**Zhengqi, Gao**

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Homepage: <https://zhengqigao.github.io/>

**Education**

**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**

**Machine Learning**

1. **K. Zha\***, **Z. Gao\***, M. Shen, Z-W Hong, D. S. Boning, and D. Katabi, “RL Tango: Reinforcing Generator and Verifier Together for Language Reasoning,” *Arxiv Print*, 2025. [[PDF](https://arxiv.org/pdf/2505.15034)] (\*indicates equal contribution)
2. **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](https://arxiv.org/abs/2501.18865)]
3. 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)
4. 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](https://openreview.net/forum?id=5jWaN6AplJ&referrer=%5BAuthor%20Console%5D(%2Fgroup%3Fid%3DICLR.cc%2F2024%2FWorkshop%2FBGPT%2FAuthors%23your-submissions))]
5. 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](https://arxiv.org/pdf/2310.15416.pdf)][[Code](https://github.com/andrewlai61616/NPSR)]
6. 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](https://arxiv.org/pdf/2206.06487.pdf)] [[Code](https://github.com/zihuixue/MFH)] (\* indicates equal contribution)
7. **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](https://arxiv.org/abs/2207.11327)] [[Code](https://github.com/zhengqigao/Learning-from-Multiple-Annotator-Noisy-Labels)]
8. 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](https://arxiv.org/abs/2209.10098)] [[Code](https://github.com/JeremieMelo/NeurOLight)]
9. **Z. Gao**, S. Ren, Z. Xue, and H. Zhao, “Training-Free Robust Multimodal Learning via Sample-Wise Jacobian Regularization,” *Arxiv Preprint*, 2022. [[PDF](https://arxiv.org/pdf/2204.02485.pdf)]
10. 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](https://arxiv.org/abs/2206.07692)] [[Code](https://github.com/OliverRensu/SDMP)]
11. 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](https://arxiv.org/pdf/2106.12378)] [[Code](https://github.com/OliverRensu/co-advise)]
12. Z. Xue, S. Ren, **Z. Gao** and H. Zhao, “Multimodal Knowledge Expansion,” *IEEE International Conference on Computer Vision (ICCV)*, Oct. 2021. [[PDF](https://arxiv.org/abs/2103.14431)] [[Code](https://github.com/zihuixue/MKE)]

**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](https://opg.optica.org/directpdfaccess/091ca1ea-2720-4f37-90f3054537f40a3c_561081/oe-32-21-37585.pdf?da=1&id=561081&seq=0&mobile=no)]
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](https://arxiv.org/pdf/2310.15872)][[Code](https://github.com/zhengqigao/kirchhoffnet/tree/main)]
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](https://ieeexplore.ieee.org/document/10530318)]
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](https://arxiv.org/pdf/2310.19167.pdf)][[Code](https://github.com/zhengqigao/NOFIS-DAC24/tree/main)]
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](https://ieeexplore.ieee.org/document/10491250)]
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](https://ieeexplore.ieee.org/abstract/document/10109764/)]
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](https://ieeexplore.ieee.org/abstract/document/10138792)] (\* 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,” *Opica Express* (OE). [[PDF](https://opg.optica.org/oe/viewmedia.cfm?uri=oe-31-8-12912&html=true)]
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](https://opg.optica.org/prj/fulltext.cfm?uri=prj-11-4-643&id=528691)] [[Code](https://github.com/zhengqigao/BayesOpt-JLT2022)]
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](https://ieeexplore.ieee.org/abstract/document/10024314)]
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](https://arxiv.org/abs/2208.14453)]
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](https://ieeexplore.ieee.org/document/9893366/)][[Code](https://github.com/zhengqigao/BayesOpt-JLT2022)]
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](https://opg.optica.org/abstract.cfm?uri=CLEO_SI-2022-JW3B.156)]
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](https://arxiv.org/abs/2203.17267)]
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](https://ieeexplore.ieee.org/document/9428031)]
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](https://ieeexplore.ieee.org/document/9383808)]
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](https://ieeexplore.ieee.org/document/9371605)]
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](https://ieeexplore.ieee.org/document/8883237)] [[Code](https://github.com/zhengqigao/multi-corner-failure-rate-estimation)]
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](https://ieeexplore.ieee.org/document/8832253)] [[Code](https://github.com/zhengqigao/multi-corner-yield-estimation)]
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](https://ieeexplore.ieee.org/document/9180517)]
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](https://ieeexplore.ieee.org/document/9218696)]
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](https://arxiv.org/abs/2001.07072)]
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](https://ieeexplore.ieee.org/document/8942174)]
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](https://ieeexplore.ieee.org/document/8565038)]

**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](https://github.com/zhengqigao/CACHEFE)]

**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**

* 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
* 2nd 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 2nd 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 2nd prize, China Mathematical Contest in Modeling (top 15%) 2016

**Representative Projects**

***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](https://github.com/zhengqigao/PRML-Solution-Manual)]
* 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 Submitty
* Developed a fully automatic grading system based on Submitty

**“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](https://github.com/zhengqigao/Dr-Stanley-house)]
* 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**

**Computer and Language Skills**

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

**Professional Services**

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