JIAQI GU

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Ph.D. Candidate ⋄ Department of Electrical & Computer Engineering

RESEARCH INTERESTS

Emerging Hardware for High-Performance, Efficient Computing

- Efficient AI hardware design
- Electronic-photonic mixed-signal computing platform design

Efficient Algorithm, Co-Design & Automation

- Hardware-software co-design & automation (for photonics, post-CMOS electronics, quantum)
- Efficient ML model/algorithm
- AI/ML for hardware design & design automation

EDUCATION

The University of Texas at Austin, TX, USA   *Aug. 2018 – Present*
Ph.D. Candidate, Department of Electrical and Computer Engineering
Advisor: David Z. Pan
Co-advisor: Ray T. Chen
(GPA 4.0/4.0)

Fudan University, Shanghai, China   *Sep. 2014 – Jun. 2018*
B.E., Department of Microelectronic Science and Engineering
(GPA: 3.91/4.0)
(Rank top 2/71)

AWARDS AND HONORS

Winner at Robert S. Hilbert Memorial Optical Design Competition	Synopsys	2022
Donald O. Pederson Best Paper Award	IEEE TCAD	2021
Cockrell School Graduate Student Fellowship	UT Austin	2021
First Place at ACM Student Research Competition Grand Finals	ACM	2021
Best Poster Award at NSF Workshop on Machine Learning Hardware	NSF Workshop	2020
First Place at ACM/SIGDA Student Research Competition	ACM/SIGDA	2020
7th Place at IWLS Contest on Machine Learning+Logic Synthesis	IWLS	2020
DAC Young Fellow	DAC	2020,2021
Best Paper Finalist (1 out of 6)	DAC	2020
Best Paper Award	ASP-DAC	2020
4th Place, System Design Contest on Low Power Object Detection	DAC-SDC	2019
First Prize Scholarship	Fudan University	2017–2018
2nd & 3rd Prize, National Mathematical Contest in Modeling	Fudan University	2016–2017

PROFESSIONAL EXPERIENCE

Nvidia Inc., CA, USA   *May 2022 – Oct 2022*
Research Intern, ASIC & VLSI Research Team

- Hardware-efficient Transformer compression for natural language processing

Meta Platforms Inc., CA, USA   *May 2021 – Dec 2021*
Research Intern, Meta reality labs, FAST AI team

- Efficient multi-scale Vision Transformer design for high-performance computer vision

SELECTED RESEARCH PROJECTS

Emerging Hardware for Efficient Computing
Open-source library for photonic AI computing: https://github.com/JeremieMelo/pytorch-onn [J11]
Contribute to library for quantum machine learning: https://github.com/mit-han-lab/torchquantum
Electronic-photonic NN accelerator [J13], [J10], [J7], [C16], [C9], [C5], [C2]
Photonic in-memory computing [J12], [C24]

Co-Design & Optimization for Emerging Hardware
Reliability and efficiency-driven model-circuit co-optimization flow [J13], [J10], [C34], [C27], [C5], [C1]
Machine learning-enabled hardware simulation & performance prediction [C37], [C33]
Automated circuit/architecture design [C34], [C26], [C25]
Efficient on-chip/on-device training for self-learnable AI hardware [C28], [C23], [C18], [C11], [C10]

PROFESSIONAL SERVICE

Working Group Member
- NSF AI Institute TILOS Ethics and Early Career Development, 2022.

Local Arrangement Co-Chair
- IEEE CAS Seasonal School: AI/ML for IC Design and EDA, 2022.

Program Committee Member
- Association for the Advancement of Artificial Intelligence (AAAI), 2023

Reviewer
- IEEE Transaction on Computer-Aided Design of Integrated Circuits and Systems (TCAD)
- ACM/IEEE Design Automation Conference (DAC)
- IEEE/ACM International Conference on Computer-Aided Design (ICCAD)
- IEEE Computer Society Annual Symposium on VLSI (ISVLSI)
- ACM Great Lakes Symposium on VLSI (GLSVLSI)
- Conference on Neural Information Processing Systems (NeurIPS)
- IEEE / CVF Computer Vision and Pattern Recognition Conference (CVPR)
- European Conference on Computer Vision (ECCV)
- Association for the Advancement of Artificial Intelligence (AAAI)
- IEEE Journal of Selected Topics in Quantum Electronics (JSTQE)
- Applied Physics Letters (APL)
- IEEE Photonics Technology Letters (PTL)

TEACHING

Graduate Teaching Assistant	EE382M: VLSI Physical Design Automation	Spring 2022

SKILLS

Programming Languages
Python (PyTorch/TensorFlow), C/C++, CUDA, Matlab, Verilog

EDA Tools
Cadence Virtuoso, Synopsys Design Compiler, Xilinx Vivado Design Suite, Synopsys Optodesigner

PUBLICATIONS

Journal Papers

[J13] **Jiaqi Gu**, Chenghao Feng, Hanqing Zhu, Zheng Zhao, Zhoufeng Ying, Mingjie Liu, Ray T. Chen, and David Z. Pan, "SqueezeLight: A Multi-Operand Ring-Based Optical Neural Network with Cross-Layer Scalability," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, Jul. 2022.

[J12] Hanqing Zhu, **Jiaqi Gu**, Chenghao Feng, Mingjie Liu, Zixuan Jiang, Ray T. Chen, and David Z. Pan, "ELight: Towards Efficient and Aging-Resilient Photonic In-Memory Neurocomputing," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, Jun. 2022.

[J11] **Jiaqi Gu**, Chenghao Feng, Hanqing Zhu, Ray T. Chen, and David Z. Pan, "Light in AI: Toward Efficient Neurocomputing with Optical Neural Networks - A Tutorial," *IEEE Transactions on Circuits and Systems–II: Express Briefs (TCAS-II)*, Apr. 2022.

[J10] Chenghao Feng*, **Jiaqi Gu***, Hanqing Zhu, Zhoufeng Ying, Zheng Zhao, David Z. Pan, and Ray T. Chen, "A compact butterfly-style silicon photonic-electronic neural chip for hardware-efficient deep learning," *ACS Photonics*, 2022.

[J9] Chenghao Feng, Zhoufeng Ying, Zheng Zhao, **Jiaqi Gu**, David Z. Pan, and Ray T. Chen, "Towards high-speed and energy-efficient computing: A WDM-based scalable on-chip silicon integrated optical comparator," *Laser & Photonics Reviews*, Jun. 2021.

[J8] Zhoufeng Ying, Chenghao Feng, Zheng Zhao, **Jiaqi Gu**, Richard Soref, David Z. Pan, and Ray T. Chen, "Sequential logic and pipelining in chip-based electronic-photonic digital computing," *IEEE Photonics Journal*, Oct. 2020.

[J7] **Jiaqi Gu**, Zheng Zhao, Chenghao Feng, Zhoufeng Ying, Mingjie Liu, Ray T. Chen, and David Z. Pan, "Towards Hardware-Efficient Optical Neural Networks: Beyond FFT Architecture via Joint Learnability," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, 2020.

[J6] Chenghao Feng, Zhoufeng Ying, Zheng Zhao, **Jiaqi Gu**, Ray T. Chen, and David Z. Pan, "Wavelength-division-multiplexing (WDM)-based integrated electronic–photonic switching network (EPSN) for high-speed data processing and transportation," *Nanophotonics*, Aug. 2020.

[J5] Yibo Lin, Zixuan Jiang, **Jiaqi Gu**, Wuxi Li, Shounak Dhar, Haoxing Ren, Brucek Khailany, and David Z. Pan, "DREAMPlace: Deep Learning Toolkit-Enabled GPU Acceleration for Modern VLSI Placement," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, Jun. 2020. (**Best Paper Award**)

[J4] Zhoufeng Ying, Chenghao Feng, Zheng Zhao, Shounak Dhar, Hamed Dalir, **Jiaqi Gu**, Yue Cheng, Richard Soref, David Z. Pan, and Ray T. Chen, "Electronic-photonic Arithmetic Logic Unit for High-speed Computing," *Nature Communications*, Apr. 2020.

[J3] Yibo Lin, Wuxi Li, **Jiaqi Gu**, Mark Ren, Brucek Khailany, and David Z. Pan, "ABCDPlace: Accelerated Batch-based Concurrent Detailed Placement on Multi-threaded CPUs and GPUs," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, Feb. 2020.

[J2] Ruoyao Wang, Zhenghan Fang, **Jiaqi Gu**, Yi Guo, Shicong Zhou, Yuanyuan Wang, Cai Chang, and Jinhua Yu, "High-resolution Image Reconstruction for Portable Ultrasound Imaging Devices," *EURASIP Journal on Advances in Signal Processing*, Dec. 2019.

[J1] **Jiaqi Gu**, Zeju Li, Yuanyuan Wang, Haowei Yang, Zhongwei Qiao, and Jinhua Yu, "Deep Generative Adversarial Networks for Thin-section Infant MR Image Reconstruction," *IEEE Access*, May 2019.

Refereed Conference Papers

[C37] **Jiaqi Gu**, Zhengqi Gao, Chenghao Feng, Hanqing Zhu, Ray T. Chen, Duane S. Boning, and David Z. Pan, "NeurOLight: A Physics-Agnostic Neural Operator Enabling Parametric Photonic Device Simulation," *Conference on Neural Information Processing Systems (NeurIPS)*, Dec. 2022. (**Spotlight**) (Acceptance Rate: 25.6%)

[C36] **Jiaqi Gu**, Ben Keller, Jean Kossaifi, Anima Anandkumar, Brucek Khailany, and David Z. Pan, "HEAT: Hardware-Efficient Automatic Tensor Decomposition for Transformer Compression," *Conference on Neural Information Processing Systems (NeurIPS), ML for System Workshop (MLSys)*, Dec. 2022. (**Spotlight**)

[C35] Wei Shi, Hanrui Wang, **Jiaqi Gu**, Mingjie Liu, David Pan, Song Han, and Nan Sun, "RobustAnalog: Fast Variation-Aware Analog Circuit Design Via Multi-task RL," *ACM/IEEE Workshop on Machine Learning for CAD (MLCAD)*, Aug. 2022.

[C34] Hanqing Zhu, Keren Zhu, **Jiaqi Gu**, Harrison Jin, Ray T.Chen, Jean Anne Incorvia, and David Z. Pan, "Fuse and Mix: MACAM-Enabled Analog Activation for Energy-Efficient Neural Acceleration," *IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*, Jul. 2022. (Acceptance Rate: 23.5%)

[C33] Hanrui Wang, Pengyu Liu, Jinglei Cheng, Zhiding Liang, **Jiaqi Gu**, Zirui Li, Yongshan Ding, Weiwen Jiang, Yiyu Shi, Xuehai Qian, David Z. Pan, Frederic T. Chong, and Song Han, "QuEst: Graph Transformer for Quantum Circuit Reliability Estimation," *IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*, Jul. 2022. (Acceptance Rate: 23.5%)

[C32] Chenghao Feng, **Jiaqi Gu**, Hanqing Zhu, Zhoufeng Ying, Zheng Zhao, David Z. Pan, and Ray T. Chen, "Optoelectronically Interconnected Hardware-Efficient Deep Learning using Silicon Photonic Chips," *Conference on Lasers and Electro-Optics*, Mar. 2022.

[C31] Chenghao Feng, **Jiaqi Gu**, Hanqing Zhu, David Z. Pan, and Ray T. Chen, "Design and Experimental Demonstration of A Hardware-Efficient Integrated Optical Neural Network," *Conference on Lasers and Electro-Optics*, Mar. 2022.

[C30] **Jiaqi Gu**, Hyoukjun Kwon, Dilin Wang, Wei Ye, Meng Li, Yu-Hsin Chen, Liangzhen Lai, Vikas Chandra, and David Z. Pan, "Multi-Scale High-Resolution Vision Transformer for Semantic Segmentation," *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2022. (Acceptance Rate: 25.3%)

[C29] **Jiaqi Gu**, Hanqing Zhu, Chenghao Feng, Zixuan Jiang, Mingjie Liu, Shuhan Zhang, Ray T. Chen, and David Z. Pan, "ADEPT: Automatic Differentiable DEsign of Photonic Tensor Cores," *ACM/IEEE Design Automation Conference (DAC)*, Jul. 2022. (**Best-in-Track Paper**) (Acceptance Rate: 23%)

[C28] Hanrui Wang, Zirui Li, **Jiaqi Gu**, Yongshan Ding, David Z. Pan, and Song Han, "QOC: Quantum On-Chip Training with Parameter Shift and Gradient Pruning," *ACM/IEEE Design Automation Conference (DAC)*, Jul. 2022. (Acceptance Rate: 23%)

[C27] Hanrui Wang, **Jiaqi Gu**, Yongshan Ding, Zirui Li, Frederic T. Chong, David Z. Pan, and Song Han, "QuantumNAT: Quantum Noise-Aware Training with Noise Injection, Quantization and Normalization," *ACM/IEEE Design Automation Conference (DAC)*, Jul. 2022. (Acceptance Rate: 23%)

[C26] Zizheng Guo, Mingjie Liu, **Jiaqi Gu**, Shuhan Zhang, David Z. Pan, and Yibo Lin, "A Timing Engine Inspired Graph Neural Network Model for Pre-Routing Slack Prediction," *ACM/IEEE Design Automation Conference (DAC)*, Jul. 2022. (**Best-in-Track Paper**) (Acceptance Rate: 23%)

[C25] Hanrui Wang, Yongshan Ding, **Jiaqi Gu**, Yujun Lin, David Z. Pan, Frederic T. Chong, and Song Han, "QuantumNAS: Noise-Adaptive Search for Robust Quantum Circuits," *IEEE International Symposium on High Performance Computer Architecture (HPCA)*, Feb. 2022. (Acceptance Rate: 29%)

[C24] Hanqing Zhu, **Jiaqi Gu**, Chenghao Feng, Mingjie Liu, Zixuan Jiang, Ray T. Chen, and David Z. Pan, "ELight: Enabling Efficient Photonic In-Memory Neurocomputing with Life Enhancement," *IEEE/ACM Asia and South Pacific Design Automation Conference (ASPDAC)*, Jan. 2022.

[C23] **Jiaqi Gu**, Hanqing Zhu, Chenghao Feng, Zixuan Jiang, Ray T. Chen, and David Z. Pan, "L2ight: Enabling On-Chip Learning for Optical Neural Networks via Efficient in-situ Subspace Optimization," *Conference on Neural Information Processing Systems (NeurIPS)*, Dec. 2021. (Acceptance Rate: 22.7%)

[C22] **Jiaqi Gu**, Hanqing Zhu, Chenghao Feng, Mingjie Liu, Zixuan Jiang, Ray T. Chen, and David Z. Pan, "Towards Memory-Efficient Neural Networks via Multi-Level in situ Generation," *International Conference on Computer Vision (ICCV)*, Oct. 2021. (Acceptance Rate: 25.9%)

[C21] Zixuan Jiang, **Jiaqi Gu**, Mingjie Liu, Keren Zhu, and David Z. Pan, "Optimizer Fusion: Efficient Training with Better Locality and Parallelism," *International Conference on Learning Representations (ICLR) Workshop, Hardware Aware Efficient Training (HAET)*, May 2021. (Acceptance Rate: 28.7%)

[C20] Chenghao Feng, **Jiaqi Gu**, Hanqing Zhu, David Z. Pan, and Ray T. Chen, "Experimental Demonstration of a WDM-based Integrated Optical Decoder for Compact Optical Computing," *Conference on Lasers and Electro-Optics*, May 2021.

[C19] Jason Midkiff, Ali Rostamian, Kyoung Min Yoo, Aref Asghari, Chao Wang, Chenghao Feng, Zhoufeng Ying, **Jiaqi Gu**, Haixia Mei, Ching-Wen Chang, James Fang, Alan Huang, Jong-Dug Shin, Xiaochuan Xu, Michael Bukshtab, David Z. Pan, and Ray T. Chen, "Integrated Photonics for Computing, Interconnects and Sensing," *Conference on Lasers and Electro-Optics*, May 2021. (**Invited Paper**)

[C18] **Jiaqi Gu**, Chenghao Feng, Zheng Zhao, Zhoufeng Ying, Ray T. Chen, and David Z. Pan, "Efficient On-Chip Learning for Optical Neural Networks Through Power-Aware Sparse Zeroth-Order Optimization," *Association for the Advancement of Artificial Intelligence (AAAI)*, Feb. 2021. (Acceptance Rate: 21%)

[C17] Shubham Rai, Walter Lau Neto, Yukio Miyasaka, Xinpei Zhang, Mingfei Yu, Qingyang Yi, Masahiro Fujita, Guilherme B. Manske, Matheus F. Pontes, Leomar S. da Rosa Junior, Marilton S. de Aguiar, Paulo F. Butzen, Po-Chun Chien, Yu-Shan Huang, Hoa-Ren Wang, Jie-Hong R. Jiang, **Jiaqi Gu**, Zheng Zhao, Zixuan Jiang, David Z. Pan, *et al.*, "Logic Synthesis Meets Machine Learning: Trading Exactness for Generalization," *IEEE/ACM Proceedings Design, Automation and Test in Europe (DATE)*, Feb. 2021. (Acceptance Rate: 24%)

[C16] **Jiaqi Gu**, Chenghao Feng, Zheng Zhao, Zhoufeng Ying, Mingjie Liu, Ray T. Chen, and David Z. Pan, "SqueezeLight: Towards Scalable Optical Neural Networks with Multi-Operand Ring Resonators," *IEEE/ACM Proceedings Design, Automation and Test in Europe (DATE)*, Feb. 2021. (Acceptance Rate: 24%)

[C15] **Jiaqi Gu**, Zheng Zhao, Chenghao Feng, Zhoufeng Ying, Ray T. Chen, and David Z. Pan, "O2NN: Optical Neural Networks with Differential Detection-Enabled Optical Operands," *IEEE/ACM Proceedings Design, Automation and Test in Europe (DATE)*, Feb. 2021. (Acceptance Rate: 24%)

[C14] Chenghao Feng, **Jiaqi Gu**, Zhoufeng Ying, Zheng Zhao, Ray T. Chen, and David Z. Pan, "Scalable fast-Fourier-transform-based (FFT-based) integrated optical neural network for compact and energy-efficient deep learning," *SPIE Photonics West*, Mar. 2021.

[C13] Chenghao Feng, Zhoufeng Ying, Zheng Zhao, **Jiaqi Gu**, Ray T. Chen, and David Z. Pan, "Wavelength-division-multiplexing (WDM)-based integrated electronic–photonic switching network (EPSN) for high-speed data processing and transportation," *SPIE Photonics West*, Mar. 2021.

[C12] **Jiaqi Gu**, Zixuan Jiang, and David Z. Pan, "DREAMPlace 3.0: Multi-Electrostatics Based Robustness VLSI Placement with Region Constraints," *IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*, Nov. 2020. (Acceptance Rate: 27%)

[C11] Zixuan Jiang, Keren Zhu, Mingjie Liu, **Jiaqi Gu**, and David Z. Pan, "An Efficient Training Framework for Reversible Neural Architectures," *European Conference on Computer Vision (ECCV)*, Aug. 2020. (Acceptance Rate: 26%)

[C10] **Jiaqi Gu**, Zheng Zhao, Chenghao Feng, Wuxi Li, Ray T. Chen, and David Z. Pan, "FLOPS: Efficient On-Chip Learning for Optical Neural Networks Through Stochastic Zeroth-Order Optimization," *ACM/IEEE Design Automation Conference (DAC)*, Jul. 2020. (**Best Paper Finalists**) (Acceptance Rate: 23.2%)

[C9] Mario Miscuglio, Zibo Hu, Shurui Li, **Jiaqi Gu**, Aydin Babakhani, Puneet Gupta, Chee-Wei Wong, David Pan, Seth Bank, Hamed Dalir, and Volker J. Sorger, "Massive parallelism Fourier-optic convolutional processor," *Signal Processing in Photonic Communications (SPPCom)*, Jul. 2020.

[C8] Mario Miscuglio, Zibo Hu, Shurui Li, **Jiaqi Gu**, Aydin Babakhani, Puneet Gupta, Chee-Wei Wong, David Z. Pan, Seth Bank, Hamed Dalir, and Volker J. Sorger, "Million-channel parallelism Fourier-optic convolutional filter and neural network processor," *Conference on Lasers and Electro-Optics*, May 2020.

[C7] Chenghao Feng, Zhoufeng Ying, Zheng Zhao, **Jiaqi Gu**, Ray T. Chen, and David Z. Pan, "Integrated WDM-based Optical Comparator for High-speed Computing," *Conference on Lasers and Electro-Optics*, May 2020.

[C6] Chenghao Feng, Zheng Zhao, Zhoufeng Ying, **Jiaqi Gu**, David Z. Pan, and Ray T. Chen, "Compact design of On-chip Elman Optical Recurrent Neural Network," *Conference on Lasers and Electro-Optics*, May 2020.

[C5] **Jiaqi Gu**, Zheng Zhao, Chenghao Feng, Hanqing Zhu, Ray T. Chen, and David Z. Pan, "ROQ: A Noise-Aware Quantization Scheme Towards Robust Optical Neural Networks with Low-bit Controls," *IEEE/ACM Proceedings Design, Automation and Test in Europe (DATE)*, Mar. 2020. (Acceptance Rate: 24.5%)

[C4] Mingjie Liu, Keren Zhu, **Jiaqi Gu**, Linxiao Shen, Xiyuan Tang, Nan Sun, and David Z. Pan, "Towards Decrypting the Art of Analog Layout: Placement Quality Prediction via Transfer Learning," *IEEE/ACM Proceedings Design, Automation and Test in Europe (DATE)*, Mar. 2020. (Acceptance Rate: 24.5%)

[C3] Chenghao Feng, Zhoufeng Ying, Zheng Zhao, **Jiaqi Gu**, Ray T. Chen, and David Z. Pan, "Wavelength-division-multiplexing-based electronic-photonic network for high-speed computing," *SPIE, Smart Photonic and Optoelectronic Integrated Circuits XXII*, Feb. 2020.

[C2] **Jiaqi Gu**, Zheng Zhao, Chenghao Feng, Mingjie Liu, Ray T. Chen, and David Z. Pan, "Towards Area-Efficient Optical Neural Networks: An FFT-based Architecture," *IEEE/ACM Asia and South Pacific Design Automation Conference (ASPDAC)*, Jan. 2020. (**Best Paper Award**)

[C1] Zheng Zhao, **Jiaqi Gu**, Zhoufeng Ying, Chenghao Feng, Ray T. Chen, and David Z. Pan, "Design Technology for Scalable and Robust Photonic Integrated Circuits," *IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*, 2019. (**Invited Paper**)