

# Yang Liu

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## RESEARCH INTERESTS

**Scientific Computing:** fast direct and iterative solvers for highly oscillatory problems, randomized butterfly algebras, parallel computing algorithms, compressive sensing, uncertainty quantification, fast algorithms for data science applications.

**Computational Electromagnetics:** FMM and butterfly-based integral equation solvers for large-scale electromagnetic problems, scalable parallelization and multi-resolution algorithms for large-scale transient problems, multi-physics and multi-scale modeling.

## 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

- 1<sup>st</sup> Place in Student Paper Competition, 12th International Workshop on Finite Elements for Microwave Engineering, 2014
- 2<sup>nd</sup> 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”, “International Journal of Antennas and Propagation”, “The Open Electrical and Electronic Engineering Journal”, 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.

## RESEARCH EXPERIENCE

**Postdoctoral Research Fellow**, University of Michigan, June 2015 - Present

- Develop randomized algorithms for butterfly factorizations and butterfly-based fast direct integral equation solvers for high-frequency Helmholtz problems.

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

- Develop provably scalable and wavelet-enhanced plane-wave-time-domain algorithms for integral equation analysis of large-scale transient problems.

#### 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.* 2016. doi:10.1109/LAWP.2016.2626786
- [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

#### IN 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 HSS-type butterfly-based direct integral equation solver for 3D perfect electrically conducting objects," in *Proc. IEEE Int. Symp. AP-S/URSI*, 2017.
- [2] **Y. Liu**, H. Guo, and E. Michielssen, "A linear-complexity randomized butterfly scheme for direct integral equation solvers," in *Proc. IEEE Int. Symp. AP-S/URSI*, 2017.
- [3] W. Sheng, H. Guo, **Y. Liu**, A. C. Yucel, and E. Michielssen, "A butterfly-based domain decomposition SIE simulator for EM analysis of wireless communication systems in mine environments," in *Proc. IEEE Int. Symp. AP-S/URSI*, 2017.
- [4] **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.

- [5] **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.
- [6] **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.
- [7] 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.
- [8] **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.
- [9] **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.
- [10] 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.
- [11] **Y. Liu**, A. C. Yucel, H. Bagci, and E. Michielssen, “Parallel multilevel PWTD-enhanced time domain integral equation solvers,” in *Proc. SC13*, 2013.
- [12] 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.
- [13] 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.
- [14] **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.
- [15] **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.
- [16] **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.
- [17] **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.
- [18] **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.
- [19] 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