

# ZHENGQI, GAO

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## EDUCATION

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### Massachusetts Institute of Technology

Cambridge, USA

*Ph.D. in Electrical Engineering and Computer Science*

Sep 2021 – Apr 2026 (Expected)

- GPA: 5.00/5.00 (Rank: NA); work with Prof. Duane S. Boning
- Research interests: statistical metrology, design automation for photonic/electronic integrated circuits, and applied machine learning

### Fudan University

Shanghai, China

*M.S. in Microelectronics and Solid State Electronics*

Sep 2018 – Jun 2021

- GPA: 3.82/4.00 (Rank: NA); worked with Prof. Jun Tao and Prof. Xin Li (Duke Univ.)
- Research interests: electronic design automation (EDA), Bayesian methods, and machine learning

*B.E. in Microelectronic Science and Engineering*

Sep 2014 – Jun 2018

- GPA: 3.84/4.00 (Rank: 4/71); selected to Elite Engineering Program (top 5%)
- Relevant coursework: Mathematical Analysis, Probability, Mathematical Statistics and Stochastic Process, Signal and System, Data Structure and Algorithm Design, Design of Analog Integrated Circuits

## PUBLICATIONS

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### Machine Learning

1. **Z. Gao**, K. Zha, T. Zhang, Z. Xue, D. S. Boning, “REG: Rectified Gradient Guidance for Conditional Diffusion Models,” *International Conference on Machine Learning (ICML)*, 2025. [\[PDF\]](#)
2. S. Zheng\*, **Z. Gao\***, F.-K. Sun, D. S. Boning, B. Yu, M. Wong, “Improving Neural ODE Training with Temporal Adaptive Batch Normalization,” *Conference on Neural Information Processing Systems (Neurips)*, 2024. (\* indicates equal contribution)
3. H. Lin, C. Liu, C. Xu, **Z. Gao**, Yanwei Fu, Yuan Yao, “On the Theory of Cross-Modality Distillation with Contrastive Learning,” *International Conference on Learning Representations BGPT workshop*, 2024. [\[PDF\]](#)
4. C.-Y. Lai, F.-K. Sun, **Z. Gao**, J. Lang, and D. S. Boning, “Nominality Score Conditioned Time Series Anomaly Detection by Point/Sequential Reconstruction,” *Conference on Neural Information Processing Systems (Neurips)*, 2023. [\[PDF\]](#)[\[Code\]](#)
5. Z. Xue\*, **Z. Gao\***, S. Ren\*, and H. Zhao, “The Modality Focusing Hypothesis: Towards Understanding Crossmodal Knowledge Distillation,” *International Conference on Learning Representations (ICLR spotlight/oral, top 5%)*, 2023. [\[PDF\]](#) [\[Code\]](#) (\* indicates equal contribution)
6. **Z. Gao**, F. Sun, M. Yang, S. Ren, Z. Xiong, M. Engeler, A. Burazer, L. Wildling, L. Daniel, and D. S. Boning “Learning from Multiple Annotator Noisy Labels via Sample-wise Label Fusion,” *European Conference on Computer Vision (ECCV)*, 2022. [\[PDF\]](#) [\[Code\]](#)
7. J. Gu, **Z. Gao**, C. Feng, H. Zhu, R. T. Chen, D. S. Boning, and D. Z. Pan, “NeurOLight: A Physics-Agnostic Neural Operator Enabling Parametric Photonic Device Simulation,” *Conference on Neural Information Processing Systems (Neurips)*, 2022. [\[PDF\]](#) [\[Code\]](#)
8. **Z. Gao**, S. Ren, Z. Xue, and H. Zhao, “Training-Free Robust Multimodal Learning via Sample-Wise Jacobian Regularization,” *Arxiv Preprint*, 2022. [\[PDF\]](#)
9. S. Ren, H. Wang, **Z. Gao**, S. He, A. Yuille, Y. Zhou and C. Xie, “A Simple Data Mixing Prior for Improving Self-Supervised Learning,” *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, Jun. 2022. [\[PDF\]](#) [\[Code\]](#)
10. S. Ren, **Z. Gao**, T. Hua, Z. Xue, Y. Tian, S. He and H. Zhao, “Co-Advise: Cross Inductive Bias Distillation,” *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, Jun. 2022. [\[PDF\]](#) [\[Code\]](#)
11. Z. Xue, S. Ren, **Z. Gao** and H. Zhao, “Multimodal Knowledge Expansion,” *IEEE International Conference on Computer Vision (ICCV)*, Oct. 2021. [\[PDF\]](#) [\[Code\]](#)

### Design Automation for Photonic/Electronic Integrated Circuits

1. **Z. Gao**, Z. Zhang, Z. He, J. Gu, D. Z. Pan, and D. S. Boning, "Selecting robust silicon photonic designs after Bayesian optimization without extra simulations," *Optica Express (OE)*, 2024. (highlighted as an editor's pick) [\[PDF\]](#)
2. **Z. Gao**, F. Sun, R. Rohrer, and D. S. Boning, "KirchhoffNet: A Scalable Ultra Fast Analog Neural Network," *IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*, Oct. 2024 [\[PDF\]](#)[\[Code\]](#)
3. **Z. Gao**, X. Chen, Z. Zhang, U. Chakraborty, W. Bogaerts, and D. S. Boning, "Gradient-Based Power Efficient Functional Synthesis for Programmable Photonic Circuits," *IEEE Journal of Lightwave Technology (IEEE JLT)*. [\[PDF\]](#)
4. **Z. Gao**, D. Zhang, L. Daniel, and D. S. Boning, "NOFIS: Normalizing Flow for Rare Circuit Failure Analysis," *Design Automation Conference (DAC)*, 2024. (MARC 2024 Best Pitch Award) [\[PDF\]](#)[\[Code\]](#)
5. **Z. Gao**, X. Chen, Z. Zhang, C. Y. Lai, U Chakraborty, W. Bogaerts, and D. S. Boning, "Provable Routing Analysis of Programmable Photonics," *IEEE Journal of Lightwave Technology (IEEE JLT)*. [\[PDF\]](#)
6. **Z. Gao**, Z. Zhang, and D. S. Boning, "Few-Shot Bayesian Performance Modeling for Silicon Photonic Devices Under Process Variation," *IEEE Journal of Lightwave Technology (IEEE JLT)*. [\[PDF\]](#)
7. J. Li\*, D. Ahsanullah\*, **Z. Gao\***, and R. Rohrer, "Circuit Theory of Time Domain Adjoint Sensitivity," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (IEEE TCAD)*. [\[PDF\]](#) (\* indicates equal contribution)
8. Z. Zhang, M. Notaros, **Z. Gao**, U. Chakraborty, J. Notaros, and D. S. Boning, "Impact of process variations on splitter-tree-based integrated optical phased arrays," *Optica Express (OE)*. [\[PDF\]](#)
9. **Z. Gao**, X. Chen, Z. Zhang, U. Chakraborty, W. Bogaerts, and D. S. Boning, "Automatic Synthesis of Light Processing Functions for Programmable Photonics: Theory and Realization," *Photonics Research* (highlighted as an editor's pick). [\[PDF\]](#) [\[Code\]](#)
10. C. Li, C. An, **Z. Gao**, F. Yang, Y. Su and X. Zeng, "Unleashing the Power of Graph Spectral Sparsification for Power Grid Analysis via Incomplete Cholesky Factorization," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (IEEE TCAD)*. [\[PDF\]](#)
11. **Z. Gao**, X. Chen, Z. Zhang, U. Chakraborty, W. Bogaerts, and D. S. Boning "Automatic Synthesis of Light Processing Functions for Programmable Photonics," *IEEE Photonics Conference (IEEE IPC)*, 2022. [\[PDF\]](#)
12. **Z. Gao**, Z. Zhang and D. S. Boning, "Automatic Synthesis of Broadband Silicon Photonic Devices via Bayesian Optimization," *IEEE Journal of Lightwave Technology (IEEE JLT)*. [\[PDF\]](#)[\[Code\]](#)
13. **Z. Gao**, Z. Zhang and D. S. Boning, "Automatic Design of a Broadband Directional Coupler via Bayesian Optimization," *Conference on Lasers and Electro-Optics (CLEO)*, 2022. [\[PDF\]](#)
14. Z. Liang, H. Wang, J. Cheng, Y. Ding, H. Ren, **Z. Gao**, Z. Hu, D. S. Boning, X. Qian, S. Han, W. Jiang, and Y. Shi "Variational Quantum Pulse Learning," *IEEE International Conference on Quantum Computing and Engineering (IEEE QCE)*, 2022. [\[PDF\]](#)
15. **Z. Gao** and R. Rohrer, "Efficient Non-Monte-Carlo Yield Estimation," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (IEEE TCAD)*. [\[PDF\]](#)
16. **Z. Gao**, J. Tao, Y. Su, D. Zhou, X. Zeng and X. Li, "Fast Statistical Analysis of Rare Failure Events with Truncated Normal Distribution in High-Dimensional Variation Space," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (IEEE TCAD)*. [\[PDF\]](#)
17. **Z. Gao**, Z. Chen, J. Tao, Y. Sun, D. Zhou, and X. Zeng, "Bayesian Inference on Introduced General Region: An Efficient Parametric Yield Estimation Method for Integrated Circuits," *ACM/IEEE Asia and South Pacific Design Automation Conference (ASPDAC)*, Jan. 2021. [\[PDF\]](#)
18. **Z. Gao**, J. Tao, D. Zhou, X. Zeng and X. Li, "Efficient Rare Failure Analysis over Multiple Corners via Correlated Bayesian Inference," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (IEEE TCAD)*, Oct. 2020. [\[PDF\]](#) [\[Code\]](#)
19. **Z. Gao**, J. Tao, D. Zhou and X. Zeng, "Efficient Parametric Yield Estimation over Multiple Process Corners via Bayesian Inference Based on Bernoulli Distribution," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (IEEE TCAD)*, Oct. 2020. [\[PDF\]](#) [\[Code\]](#)
20. J. Shi, **Z. Gao**, J. Tao, Y. Su, D. Zhou and X. Zeng, "Multi-Corner Parametric Yield Estimation via Bayesian Inference on Bernoulli Distribution with Conjugate Prior," *IEEE International Symposium on Circuits and*

- Systems (ISCAS)*, Oct. 2020. [[PDF](#)]
21. Y. Li, X. Zeng, **Z. Gao**, L. Lin, J. Tao, J. Han, X. Cheng, M. Tahoori and X. Zeng, “Exploring A Bayesian Optimization Framework Compatible with Digital Standard Flow for Soft-Error-Tolerant Circuit,” *IEEE/ACM Design Automation Conference (DAC)*, Jul. 2020. [[PDF](#)]
  22. **Z. Gao**, J. Tao, Y. Su, D. Zhou and X. Zeng, “Projection Based Active Gaussian Process Regression for Pareto Front Modeling,” *Arxiv Preprint*. [[PDF](#)]
  23. **Z. Gao**, J. Tao, F. Yang, Y. Su, D. Zhou and X. Zeng, “Efficient Performance Trade-Off Modeling for Analog Circuit Based on Bayesian Neural Network,” *IEEE/ACM International Conference on Computer Aided Design (ICCAD)*, Nov. 2019. [[PDF](#)]
  24. J. Tao, **Z. Gao**, D. Zhou and X. Zeng, “Efficient Statistical Analysis for Correlated Rare Failure Events,” *IEEE International Conference on Solid-State and Integrated Circuit Technology (ICSICT)*, Nov. 2018. [[PDF](#)]

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## RESEARCH EXPERIENCE

- Massachusetts Institute of Technology** Cambridge, USA  
*Research Assistant to Prof. Duane S. Boning* Sep 2021 – Jun 2026 (expected)
- Researched on automatic light processing functions synthesis on programmable photonics
  - Optimized silicon photonic devices via Bayesian optimization
  - Analyze the error of a photonic-electronic AI chip
- Shanghai Qizhi Institute** Shanghai, China  
*Research Assistant to Prof. Hang Zhao* Mar 2021 – Jun 2021
- Exploited multimodal learning under knowledge distillation
  - Developed a method to address adversarial attack by utilizing the multimodal data
- Southern Methodist University** Remotely  
*Research Assistant to Prof. Ron Rohrer* May 2020 – Sep 2021
- Built a power grid DC simulator for the electromigration problem
  - Analyzed parametric yield based on the adjoint method
- Fudan University (State Key Laboratory of ASIC & System)** Shanghai, China  
*Research Assistant to Prof. Jun Tao (in collaboration with Prof. Xin Li)* Sep 2016 – Jul 2021
- Improved post-silicon yield estimation with the domain adaptation technique
  - Estimated multi-corner failure rate and yield with Bayesian inference
  - Modeled performance trade-off of analog circuits based on a Bayesian neural network
  - Optimized a time variant analog filter by hierarchical clustering (bachelor thesis)
  - Developed an SRAM failure-rate estimation tool in collaboration with Prof. Xuan Zhang (WUSTL) [[see here](#)]

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## TEACHING AND INTERNSHIPS

- Apple** Sunnyvale, USA  
*Hardware Intern* May 2025 – Aug 2025
- Interned in Apple AR/VR display team.
- Massachusetts Institute of Technology** Cambridge, USA  
*Teaching Assistant* Feb 2025 – May 2025
- Performed TA duties for 6.3900 Introduction to Machine Learning (~400 students).
- Nvidia Corporation** Austin, USA  
*Research Intern* Jun 2023 – Sep 2023
- Developed deep neural network model for semiconductor lithography (manager: Mark Ren)
  - Produced a large-scale image translation model (> 1GB) based on Pixel2Pixel and model compression technique
  - Achieved <0.02% MSE error on Nvidia proprietary chip layout dataset containing over 3M images
- Fudan University (FDU) and Duke Kunshan University (DKU)** China  
*Teaching Assistant* Sep 2019 – Mar 2020
- Performed TA duties for Design of Analog Integrated Circuits at FDU (instructor: Prof. Jun Xu) and Introduction to Programming & Data Structure at DKU (instructor: Prof. Dennis Quan [Duke Univ.])
- Baidu Inc.** Shanghai, China  
*Quality Assurance (QA) Engineering Intern* Jun 2017 – Sep 2017

- Measured the robustness of programs and took charge of the FEEDS project

## SELECTED AWARDS AND HONORS

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- Editor's highlight, Optica Express 2024
- ML and Systems Rising Star, MLCommons (41 out of 170) 2024
- Best Pitch Award, Microsystem Annual Research Conference (4 out of ~60) 2024
- Oral(Spotlight) paper, International Conference on Learning Representations (top 5%) 2023
- Editor's highlight, Optica Photonics Research 2023
- 2<sup>nd</sup> place, CVPR'23 Ego4d TTM challenge 2023
- DAC young fellowship 2023
- Outstanding Graduates of Shanghai (top 5%) 2021
- Biren Scholarship (3 awardees nationwide) 2020
- The Integrated Circuits Scholarship, Chinese Institute of Electronics (44 awardees nationwide) 2020
- National Scholarship, Fudan University (top 1%) 2020
- Rising Star of Academic, Fudan University (awarded to 11 graduate students majoring in Sci. & Engi.) 2020
- Pacemaker to Merit Student, Fudan University (awarded to 15 graduate students) 2019
- First Prize Scholarship, Fudan University (top 5%) 2019
- National Gold Award, China "Internet+" College Student Innovation & Entrepreneur Competition(top 5%) 2018
- National 2<sup>nd</sup> Prize, China Post-Graduate Mathematical Contest in Modeling (top 15%) 2018
- Outstanding Undergraduates of Shanghai (top 5%) 2018
- Meritorious Winner, American Mathematical Contest in Modeling (top 13%) 2017
- Top 11%, 2017 IEEE Xtreme Global Programming Competition (out of 3,350 teams worldwide) 2017
- First Prize Scholarship, Fudan University (top 5%) 2015, 2016, 2017
- National 2<sup>nd</sup> prize, China Mathematical Contest in Modeling (top 15%) 2016

## REPRESENTATIVE PROJECTS

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**PRML Solution Manual (GitHub 900+ Stars)** Shanghai, China  
*An Original Solution Manual for Pattern Recognition and Machine Learning (PRML)* Sep 2017 – Present

- Solved nearly all exercises in *PRML* [[see here](#)]
- Communicated with people globally via email, helping them solve problems relevant to *PRML*

**Auto-Grading System** Kunshan, China  
*An Auto-Grading System Developed at DKU* Jan 2020 – Mar 2020

- Led a small TA group to peruse the source code of Submittly
- Developed a fully automatic grading system based on Submittly

**"Dr. Stanley's House" (Puzzle Video Game) Written in Haskell** Shanghai, China  
*Final Project for Introduction to Functional Programming: From C/C++ to Haskell* Sep 2018 – Jan 2019

- Implemented the game with a complete plot via Haskell [[see here](#)]
- Organized the program structure, sorted the logic, and set the schedule as the team leader
- Exploited Haskell libraries (e.g., SDL2, SDL2-ttf, and SDL2-mixer) to add music and animation

## ADDITIONAL INFORMATION

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### Computer and Language Skills

- **Programming languages & Software:** C/C++, MATLAB, Python, Linux, HSPICE, SPECTRE, Lumerical
- **Languages:** Mandarin Chinese (native), English (proficient)

## PROFESSIONAL SERVICES

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- **Independent reviewer:** IEEE TCAD, CVPR, Neurips, etc.,