Brian MacKie-Mason <bmackiemason@anl.gov>

http://brianmackiemason.com

EDUCATION

Doctor of Philosophy Electrical Engineering *2018*
University of New Mexico, Advisor: Professor Zhen Peng
Novel Algorithms for Ultra Scale Electromagnetic Problems in the Supercomputing Era

Master of Science Nuclear Engineering *2013*
University of Wisconsin-Madison

Bachelor of Science in Engineering Nuclear Engineering *2011*
University of Michigan

JOURNAL PUBLICATIONS

1. **B. MacKie-Mason** and Z. Peng, "Rapid Antenna Prototyping on Large Platforms via Data-Sparse Schur Complement," [Working].
2. **B. MacKie-Mason**, Y. Shao, A. Greenwood, and Z. Peng, "Supercomputing-Enabled First-Principles Analysis of Radio Wave Propagation in Urban Environments," *IEEE Transactions on Antennas and Propagation,* **66**, pp. 6606–6612 (2018). doi:10.1109/TAP.2018.2874674.
3. Z. Peng, R. Hiptmair, Y. Shao, **B. MacKie-Mason**, "Domain Decomposition Preconditioning for Surface Integral Equations in Solving Challenging Electromagnetic Scattering Problems," *IEEE Transactions on Antennas and Propagation,* **64**, pp. 210–223 (2016). doi:10.1109/TAP.2015.2500908.
4. **B. MacKie-Mason**, A. Greenwood, and Z. Peng, "Adaptive and Parallel Surface Integral Equation Solvers for Very Large-Scale Electromagnetic Modeling and Simulation (invited paper)," *Progress in Electromagnetics Research,* **154**, pp. 143–162 (2015). doi:10.2528/PIER15113001.

CONFERENCE PUBLICATIONS

1. A. Yilmaz, **B. MacKie-Mason** S. Cox, C. Courtney and G. Burchuk, "On the Sensitivity of RCS to the Wall Conductivity of Highly-Conductive Structures with Voids", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting,* Denver, CO, July 10–15, 2022.
2. A. Yilmaz, E. Smith, S. Cox, **B. MacKie-Mason** C. Courtney and G. Burchuk, "Camera Boxes: A Set of Complex Scattering Problems to Test EM Simulations and Measurements", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting,* Denver, CO, July 10–15, 2022. doi:10.1109/AP-S/USNC-URSI47032.2022.9887014.
3. A. Maicke, J. Kelley, **B. MacKie-Mason** C. Courtney, S. Cox, D. Chamulak, G. Burchuk and A. Yilmaz, "A Benchmark Airplane Model with Ducts", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting,* Denver, CO, July 10–15, 2022. doi:10.1109/AP-S/USNC-URSI47032.2022.9887354.
4. S. Wang, **B. Mackie-Mason**, and Z. Peng, "Platform-Aware In-Situ Antenna and Metamaterial Analysis and Design," *International Review of Progress in Applied Computational Electromagnetics (ACES),* Miami, Florida, USA, April 14–18, 2019. (Best Student Paper Award). https://bit.ly/2VuzVgy.
5. **B. MacKie-Mason** and Z. Peng, "Towards Real-time In-Situ Antenna Analysis and Design on Platforms of 1000 Wavelengths", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting,* San Diego, CA, July 9–14, 2017.

doi:10.1109/APUSNCURSINRSM.2017.8072714.

6. Z. Peng and **B. MacKie-Mason**, "High-Performance Surface Integral Equation Solvers Towards Extreme-Scale Electromagnetic Modeling and Simulation," *IEEE International Conference on Wireless Information Technology and Systems (ICWITS) and Applied Computational Electromagnetics (ACES),* Honolulu, HI, 22–26, March 2016. doi:10.1109/ROPACES.2016.7465365.
7. **B. MacKie-Mason** and Z. Peng, "Adaptive, Scalable Domain Decomposition Methods for Surface Integral Equations," *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting,* Vancouver, B.C., July 19–25, 2015. doi:10.1109/APS.2015.7305220.

CONTRIBUTED ABSTRACTS

1. Aaron Scheinberg, **B. MacKie-Mason**, S. Ethier, G. Chen, S. Slattery, R. Bird, E. D'Azevedo, CS Chang, et. al., "XGC", *Preparing Applications for Aurora at the Exascale Computing Project Annual Meeting,* Houston, TX, U.S.A. February 3–7, 2020. https://bit.ly/2KsYdRV
2. **B. MacKie-Mason** and XGC Team, "Early OpenMP Experience with Collision Kernel", *OpenMP BOF at the Exascale Computing Project Annual Meeting,* Houston, TX, U.S.A. February 3–7, 2020. https://bit.ly/2zqN3uB
3. **B. MacKie-Mason**, P. Velesko, R. Hager, C.-S. Chang, and T.J. Williams, "Application Study of Gyrokinetic PIC codes on Intel KNL architecture", *IXPUG Annual Fall Conference,* Hillsboro, OR, U.S.A. September 25–28, 2018. https://goo.gl/iLGnTv.
4. **B. MacKie-Mason** and Z. Peng, "Towards a Real-Time Solution of Extreme-Scale Electromagnetic Problems", *National Radio Science Meeting,* Boulder, CO, U.S.A., January 4–7, 2017. https://goo.gl/bK4wms.
5. **B. MacKie-Mason** and Z. Peng, "High-fidelity, High-performance Integral Equation Solver for Time-Harmonic Maxwell's Equations", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting,* Fajardo, Puerto Rico, U.S.A., June 26–July 1, 2016. https://goo.gl/fgmgvk.
6. Z. Peng and **B. MacKie-Mason**, "Integral equation discontinuous Galerkin methods for time harmonic electromagnetic wave problems," *International Review of Progress in Applied Computational Electromagnetics (ACES),* Williamsburg, VA, March 22–26, 2015. https://goo.gl/dkiiyX.

POSTERS

1. E. D'Azevedo, A. Scheinberg, M. Shephard, P. Worley, S. Sreepathi, **B. MacKie-Mason**, T.J. Williams, and the SciDAC HBPS XGC Team, "Performance Enhancements of XGC", *2019 Scientific Discovery through Advanced Computing Principal Investigator (PI) Meeting,* July 16–18, 2019. https://bit.ly/3ayDYwC
2. **B. MacKie-Mason** and XGC Team, "Performance Portability of XGC code at DOE supercomputing facilities", *DOE Performance, Portability and Productivity Annual Meeting,* Apr. 2–4, 2019. https://bit.ly/2UHXMda.
3. **B. MacKie-Mason**, P. Velesko, R. Hager, C.-S. Chang, and T.J. Williams, "Performance Optimization of the XGC code on KNL architecture", *Annual Meeting of the APS Division of Plasma Physics,* Nov. 5–9, 2018. https://goo.gl/wirgSu.
4. **B. MacKie-Mason**, Z. Peng, and C. Kung, "Extreme Fidelity Computational Electromagnetic Analysis in the Supercomputer Era", *The International Conference for High Performance Com-*

puting, Networking, Storage and Analysis, Salt Lake City, Utah, U.S.A., November 13–18, 2016. https://goo.gl/jeQSKR.

5. **B. MacKie-Mason**, W. Tang, "Modeling of laser-induced field emission", *Air Force Research Lab Annual Scholar Presentation,* Albuquerque, NM, July 2013. [Poster Unavailable].
6. **B. MacKie-Mason**, N. Lockwood, W. Tang, "Development of single-walled nanotube fiber cathode diagnostics", *Air Force Research Lab Annual Scholar Presentation,* Albuquerque, NM, July 2012. [Poster Unavailable].
7. **B. MacKie-Mason**, A. Greenwood, N. Lockwood, "Automated Testing of ICEPIC", *Air Force Research Lab Annual Scholar Presentation,* Albuquerque, NM, July 2011. [Poster Unavailable].

OTHER

1. **B. MacKie-Mason** and XGC Team, "Porting XGC to Aurora", *A21 Apps Working Group Meeting,* Argonne National Laboratory, IL, U.S.A., April 19, 2019. [Presentation Unavailable Until Aurora is Stood Up].
2. **B. MacKie-Mason**, "What Can KNL Do For You?", *CoPA Workshop on Deep-dive into XGC,* Princeton Plasma Physics Laboratory, NJ, U.S.A., Dec. 11–12, 2018. https://bit.ly/2MH3OFT.
3. **B. MacKie-Mason**, "What do I do?", *Argonne Computing Coffee & Code,* Argonne National Laboratory, IL, U.S.A., September 12, 2018. https://goo.gl/AtWQSD.
4. **B. MacKie-Mason** and Z. Peng, "Adaptive and parallel surface integral equation solvers for very large-scale electromagnetic modeling and simulation," *Electrical and Computer Engineering Student Paper Competition,* Albuquerque, NM, April 2016. https://goo.gl/aK2KUn.

TECHNICAL SKILLS

- **Academic**: Algorithm Development, High Performance Computing, Electromagnetic Analysis, Domain Decomposition Methods, Surface Integral Equation Methods, Scientific Computing, Particle-in-Cell
- **Languages**: Fortran, C/C++, MATLAB, Bash shell, Python
- **Programming Models**: MPI, OpenMP, (some) OpenACC
- **Software Packages**: ViSiT, CUBIT, KDevelop, SolidWorks (CAD), Intel VTUNE Amplifier
- (Well-known) **Research Codes**: Improved Concurrent Electromagnetic Particle-in-Cell (ICEPIC), X-Point Gyrokinetic Code
- **HPC Platforms**: Theta (ALCF), Cori-KNL (NERSC), JLSE (ALCF), Bebop (ANL), Mira (ALCF), Ulam (UNM), Summit (OLCF), Titan (OLCF), Excalibur (ARL), Topaz (ERDC)
- μ**Architectures**: Intel KNL, Intel's next generation

RESEARCH EXPERIENCE

Staff Research Scientist, Computational Electromagnetics *January 2023 - Present*
Senior Research Scientist, Computational Electromagnetics *April 2020 - Present*
Lockheed Martin Aeronautics
Skunk Works
Kendall Crouch

- Scientific Software Developer for 3D Method of Moments RCS Prediction Code
- PI for Domain Decomposition Methods
- TS Clearance

Postdoctoral Appointee, Computational Plasma Physics *March 2018 - March 2020*
Leadership Computing Facility
Argonne National Laboratory
Timothy J. Williams

- Optimize XGC code for Intel KNL architecture. 30% speed-up acheived on target kernel.
- Expert in electron push routine for XGC codebase. 70% of computational time.
- Investigate portability and suitability of XGC code for Aurora.
- Present research findings at inter/national conferences and meetings.
- Argonne Training Program for Extreme-Scale Computing (ATPESC) 2019 participant.

Research Assistant, Computational Electromagnetics *Fall 2013 - Spring 2018*
Electrical and Computer Engineering
University of New Mexico
Professor Zhen Peng

- Researched and developed a geometry-aware domain decomposition (GA-IE-DDM) method for the integral solution to extreme-scale, multi-scale electromagnetics problems.
- Developed tools to integrate many different solvers and post-processing techniques to aid in the solution of different types of antenna problems.
- Parallelized GA-IE-DDM in distributed memory environment for a scalable solution method to the Electric Field Integral Equation.
- Developed a model order reduction technique for solving electromagnetic radiation problems when many antennas are mounted on very large PEC platforms.

Research Assistant, Computational Electromagnetics *June 2013 - August 2013*
Air Force Research Lab
Directed Energy Directorate
Wilkin Tang

- Designed and analyzed input decks for laser-induced field emission in ICEPIC.
- Participated in the improvement of computational tools available to the research group.
- Presented research at laboratory symposium to other research scientists.

Research Assistant, Computational Electromagnetics *June 2012 - August 2012*
Air Force Research Lab
Directed Energy Directorate
Nathaniel Lockwood

- Designed diagnostics for field emission devices using simulation.
- Participated in the improvement of computational tools available to the research group.
- Presented research at laboratory symposium to other research scientists.

Research Assistant, Computational Electromagnetics *May 2011 - August 2011*
Air Force Research Lab
Directed Energy Directorate
Andrew Greenwood

- Converted scripts from C-shell to Python for the ICEPIC test suite.
- Designed Monte Carlo collision plasma tests for the ICEPIC test suite.
- Presented poster at Directed Energy Conference, August 2011.
- Presented research at laboratory symposium to other research scientists.

Lab Assistant, Nuclear Materials *May 2009 - August 2009*
Nuclear Engineering & Radiological Sciences
University of Michigan
Professor Gary Was
- Wrote MATLAB programs to smooth data and extract empirical modeling equations.
- Made schematic drawings of laboratory equipment using SolidWorks.
- Prepared for and attended lab group meetings.

Undergraduate Research Assistant, Information Sciences *March 2008 - May 2009*
School of Information
University of Michigan
Professor Yan Chen
- Conducted human subject computer laboratory experiments.
- Studied trends of Facebook start-up using SQL.

Lab Assistant, Information Sciences *March 2008 - May 2009*
School of Information
University of Michigan
Professor Yan Chen
- Assisted graduate students in their human subject computer laboratory experiments.
- Recruited subjects for experiments.
- Edited instructions for experiments.

REU Student, Information Sciences *May 2008 - July 2008*
School of Information
University of Michigan
Professor Yan Chen
- Investigated trends of Facebook start-up (urTurn.com) using SQL.
- Made a research presentation on urTurn.com.
- Attended career training seminars.

Lab Assistant *May 2007 - August 2007*
Department of Chemistry
University of Michigan
Professor Penner-Hahn
- Improved upon MATLAB algorithm that imaged microscopic worms.
- Assisted in series of experiments at Argonne National Laboratory.

Lab Assistant *June 2006 - July 2006*
Department of Biology
University of Michigan
Professor Sherman
- Prepared ocean floor samples for discovery of possible bacteria strains.
- Assisted graduate students in preparing laboratory experiments.

TEACHING EXPERIENCE

Graduate Teaching Assistant *August 2014 - December 2014*
Department of Electrical & Computer Engineering
University of New Mexico
- **ECE 561: Engineering Electrodynamics.** Provided selected lectures.

- **ECE 555: Foundations of Engineering Electromagnetics.** Provided selected lectures.
- **ECE 563: Computational Electromagnetics.** Provided selected lectures.
- **ECE 360: Introduction to Electromagnetics**:
  - Graded bi-weekly homework assignments.
  - Prepared and held weekly office hours.
  - Provided selected lectures.

- **ECE 131: Programming Fundamentals**:
  - Graded bi-weekly homework assignments.
  - Prepared for and held weekly office hours.

Graduate Teaching Assistant, EMA 201: Statics *January 2012 - May 2013*
Department of Engineering Physics
University of Wisconsin-Madison

- Prepared and taught two or three hours of discussion section each week.
- Held weekly office hours.
- Graded tests and assignments.
- Participated in bi-weekly planning sessions with other teaching assistants and lead instructor.

Teaching Assistant, Calculus *September 2006 - January 2007*
Department of Mathematics
Pioneer High School, Ann Arbor
Laurie Hochrein

- Graded extra credit assignments.
- Taught lessons on selected topics.
- Answered student questions.

Math Tutor *January 2006 - May 2006*

- Provdided tutoring for two middle school students in mathematics.
- Developed curriculum for tutoring sessions.

PROFESSIONAL SERVICE

Margaret Butler Review Committee	*March 2019*
INCITE Computational Readiness Review Committee	*2019*
Career Mentoring to High School Students	*2018-19*
International Journal of Antennas and Propagation	*Reviewer*
Waves in Random and Complex Media	*Reviewer*

PROFESSIONAL SOCIETIES

IEEE	*2015 - 2018*
SIAM	*2016 - 2018*
APS	*2018 - 2019*

CLEARANCES

Department of Defense Secret	*2012-2022*

AWARDS & HONORS

- UNM Leadership and Involvement Award, 2018.
- GPSA President's Award for Innovative Leadership, 2017.
- ECE Outstanding Graduate Student, 2017.
- Who's Who Among American Colleges & Universities, 2017.
- ECE GSA Student Paper Competition – Journal Paper Section, 3rd prize, 2016.
- Eagle Scout, February 2007.
- Michigan Peace Prize, January 2007.

OTHER EXPERIENCE

UNM GPSA *Fall 2015 - May 2018*

- GPSA Alternate Representative to Student Fee Review Board (July 2017 - May 2018)
- Department of ECE Delegate (August 2015 - May 2016, August 2016 - May 2017)
- GPSA Finance Committee Member (August 2016 - May 2017)
- GPSA Representative to Information Technology Committee (August 2015 - May 2016)
- Legislative Steering Committee Member-at-large (February 2016 - May 2016)
- Organized first annual department-wide student paper competition.
- Helped arrange for a regular meeting room within the department.

UNM ECE Graduate Student Association (GSA) *Fall 2015 - May 2017*

- ECE GSA Vice-President (June 2016 - May 2017)
- ECE GSA Volunteer Member (August 2015 - May 2016)

Alpha Sigma Phi *Fall 2007 - Present*

- Grand Chapter Advisor (November 2012 - May 2013)
- Financial Advisor (November 2012 - August 2014)
- Brotherhood Development Director (January 2011 - April 2011)
- Philanthropy Director (January 2009 - December 2010)
- Treasurer (January 2008 - December 2009)

Study Abroad in Argentina *June 2010 - August 2010*

- Attained an intermediate working knowledge of spoken and written Spanish.
- Gained extensive practice in intercultural interactions.

MPowered Entrepreneurship *September 2009 - December 2009*

- Member of team that planned Global Entrepreneurship week.
- Recruited entrants for 1000 Pitches contest.
- Promoted the philosophy of entrepreneurship throughout campus.

Youth Group of First United Methodist *September 2001 - June 2007*

- Leader within a high school team that raised $50,000 to build a church in Bulgaria.
- Part of team that won Michigan Peace Prize (2007) for filming a documentary on religious diversity.
- Participated in multiple service mission trips, including three international locations.

Boy Scouts of America *September 2000 - June 2007*

- Completed an Eagle Scout Service Project.
- Held various leadership positions, including Senior Patrol Leader.
- Participated in outdoor adventure activities with the Venture Patrol.
- Attended the 2001 National Scout Jamboree.
- Completed 25 skills-based merit badges.