Yang Liu

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RESEARCH INTERESTS

Computational Electromagnetics: fast time-domain and frequency-domain integral equation methods, butterfly-based direct solver for highly oscillatory problems, plane-wave-time-domain algorithm for solving large-scale transient scattering problems, multi-physics and multi-scale modeling, high performance computing, randomized matrix algorithms, compressive sensing, uncertainty quantification, data-driven simulation techniques.

EDUCATION

University of Michigan

- Ph.D., Electrical Engineering, May 2015
  Advisor: Eric Michielssen
  Thesis: Solving electrically very large transient electromagnetic problems using plane-wave time-domain algorithms
- M.S., Mathematics, Nov. 2014
- M.S., Electrical Engineering, May 2013

Shanghai Jiao Tong University

- B.S., Electrical Engineering, June 2010

HONORS AND AWARDS

- 1st Place in Student Paper Competition, 12th International Workshop on Finite Elements for Microwave Engineering, 2014
- 2nd Place in Student Paper Competition, 28th Annual Review of Progress in Applied Computational Electromagnetics, 2012
- Rackham Travel Grant, University of Michigan, 2012 to 2014
- Outstanding Graduate Award, Shanghai Jiao Tong University, 2010
- Third Prize in National Electronic Contest, China, 2009

PROFESSIONAL ACTIVITIES

- **Reviewer** for "International Journal of Numerical Modelling: Electronic Networks, Devices and Fields", "Journal of Applied Computational Electromagnetics Society", and "Journal of Microwaves, Optoelectronics and Electromagnetic Applications".
- **Session Chair** for "Time-Domain Numerical Methods," IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, 2012.
- **Session Judge** for the 10th Annual Engineering Graduate Symposium, University of Michigan, 2015.
- **Steering Committee** for "Celebrating Maxwell's Equations: 150 years" workshop, 2015.
- **Secretary** for Technical Activities Committee, IEEE Southeastern Michigan Section.
- **Treasurer** for Chapter IV, IEEE Southeastern Michigan Section.

RESEARCH EXPERIENCE

Research Fellow, University of Michigan, June 2015 - Present

- Invent fast randomized algorithms for arbitrary-level butterfly factorizations.
- Develop butterfly-based low-complexity direct frequency-domain integral equation solvers for high-frequency electromagnetic problems.

Research Assistant, University of Michigan, Sept. 2010 - May 2015

- Create provably scalable parallel plane-wave-time-domain algorithms for accelerating time-domain surface and volume integral equation solvers.
- Create a wavelet-enhanced plane-wave-time-domain algorithm-accelerated surface integral equation solver for transient problems involving quasi-planar objects.

Undergraduate Researcher, Shanghai Jiao Tong University, Apr. 2009 - June 2010

- Develop a two-dimensional ADE-FDTD algorithm for numerical modeling the ELF wave propagation in ionosphere.
- Develop a robust compressive sensing algorithm for joint signal recovery in cognitive radio networks.

TEACHING
EXPERIENCE

Teaching Assistant, Shanghai Jiao Tong University, Mar. 2009 - June 2009

- Instruct students in FPGA programming for digital circuit designs.

REFEREED
JOURNAL
PUBLICATIONS

[1] **Y. Liu**, H. Guo, and E. Michielssen, "A HSS matrix-inspired butterfly-based direct solver for analyzing scattering from two-dimensional objects," *IEEE Antennas Wireless Propag. Lett.* (submitted) arXiv:1608.01235.

[2] H. Guo, **Y. Liu**, J. Hu, and E. Michielssen, "A butterfly-based direct integral equation solver using hierarchical LU factorization for analyzing scattering from electrically large conducting objects," *IEEE Trans. Antennas Propag.,* (submitted) arXiv:1610.00042.

[3] **Y. Liu**, H. Guo, and E. Michielssen, "Randomized algorithms for butterfly factorization," *SIAM J. Sci. Comput.,* (submitted).

[4] **Y. Liu**, A. C. Yucel, H. Bagci, A. C. Gilbert, and E. Michielssen, "Wavelet-enhanced plane-wave time-domain algorithm for analysis of transient scattering from electrically large conducting objects," *IEEE Trans. Antennas Propag.,* (submitted).

[5] **Y. Liu**, A. Al-Jarro, H. Bagci, and E. Michielssen, "Parallel PWTD-accelerated explicit solution of the time domain electric field volume integral equation," *IEEE Trans. Antennas Propag.,* 2016. doi:10.1109/TAP.2016.2546964

[6] **Y. Liu**, A. C. Yucel, H. Bagci, and E. Michielssen, "A scalable parallel PWTD-accelerated surface integral equation solver for analysis of transient scattering from large-scale objects," *IEEE Trans. Antennas Propag.,* 2016. doi:10.1109/TAP.2015.2508483

[7] **Y. Liu**, A. C. Yucel, V. Lomakin, and E. Michielssen, "Graphics processing unit implementation of multilevel plane-wave time-domain algorithm," *IEEE Antennas Wireless Propag. Lett.,* vol. 1, pp. 1-1, 2014. doi:10.1109/LAWP.2014.2350967

[8] A. C. Yucel, **Y. Liu**, H. Bagci, and E. Michielssen, "Statistical characterization of electromagnetic wave propagation in mine environments," *IEEE Antennas Wireless Propag. Lett.,* vol. 12, pp. 1602-1605, 2013. doi:10.1109/LAWP.2013.2293288

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PREPARATION

[9] H. Guo, **Y. Liu**, J. Hu, and E. Michielssen, "A butterfly-based direct solver using hierarchical LU factorization for PMCHWT equation," *IEEE Trans. Antennas Propag.*

CONFERENCE
PUBLICATIONS

[1] **Y. Liu**, H. Guo, and E. Michielssen, "A new MLMDA-based direct integral equation solver for electrically perfect conducting objects," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2016.

[2] **Y. Liu**, H. Guo, and E. Michielssen, "A new butterfly reconstruction method for MLMDA-

based direct integral equation solvers," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2016.

[3] **Y. Liu**, A. C. Yucel, A. C. Gilbert, H. Bagci, and E. Michielssen, "A wavelet-based PWTD algorithm-accelerated time domain surface integral equation solver," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2015.

[4] A. C. Yucel, **Y. Liu**, H. Bagci, and E. Michielssen, "An FMM-FFT accelerated integral equation solver for characterizing electromagnetic wave propagation in mine tunnels and galleries loaded with conductors," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2014.

[5] **Y. Liu**, A. C. Yucel, H. Bagci, and E. Michielssen, "A parallel wavelet-enhanced PWTD algorithm for analyzing transient scattering from electrically very large PEC targets," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2014.

[6] **Y. Liu**, A. C. Yucel, H. Bagci, and E. Michielssen, "Parallel time domain solvers for electrically large transient scattering problems," **invited talk**, in *Proc. EUCAP,* 2014.

[7] A. C. Yucel, L. Gomez, **Y. Liu**, H. Bagci, and E. Michielssen, "A FMM-FFT accelerated hybrid volume surface integral equation solver for electromagnetic analysis of re-entry space vehicles," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2014.

[8] **Y. Liu**, A. C. Yucel, H. Bagci, and E. Michielssen, "Parallel multilevel PWTD-enhanced time domain integral equation solvers," in *Proc. SC13,* 2013.

[9] H. Guo, **Y. Liu**, H. Jun, and E. Michielssen, "A parallel MLMDA-based direct integral equation solver," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2013.

[10] A. C. Yucel, **Y. Liu**, H. Bagci, and E. Michielssen, "A fast-multipole domain decomposition integral equation solver for characterizing electromagnetic wave propagation in mine environments," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2013.

[11] **Y. Liu**, H. Bagci, and E. Michielssen, "Progress in parallel implementation of the multilevel plane wave time domain algorithm," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2013.

[12] **Y. Liu**, H. Bagci, and E. Michielssen, "Solving very large scattering problems using a parallel PWTD-enhanced surface integral equation solver," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2013.

[13] **Y. Liu**, A. Al-Jarro, H. Bagci, and E. Michielssen, "Parallel, explicit, and PWTD-enhanced time domain volume integral equation solver," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2013.

[14] **Y. Liu**, V. Lomakin, and E. Michielssen, "Graphics processing unit-accelerated implementation of the plane wave time domain algorithm," *28th Ann. Rev. Prog. Appl. Computat. Electromagn.,* 2012.

[15] **Y. Liu**, A. C. Yucel, V. Lomakin, and E. Michielssen, "A scalable parallel implementation of the plane wave time domain algorithm on graphics processing unit-augmented clusters," in *Proc. IEEE Int. Symp. AP-S/URSI,* 2012.

[16] J. Liang, **Y. Liu**, W. Zhang, Y. Xu, X. Gan, and X. Wang, "Joint compressive sensing in wideband cognitive networks," in *Proc. IEEE WCNC,* 2010.

APPLICABLE
SKILLS

- Computer Programming: Fortran, C, C++, ASM, Verilog, VHDL, Python
- Numerical Analysis: Matlab, R, Mathematica
- Electromagnetic and other relevant Softwares: CST, ADS, HFSS, FEKO, COMSOL, ProE, Solidworks