	3.82	3.16	3.64	2.86
Average Score		3.45	2.78	3.75	3.23	3.39	2.85
Differential		+0.67		+0.52		+0.54	

1993: Five ratings, each graded as SA (1), A (2), N (3), D (4), SD (5).

Semester / Course	No. of student responses	“Avail-ability”	“Explan-ation”	“Prepar-ation”	“Organi-zation”	“Overall rating”
F '93 – EE 929A	9	1.22	1.44	1.22	1.33	1.22
F '93 – EE 435	6 (lab)	1.00	1.00	1.00	1.00	1.00

1994-present: Four ratings, each graded as SA (1), A (2), N (3), D (4), SD (5) + overall instructor rating on a 4.0 scale

Semester / Course	No. of student responses	“Availability”	“Explanation”	“Preparation”	“Organization”	“Overall rating”
S '94 – EE 305	28	1.25	1.46	1.43	1.57	3.71
F '94 – EE 435	14	1.21	1.38	1.29	1.29	3.71
F '95 – EE 305A	27	1.15	1.37	1.19	1.30	3.88
F '95 – EE 305B	23	1.35	1.61	1.30	1.35	3.70
S '96 – EE 306	28	1.14	1.29	1.07	1.14	3.89
Su '96 – EE 306	12	1.25	1.33	1.17	1.25	3.75
F '96 – EE 929C	5	1.50	1.83	1.50	1.67	3.50
F '96 – EE 435	21	1.24	1.50	1.57	2.00	3.65
S '97 – EE 841	6	1.17	1.33	1.33	1.67	3.50
F '97 – EE 435	11	1.55	1.64	1.36	1.91	3.82
S '98 – EE 836	5	1.00	1.00	1.00	1.00	4.00
F '98 – EE 435	9	1.11	1.33	1.11	1.33	4.00
S '99 – EE 491	11	1.18	1.64	1.82	2.00	3.82
S '99 – EE 841	7	1.14	1.43	1.14	1.43	4.00
S '99 – EE 307	5 (lab)	1.20	1.20	1.20	1.25	4.00
F '99 – ECE 929C	5	1.20	1.60	1.00	1.00	4.00
F '99 – ECE 482	5	1.80	2.00	2.25	2.00	3.40
S '00 – ECE 491	13	1.23	1.54	1.46	1.77	3.62
S '00 – ECE 306	30	1.43	1.37	1.33	1.30	3.81
F '00 – ECE 482	10	1.50	1.60	1.50	1.67	3.78
S '01 – ECE 381	22	1.45	1.45	1.48	1.26	3.96
S '01 – ECE 306	30	1.37	1.30	1.23	1.27	3.78
S '01 – ECE 841	9	1.33	1.22	1.22	1.22	4.00
F '01 – ECE 929B	4	1.00	1.25	1.25	1.00	4.00
S '02 – ECE 306	36	1.22	1.28	1.28	1.25	3.97
S '02 – ECE 491	13	1.15	1.08	1.23	1.23	4.00
F '02 – ECE 835	24	1.33	1.50	1.42	1.58	3.79
F '02 – ECE 929C	5	1.20	1.40	1.00	1.00	3.80
S '03 – ECE 306	17	1.24	1.06	1.00	1.13	4.00
F '03 – ECE 835	17	1.29	1.41	1.18	1.47	3.88
F '03 – ECE 305	29	1.28	1.41	1.24	1.34	3.71
S '04 – ECE 305	37	1.41	1.58	1.36	1.39	3.70
F '04 – ECE 929B	7	1.29	1.14	1.14	1.14	4.00
F '04 – ECE 405	24	1.17	1.39	1.17	1.39	3.92
S '05 – ECE 407	9	1.00	1.00	1.11	1.22	4.00
F '05 – ECE 280	25	1.40	1.17	1.17	1.22	3.91

F '05 – ECE 405	21	1.10	1.24	1.29	1.43	3.85
S '06 – ECE 280	22	1.41	1.55	1.45	1.32	3.75
S '06 – ECE 407	9	1.11	1.11	1.11	1.11	4.00
F '06 – ECE 929C	5	1.00	1.00	1.00	1.00	4.00
S '07 – ECE 835	13	1.08	1.08	1.23	1.15	4.00
S '07 – ECE 407	18	1.06	1.22	1.17	1.44	4.00
F '07 – ECE 405	19	1.05	1.26	1.21	1.26	3.95
F '07 – ECE 929B	11	1.09	1.09	1.09	1.18	3.91
S '08 – ECE 407	7	1.00	1.00	1.00	1.14	4.00
F '08 – ECE 405	12	1.17	1.58	1.67	1.92	3.92
S '09 – ECE 407	10	1.00	1.00	1.30	1.30	4.00
S '09 – ECE 835	9	1.11	1.22	1.22	1.22	4.00
F '09 – ECE 929C	7	1.00	1.00	1.00	1.00	4.00
F '09 – ECE 405	12	1.08	1.38	1.46	1.54	3.92
S '10 – ECE 407	11	1.09	1.00	1.09	1.09	4.00
F '10 – ECE 929B	9	1.00	1.00	1.00	1.11	4.00
S '11 – ECE 407	9	1.50	1.50	1.50	1.50	3.50
S '11 – ECE 305	25	1.00	1.28	1.16	1.20	3.88
F '11 – ECE 836	10	1.10	1.30	1.30	1.50	4.00
S '12 – ECE 407	16	1.19	1.13	1.19	1.13	3.94
F '12 – ECE 929C	6	1.00	1.17	1.00	1.50	4.00
S '13 – ECE 407	10	1.00	1.20	1.10	1.20	4.00
S '13 – ECE 835	15	1.00	1.07	1.00	1.13	4.00
S '14 – ECE 929B	7	1.00	1.14	1.00	1.14	4.00
S '14 – ECE 407	10	1.00	1.20	1.10	1.20	4.00
F '14 – ECE 305	17	1.06	1.38	1.13	1.19	3.88
S '15 – ECE 305	24	1.16	1.16	1.08	1.12	4.00
F '15 – ECE 835	9	1.00	1.00	1.00	1.22	4.00
S '16 – ECE 836	10	1.20	1.20	1.10	1.30	4.00
S '16 – ECE 407	16	1.13	1.06	1.06	1.06	4.00
F '16 – ECE 280	70	1.34	1.39	1.30	1.39	3.80
F '16 – ECE 929C	8	1.25	1.50	1.38	2.00	3.75
S '17 – ECE 280	59	1.58	1.61	1.53	1.58	3.75
S '17 – ECE 407	22	1.14	1.27	1.18	1.27	3.90
F '17 – ECE 929B	12	1.00	1.08	1.00	1.42	4.00
S '18 – ECE 407	20	1.05	1.00	1.05	1.05	4.00
S '18 – ECE 836	6	1.17	1.33	1.17	1.33	4.00
F '18 – ECE 835	13	1.00	1.15	1.38	1.54	4.00
F '18 – ECE 835 (online)	3	1.00	2.00	1.00	1.33	3.67
F '19 – ECE 835	8	1.11	1.11	1.11	1.11	3.88
F '19 – ECE 835 (online)						
S '20 – ECE 835						

(online)						
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Student Opinion of Courses and Teaching (SOCT)

2002-present: Six ratings, each graded as SA (1), A (2), N (3), D (4), SD (5). Four instructor-related ratings shown below

Semester / Course	No. of student responses	“Instructor effective”	“Course worthwhile”	“Instructor available”	“Course organized”
S '02 – ECE 491	13	1.08	1.15	1.15	1.38
S '02 – ECE 306	36	1.06	1.44	1.40	1.33
S '03 – ECE 306	17	1.12	1.29	1.13	1.12
F '03 – ECE 305	29	1.48	1.76	1.25	1.38
S '04 – ECE 305	37	1.62	2.11	1.41	1.41