Boyuan Zhang

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Education Background

- **Purdue University** *West Lafayette, IN*
  Ph.D. Candidate *in Electrical Engineering* (GPA: 3.86/4.0)*, advised by Prof. Weng Cho Chew* *2018-present*
- **Tsinghua University** *Beijing, China*
  Ph.D. *in Electrical Engineering* (GPA: 3.75/4.0) *2012-2018*
- **North China Electric Power University** *Baoding, China*
  B.E. *with First Honor in Electrical Engineering* (GPA: 92/100) *2008-2012*

Work Experience

- **Intern-Hardware Engineer (Power Integrity) at Apple, Cupertino, CA** *Summer 2023*
  - Studied the on-die fast voltage droop characterization methodology.
  - Supported creating automation flow for batch calibration, data collection and post-process.
  - Developed automation scripts for both developer and user versions.
  - Achieved excellent measurement to simulation droop correlation through the automation flow.
  - Explored automation capability for advanced features and chip compatibiltiy.
- **Intern-Software Engineer at Cadence Design Systems, San Jose, CA** *Summer 2020*
  - Implementation of Huygens Equivalence Principle in near-far field transformation based on C++ platform.
  - Accuracy comparsion between Huygens Equivalence Principle and numerical interpolation.
- **Intern-Software Engineer at Siemens EDA, Wilsonville, OR** *Summer 2019*
  - Implemented discrete exterior calculus in circuit parameter extraction (R, G and C) for SIPI purposes.
  - Research and application on second order accuracy variational electrostatic formulation in finite difference analysis.

- **Teaching Assistant, Purdue University** *2020-present*
  - Electromagnetic Field Theory (ECE 604)
  - Plane Analytic Geometry and Calculus I (MA 161)
  - Multivariate Calculus (MA 261)

Major Research Experience

- **Broadband Discrete Exterior Calculus (DEC) Method in Solving A-Φ Formulation** *2018-present*
  - Developed a new algorithm in computation electromagnetics which solves the **A**-Φ formulation using DEC.
  - The DEC **A**-Φ full-wave solver is inherently broadband stable (from DC to optics), which is extremely important in multi-scale analysis.
  - Different boundary conditions (PEC, PMC, Periodic BC, Impedance BC and PML) have been studied and implemented.
- **A-Φ Formulation DEC Broadband Field Solver for Circuit Parameter Extration** *2020-present*
  - Implemented the DEC **A**-Φ algorithm with matrix-free, iterative solver using C++ to make the solver suitable for large-scale industry problems.

- Studied and implemented an efficient preconditioner for quasi-static circuit parameter extraction problems.
- Circuit parameters R, G, L and C can be extracted over a broad spectrum using the full-wave solver.

- **Nested Dissection Ordering (NDO) Preconditioning with Low-Rank Approximation** *2021-present*
  - Implemented NDO technique in numerical solvers, such as DEC and finite difference method, as direct matrix inversion solver.
  - Introduced low-rank approximation to NDO for general complex-valued, non-Hermitian, indefinite matrix system generated by DEC. Reduced the time cost complexity from $O(N^3)$ to $O(N \log N)$ for the 3D DEC fullwave solver.

- **Fast Evaluating the Lightning EM Field and Its Impact on Power System** *2013-2018*
  - The lightning EM field is evaluated by using asymtotic expressions and contour integrals.
  - A novel semi-analytical Fourier transform technique is proposed and implemented in the evaluation of lightning EM field.

- **Modeling of Pulse Transformer Using Vector Fitting Technique** *2012-2013*
  - Proposed a wide spectrum model in both frequency domain and time domain for rail track circuit based on Vector Fitting Technique.
  - Time domain reponse of rail track circuit is simulated and analyzed.

Skill Set

- **Programming Skill:** C/C++, MatLab, Python, TCL.
- **Simulation Tool:** COMSOL Multiphysics, CST Microwave Studio, HFSS.

Coursework and Projects

- **Electromagnetic Field Theory**
  - Theory of EM field, Transmission Lines, Waveguides and Cavities.
  - Basics for Computational EM, Finite Difference Method.

- **RF Circuit and System Design**
  - S-parameters, ABCD Matrices, Smith Chart, SNR, SIR, Advanced Transmission Line Theory.
  - Filter Design, System Loss Reduction, Low Noise Amplifier Design and Stability Analysis.

- **Computational Electromagnetics**
  - Numerical Algorithms in Computational EM, Finite Difference Method, Finite Element Method and Integral Equation Solvers.
  - Common Issues in CEM, Numerical Stability, Numerical Dispersion, Efficient Implementations.

Honors, Awards & Fellowships

- **Young Scientist Award** *2023*
  URSI International Symposium on Electromagnetic Theory 2023 *Vancouver, Canada*

- **Best Student Paper Award (1st Place)** *2021*
  Progress In Electromagnetics Research Symposium (PIERS) *Hangzhou, China*

- **China National Scholarship** *2017*
  Tsinghua University *Beijing, China*

- **NCEPU Presidential Scholarship** *2011*
  North China Electric Power University *Baoding, China*
- **Meritorious Winner in Mathematical Contest in Modeling** *2011*
  Consortium for Mathematics and Its Applications (COMAP) *Bedford, MA*
- **China National Scholarship** *2010*
  North China Electric Power University *Baoding, China*

Selected Publications and Conference Talks

[*P*.1] **B. Y. Zhang** and W. C. Chew, "A Modified Sparsified Nested Dissection Ordering Preconditioner for Discrete Exterior Calculus Solver Using Vector-Scalar Potentials," *Progress In Electromagnetics Research*, under review.

[*P*.2] **B. Y. Zhang**, D. Y. Na, D. Jiao and W. C. Chew, "An **A**-Φ formulation solver in electromagnetics based on discrete exterior calculus," *IEEE Journal on Multiscale and Multiphysics Computational Techniques*, vol. 8, 2022.

[*P*.3] **B. Y. Zhang**, J. Zou, X. L. Du, J. B. Lee and M. N. Ju, "Ground admittance of an underground insulated conductor and its characteristic in lightning induced disturbance problems," *IEEE Trans. on Electromagnetic Compatibility*, vol. 59, 2017.

[*P*.4] J. B. Lee, **B. Y. Zhang**, J. Zou and M. N. Ju, "Efficient evaluation of earth return impedances of arbitrary conductor arrangements with a horizontally multilayered soil," *IEEE Trans. on Electromagnetic Compatibility*, vol. 59, 2017.

[*P*.5] **B. Y. Zhang**, J. Zou, J. B. Lee and M. N. Ju, "A Hermite interpolation model for reconstructing the frequency spectrum of the lightning horizontal electric field," *COMPEL: The International Journal for Computation and Mathematics in Electrical and Electronic Engineering*, vol. 35, 2016.

[*P*.6] **B. Y. Zhang**, J. S. Yuan, J. Zou, J. B. Lee and M. N. Ju, "Semianalytical approach to the inverse Fourier transform and its application in evaluating lightning horizontal electric field," *IEEE Trans. on Electromagnetic Compatibility*, vol. 58, 2016.

[*P*.7] **B. Y. Zhang**, K. Zhao and J. Zou, "Calculation and analysis of lighting overvoltage for foil-wound air-core reactors," *High Voltage Engineering*, vol. 42, 2016.

[*P*.8] J. Zou, **B. Y. Zhang**, X. Du, J. B. Lee and M. N. Ju, "High-efficient evaluation of the lightning electromagnetic radiation over a horizontally multilayered conducting ground with a new complex integration path," *IEEE Trans. on Electromagnetic Compatibility*, vol. 56, 2014.

[*P*.9] J. Zou, C. Zhou, **B. Y. Zhang**, J. B. Lee and S Chang, "An Efficient and Generalized Algorithm for Calculating the Earth Return Impedance With Pollaczek Integral Using the Moment Technique," *IEEE Trans. on Electromagnetic Compatibility*, vol. 55, 2013.

[*T*.1] **B. Y. Zhang** and W. C. Chew, "A broadband discrete exterior calculus **A**-Φ formulation solver with sparsified nested dissection ordering preconditioner," 2023 *IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting*, Portland, OR, USA, July 2023.

[*T*.2] **B. Y. Zhang**, D. Y. Na, D. Jiao and W. C. Chew, "An inherently broadband **A**-Φ formulation solver in electromagnetics based on discrete exterior calculus," 2023 *URSI International Symposium on Electromagnetic Theory*, Vancouver, Canada, May 2023.

[*T*.3] **B. Y. Zhang**, D. Y. Na, D. Jiao and W. C. Chew, "A broadband **A**-Φ formulation solver based on discrete exterior calculus," 2022 *IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting*, Denver, CO, USA, July 2022.

[*T*.4] **B. Y. Zhang**, D. Jiao and W. C. Chew, "Implementation of discrete exterior calculus in solving the **A**-Φ formulation," 2021 *IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting*, Marina Bay Sands, Sinapore, December 2021.

[*T*.5] **B. Y. Zhang**, D. Y. Na, D. Jiao and W. C. Chew, "An **A**-Φ formulation solver in electromagnetics based on discrete exterior calculus," 2021 *Photonics and Electromagnetics Research Symposium (PIERS)*, Hangzhou, China, November 2021.

[*T*.6] **B. Y. Zhang**, W. C. Chew, D. Jiao and H. Gan, "Numerical mode decomposition for the **A**-Φ formulation with inhomogeneous media," 2020 *IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting*, Montréal, Canada, July 2020.