

Luis Gomez

Phone: (954)8165011, E-mail: luis.gomez@duke.edu, Webpage: <https://luisgo.github.io>

Education

- Ph.D. Electrical Engineering**, University of Michigan, Ann Arbor, MI May 2015
Dissertation: “*Computational Electromagnetics Methods for Transcranial Magnetic Stimulation.*”
Advisor: Eric Michielssen
- M.S. Electrical Engineering**, University of Michigan, Ann Arbor, MI May 2014
M.S. Applied Mathematics, University of Michigan, Ann Arbor, MI Dec 2013
B.S. Electrical Engineering, University of Florida, Gainesville, FL Aug 2008
Honors Thesis: “*A MIMO-Inspired High-Resolution, Sparse, Dynamically-Steered Phased Array Receive Antenna.*”
Advisor: Henry Zmuda
- B.S. Mathematics**, University of Florida, Gainesville, FL Aug 2008

Awards/Fellowships

- K99/R00 BRAIN Initiative Advanced Postdoctoral Career Transition Award Mar 2019
EECS Outstanding Graduate Student Instructor Award (*awarded to one GSI each term*) May 2014
NSF Graduate Research Fellowship (*3 years of funding*) Nov 2009
Rackham Merit Fellowship (*2 years of funding*) Aug 2008

Research Experience

- Post-doctoral Fellow**, Duke University Medical School, Ann Arbor, MI Aug 2016-Present
- Project 1: Development of optimization methods for design of Transcranial magnetic stimulation (TMS) coils achieving optimal depth, focality and energy tradeoffs
 - Project 2: Development of novel computational electromagnetics solvers for high-fidelity electromagnetic modelling of fields generated during TMS
- Post-doctoral Fellow**, University of Michigan: Radiation Laboratory, Ann Arbor, MI Jan 2015-July 2016
- Project 1: Development of deep learning methodologies for use in inverse scattering algorithms
 - Project 2: Implementation of a general purpose fast-multipole fast-fourier transform accelerated internally combined volume surface integral equation solver for broadband electromagnetic analysis of high-permittivity and negative permittivity objects
 - Project 3: Focal single-source multicoil TMS coil design validation
- Graduate Research Assistant**, University of Michigan: Radiation Laboratory, Ann Arbor, MI Aug 2008-Dec 2014
- Project 1: Development of novel eddy-current finite-difference, integral equation techniques for the analysis of electric fields during transcranial magnetic stimulation (TMS)
 - Project 2: Development of optimization methodologies design of TMS coils
 - Project 3: Development of uncertainty quantification methodologies for TMS
 - Project 4: Development of a fast-finite difference solver for use in real-time analysis of fields generated during TMS

Publications

Journal Publications

1. **L. J. Gomez**, S. Goetz, and A. V. Peterchev, "Design of Transcranial Magnetic Stimulation Coils with Optimal Trade-off between Depth, Focality, and Energy," *Journal of neural engineering*, 2018.
2. B. Wang, Z. Deng, J. Smith, J. Tharayil, C. Gurrey, **L. J. Gomez**, A. Peterchev, "Redesigning Existing Transcranial Magnetic Stimulation Coils to Reduce Energy: Application to Low Field Magnetic Stimulation," *Journal of neural engineering*, 2018.
3. A. C. Yucel, **L. J. Gomez**, and E. Michielssen, "Internally Combined Volume-Surface Integral Equation for EM Analysis of Inhomogeneous Negative Permittivity Plasma Scatterers," *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 4, pp. 1903-1913, 2018.

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4. **L. J. Gomez**, A. C. Yücel, and E. Michielssen, "The ICVSIE: A General Purpose Integral Equation Method for Bio-Electromagnetic Analysis," *IEEE Transactions on Biomedical Engineering*, vol. 65, no. 3, pp. 565-574, 2018.
5. A. C. Yucel, **L. J. Gomez**, and E. Michielssen, "Compression of Translation Operator Tensors in FMM-FFT-Accelerated SIE Solvers via Tucker Decomposition," *IEEE Antennas and Wireless Propagation Letters*, vol. 16, pp. 2667-2670, 2017.
6. **L. J. Gomez**, A. C. Yucel, and E. Michielssen, "Internally Combined Volume-Surface Integral Equation for a 3-D Electromagnetic Scattering Analysis of High-Contrast Media," *IEEE Antennas and Wireless Propagation Letters*, vol. 16, pp. 1691-1694, 2017.
7. **L. J. Gomez**, A. C. Yücel, L. Hernandez-Garcia, S. F. Taylor, and E. Michielssen, "Uncertainty Quantification in Transcranial Magnetic Stimulation via High-Dimensional Model Representation," *IEEE Transactions on Biomedical Engineering*, vol. 62, no. 1, pp. 361-372, 2015.
8. **L. J. Gomez**, A. C. Yücel, and E. Michielssen, "Low-frequency Stable Internally Combined Volume-Surface Integral Equation for High-contrast Scatterers," *IEEE Antennas and Wireless Propagation Letters*, vol. 14, pp. 1423-1426, 2015.
9. **L. J. Gomez**, A. C. Yücel, and E. Michielssen, "Volume-Surface Combined Field Integral Equation for Plasma Scatterers," *IEEE Antennas and Wireless Propagation Letters*, vol. 14, pp. 1064-1067, 2015.
10. **L. J. Gomez**, F. Cajko, L. Hernandez-Garcia, A. Grbic, and E. Michielssen, "Numerical Analysis and Design of Single-source Multicoil TMS for Deep and Focused Brain Stimulation," *IEEE transactions on biomedical engineering*, vol. 60, no. 10, pp. 2771-2782, 2013.
11. L. Hernandez-Garcia, T. Hall, **L. J. Gomez**, and E. Michielssen, "A Numerically Optimized Active Shield for Improved Transcranial Magnetic Stimulation Targeting," *Brain Stimulation: Basic, Translational, and Clinical Research in Neuromodulation*, vol. 3, no. 4, pp. 218-225, 2010.

Book Chapters

1. A. C. Yucel, **L. J. Gomez**, W. Sheng, H. Bagci, and E. Michielssen, "Recent Trends in Uncertainty Quantification for Large-scale Electromagnetic Analysis: From Tensor Product Cubature Rules to Spectral Quantic Tensor Train Approximation," in *New Trends in Computational Electromagnetics* (ed. O. Ergul), pp. 1-31, 2019 (*In Press*)

Journal Publications in Preparation

1. **L. J. Gomez**, M. Dannhauer, L. M. Koponen and A. Peterchev, "Conditions for Numerically Accurate TMS Electric Field Simulation," *Brain Stimulation: Basic, Translational, and Clinical Research in Neuromodulation* (revisions submitted)
2. C. Zhuotong, **L. J. Gomez**, S. Zheng, A. C. Yucel, Z. Zhang, and V. Okhmatovski, "Sparsity Aware Pre-Corrected Tensor Train Algorithm For Fast Solution of 2D Scattering Problems and Current Flow Modelling on Unstructured Meshes," *Transactions on Microwave Theory and Techniques* (review revisions under preparation)

Invited Talks

1. "Computational Electromagnetics Enables Personalized Medicine: A Case Study in Transcranial Magnetic Stimulation," UCLA, Los Angeles, CA (April 2016)
2. "Computational Electromagnetics Enables Personalized Medicine: A Case Study in Transcranial Magnetic Stimulation" Michigan State University, East Lansing, MI (February 2016)

Selected Conference Publications

1. **L. J. Gomez**, A. Yücel, W. Sheng, and E. Michielssen, "Fast Surrogate Model-Assisted Uncertainty Quantification via Quantized Tensor Train Decompositions," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2019
2. **L. J. Gomez**, L. M. Koponen, R. Hamdan, S. Goetz, and A. V. Peterchev, "Computationally Designed Focal Deep Transcranial Magnetic Stimulation (fdTMS) Coils," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2019
3. M. Wang, C. Qian, Z. Chen, E. di Lorenzo, **L. J. Gomez**, S. Zheng, V. Okhmatovski, and A. C. Yucel, "Tucker-Enhanced VoxHenry Simulator for Inductance Extraction of Voxelized Conducting/Superconducting

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- Structures," *IEEE MTT-S International Conference on Numerical Electromagnetic and Multiphysics Modeling and Optimization*, May 2019
4. **L. J. Gomez**, S. Goetz, and A. V. Peterchev, "Synthesis of Focal Deep Transcranial Magnetic Stimulation (fdTMS) Coils," *NYC Neuromodulation and NANS Summer Series Conference*, August 2018
 5. **L. J. Gomez**, W. Sheng, A. Yücel, E. Michielssen, "Fast Statistical Characterization of Rough Surface Scattering via Tensor Train Decompositions," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2016
 6. **L. J. Gomez**, N. Dalal, A. Yücel, R. Villegas, L. Honglak, E. Michielssen, "Deep Learning Augmented Inverse Scattering Algorithm," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2016
 7. A. Yücel, **L. J. Gomez**, E. Michielssen, "An Internally Combined Volume-Surface Integral Equation for 3D Plasma Scatterers," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2015
 8. A. Yücel, **L. J. Gomez**, E. Michielssen, "Tucker Decomposition for Compressing Translation Operator Tensors in FMM-FFT Accelerated SIE Solvers," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2015
 9. **L. J. Gomez**, A. Yücel, E. Michielssen, "Low-Frequency Stable Internally Combined Volume-Surface Integral Equation for 3D High-Contrast Scatterers," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2015
 10. A. Yücel, **L. J. Gomez**, E. Michielssen, "An Internally Combined Volume-Surface Integral Equation for 3D Plasma Scatterers," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2015
 11. A. Yücel, **L. J. Gomez**, E. Michielssen, "Tucker Decomposition for Compressing Translation Operator Tensors in FMM-FFT Accelerated SIE Solvers," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2015
 12. A. Yücel, **L. J. Gomez**, Y. Liu, H. Bagci, E. Michielssen, "A FMM-FFT Accelerated Hybrid Volume Surface Integral Equation Solver for Electromagnetic Analysis of Re-Entry Space Vehicles," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2014
 13. **L. J. Gomez**, A. Yücel, E. Michielssen, "Sensitivity of TMS-Induced Electric Fields to the Uncertainty in Coil Placement and Brain Anatomy," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2014
 14. **L. J. Gomez**, A. Yücel, E. Michielssen, "A Well-Conditioned Volume-Surface Combined Field Integral Equation (VSCFIE) for Inhomogeneous Scatterers with Negative Permittivities," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2014
 15. **L. J. Gomez**, A. Yücel, L. Hernandez, E. Michielssen, "Uncertainty Quantification in Transcranial Magnetic Stimulation," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2013
 16. **L. J. Gomez**, E. Michielssen, "A Well-Conditioned Volume-Surface Field Integral Equation (VSCFIE) for Inhomogeneous Cylindrical Scatterers with High-Electrical Contrasts," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2013
 17. **L. J. Gomez**, L. Hernandez, A. Grbic, E. Michielssen, "Single-Source Multi-Coil Transcranial Magnetic Stimulators for Deep and Focused Stimulation of the Human Brain," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2013
 18. F. Cajko, E. Michielssen, **L. J. Gomez**, P. G. Martinsson, L. Hernandez, "A Fast Direct Solver for TMS Analysis and Design in 3D," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2011
 19. **L. J. Gomez**, L. Hernandez, A. Grbic, E. Michielssen, "Focused Multi-coil Transcranial Magnetic Stimulation," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2011
 20. F. Cajko, E. Michielssen, **L. J. Gomez**, P. G. Martinsson, L. Hernandez, "A Fast Direct Solver for Transcranial Magnetic Stimulation Analysis," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2010
 21. **L. J. Gomez**, L. Hernandez, A. Grbic, E. Michielssen, "A Simulation of Focal Brain Stimulation using Metamaterial Lenses," *Antennas and Propagation Society International Symposium (APSURSI)*, July 2010

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Teaching Experience

- Graduate Student Instructor**, University of Michigan, Ann Arbor, MI Jan-May 2014
- Class Title: Electrical Circuits, Systems, and Applications (EECS 314)
 - Collaborated on class specifics and exam development, met with students for one on one tutoring, was responsible for grading and organization of four weekly lab sections each with ~20 students
- Tutor**, University of Florida: Broward Tutoring Center, Gainesville, FL Sept-Dec 2007
- Held private, as well as, 'walk in' tutoring sessions on various subjects including: Circuits 2, Signals and Systems, Linear Algebra, Calculus 3, Advanced Calculus, Numbers and Polynomials, Digital Logic, Physics 1 and 2

Internship Experience

- Product Cost Take Out Intern**, GE Consumer and Industrial, Louisville, KY Jan-May 2008
- Worked in finding creative ways to remove cost from range electronics
 - Analyzed several temperature sensors and found a more cost efficient solution for temperature measurements in convection ovens.
- Undergraduate Research Intern**, Northwestern University: Center for Photonic Communication and Computing, Evanston, IL June-Aug 2007
- Developed a framework for automatically sending and collecting data from an AOM pulse shaping setup. Then, used the framework to collect data showing linear and quadratic phase modulation of a 2.6 picoseconds pulse.
- Undergraduate Research Intern**, Massachusetts Institute of Technology: Computer Science and Artificial Intelligence Lab (CSAIL), Cambridge, MA June-Aug 2006
- Developed automated digital filters to remove noise from an audio signal using Fourier and Short-time Fourier techniques; developed test methods to compare various filter efficiencies. Studied Speech Recognition systems and different pattern recognition algorithms

Service

- Antennas and Propagation Society International Symposium (APSURSI), July 2019**
- Technical Program Committee, Super Reviewer
 - Co-organizer and chair of a special session on “Application of Machine/Deep Learning and Uncertainty Quantification Techniques in Computational Electromagnetics”

Reviewer

- Brain Stimulation Journal
- NeuroImage Journal
- Journal of Neural Engineering
- IEEE Journal on Electromagnetics, RF, and Microwaves in Medicine and Biology
- IEEE Transactions on Biomedical Engineering
- IEEE Transactions on Antennas and Propagation
- IEEE Magnetics Letters

Society of Hispanic Professional Engineers (SHPE) University of Michigan

- SHPE-Grad Professional Chair 2013-2014
- SHPE-Grad Professional Chair 2012-2013
- SHPE Alumni Chair 2012-2013
- SHPE-Grad Graduate Programs Liaison 2012-2013
- SHPE Recruitment and Retention Chair 2011-2012
- SHPE-Grad Social Chair 2011-2012