

# HANQING ZHU

Graduate Research Assistant ◊ ECE Department ◊ University of Texas at Austin  
hqzhu@utexas.edu ◊ (512)200-6791 ◊ [Personal website](#) ◊ [Google scholar](#)

## RESEARCH INTERESTS

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My research centers on efficient AI computing, from emerging AI hardware/system to hardware-/system-aware AI algorithms.

### I: Emerging ML hardware/System with Hardware-software Co-design

- *First-of-its-kind* photonic Transformer accelerator [I12, I10], AI-aided ultra-fast optical device simulation [I3], Efficiency-/Reliability-driven optimization [I9, I8, I7, I3, I1]

### II: Efficient Training and Inference Techniques

- Memory-efficient LLM training [I14] [ [Huggingface Transformers](#); [Hacker News](#); [LLaMA-Factory](#); [FluxML](#) ], Efficient Pre-LN Transformers [I11], Efficient On-Chip Training [I6], Circuit/system-aware quantization and compression [I9, I5].

## EDUCATION

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**The University of Texas at Austin (UT-Austin)**, TX, USA *Aug. 2020 - Dec. 2025 (Expected)*

Ph.D. Candidate, Department of Electrical and Computer Engineering

Advisor: [David Z. Pan](#) (ACM, IEEE, SPIE fellow); Co-advisor: [Ray T. Chen](#) (NAI, IEEE, SPIE, OSA fellow)

*First year (2020-2021) conducted part-time in China due to COVID-19*

**Honors:** ML and Systems Rising Stars' 2025; ECE Graduate Achievement Award; Graduate School Continuing Fellowship Nominee

GPA: 3.93/4.00

**Shanghai Jiao Tong University (SJTU)**, Shanghai, China *Sept. 2016 - Jun. 2020*

B.E., Microelectronics Science and Engineering

**Graduated with Highest Honors**

Rank: 2<sup>nd</sup>/57; GPA: 3.81/4.00

## HONORS AND AWARDS

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<b>ML and Systems Rising Stars</b> (38 out of 150 globally)	<a href="#">MLCommons</a>	2025
<b>Texas ECE Graduate Achievement Award</b>	UT Austin	2024
<b>UT Graduate School Continuing Fellowship Nomination</b> (1 of 2 nominees in the entire ECE department)	UT Austin	2024
<b>1st Place</b> in IEEE/ACM MLCAD FPGA Macro-Placement Contest	MLCAD	2023
MLSys Student Travel Award	MLSys	2023
<b>Winner</b> of Robert S. Hilbert Memorial Optical Design Competition	Synopsys	2022
DAC Young Fellow	DAC	2021
<b>Shanghai Outstanding Graduate</b>	Shanghai City	2020
Departmental Excellent Undergraduate Thesis	SJTU	2020
Hongyi Scholarship	SJTU	2019
Outstanding Undergraduate Scholarship	SJTU	2019
Samsung Scholarship	SJTU	2018
Zhiyuan College Honors Scholarship	SJTU	2018
<b>1st Prize</b> , National Mathematical Contest in Modeling	Shanghai Division	2018
Academic Excellence Scholarship	SJTU	2017-2019

## PROFESSIONAL EXPERIENCE

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**Meta AI**, CA, USA *May 2025 - Aug 2025*

Incoming Research Scientist Intern, Llama Foundation Models Efficiency

Mentor: [Dr. Tijmen Blankevoort](#) (Meta GenAI, LLaMA) and [Dr. Igor Fedorov](#) (Meta Reality Labs, Core AI)

**Meta AI**, CA, USA  
Research Scientist Intern, Efficient Large-scale Training  
Mentor: [Dr. Jinwon Lee](#)

May 2024 – Oct 2024

- Memory-efficient training techniques for large language models [I11]
- Communication-efficient methods for large-scale ads model training.

**Lightelligence Inc.**, MA, USA  
Software Research Intern, Low-bit Noise-aware Training for Photonic AI Chips  
Mentor: [Dr. Weifeng Zhang](#)

May 2023 – Sept 2023

- Low-precision noise-aware training for state-of-the-art photonic AI accelerators.

**Google Brain**, CA, USA  
Student Researcher, Google Brain, RL-based Chip Placement  
Mentor: [Dr. Joe Jiang](#)

Jul 2022 – Nov 2022

- Chip placement with reinforcement learning. Integrate and tune [DREAMPlace](#) for the RL chip placer.

## INVITED TALKS

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- Invited talk at [Lightelligence](#), 2023
  - “Towards Reliable and Self-Learnable Photonic Neural Network from the Lens of Software-Hardware Co-design”

## PROFESSIONAL SERVICE

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- **Conference Reviewer:** ICML, NeurIPS, ICLR, AAAI, DAC, ICCAD, FPGA, AICAS
- **Journal Reviewer:** TNNLS, TCAD, Photonic Network Communications

## MENTORING & TEACHING & VOLUNTEER EXPERIENCES

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- Mentor for senior undergraduates’ capstone project 2023
- TA at EE316: Digital Logic Design Fall 2022
- Conference Volunteer, the IEEE International Symposium on Circuits and Systems (ISCAS) 2022
- Volunteer teacher at Eryuan No.2 high school, Yunnan, China Aug. 2017- Sept. 2017

## PUBLICATIONS

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I published papers across top conferences in design automation, computer architecture, and machine learning, e.g., MLSys, HPCA, Neurips, ICCV, DAC, ICCAD, TCAD. (\* **denoted co-first author**)

### Representative publications that I am a primary author.

- [I14] **Hanqing Zhu\***, Zhenyu Zhang\*, Wenyan Cong, Xi Liu, Sem Park, Vikas Chandra, Bo Long, David Z. Pan, Zhangyang Wang, Jinwon Lee. “APOLLO: SGD-like Memory, AdamW-level Performance.” in *Conference on Machine Learning and Systems (MLSys)*, 2025 [ [Paper](#); [Code](#), 170+ stars; [Hacker News](#); [Huggingface Transformers](#); [LLaMA-Factory](#); [FluxML](#); [机器之心](#) ]
- [I13] **Hanqing Zhu**, Wenyan Cong, Guojin Chen, Shupeng Ning, Ray Chen, Jiaqi Gu, and David Z. Pan, “PACE: Pacing Operator Learning to Accurate Optical Field Simulation for Complicated Photonic Devices,” in *Conference on Neural Information Processing Systems (NeurIPS)*, 2024 [ [Paper](#); [Code](#); ]
- [I12] **Hanqing Zhu**, Jiaqi Gu, Hanrui Wang, Zixuan Jiang, Zhekai Zhang, Rongxin Tang, Chenghao Feng, Song Han, Ray T. Chen, David Z. Pan, “Lightening-Transformer: A Dynamically-operated Optically-interconnected Photonic Transformer Accelerator,” in *IEEE International Symposium on High Performance Computer Architecture (HPCA)*, Mar. 2024 (Acceptance Rate: 18.3% (75 of 410)) [ [Paper](#); [Code](#); ]
- [I11] Zixuan Jiang, Jiaqi Gu, **Hanqing Zhu**, and David Z. Pan, “Pre-RMSNorm and Pre-CRMSNorm Transformers: Equivalent and Efficient Pre-LN Transformers,” in *Conference on Neural Information Processing Systems (NeurIPS)*, Dec 10 - Dec 16, 2023 (**Spotlight**). (Acceptance Rate: 26.1%) [ [Paper](#); [code](#); ]

- [I10] **Hanqing Zhu**, Jiaqi Gu, Hanrui Wang, Rongxin Tang, Zhekai Zhang, Chenghao Feng, Song Han, Ray T. Chen, David Z. Pan, “DOTA: A Dynamically-Operated Photonic Tensor Core for Energy-Efficient Transformer Accelerator,” in *Conference on Machine Learning and Systems (MLSys), Workshop on Systems for Next-Gen AI Paradigms (SNAP)*, Jun 4 - Jun 8, 2023
- [I9] **Hanqing Zhu**, Keren Zhu, Jiaqi Gu, Harrison Jin, Ray Chen, Jean Anne Incorvia and David Z. Pan, “Fuse and Mix: MACAM-Enabled Analog Activation for Energy-Efficient Neural Acceleration” in *IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*, Oct. 2022 [ [Paper](#); ]
- [I8] **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,” in *IEEE/ACM Asia and South Pacific Design Automation Conference (ASP-DAC)*, Jan., 2022 [ [Paper](#); ]
- [I7] 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,” in *ACM/IEEE Design Automation Conference (DAC)*, Jul., 2022 [ [Paper](#); ]
- [I6] 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,” in *Conference on Neural Information Processing Systems (NeurIPS)*, Dec., 2021 [ [Paper](#); [Code](#) ]
- [I5] 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,” in *International Conference on Computer Vision (ICCV)*, Oct., 2021 [ [Paper](#); ]
- [I4] **Hanqing Zhu\***, Shupeng Ning\*, Chenghao Feng, Jiaqi Gu, Zhixing Jiang, Zhoufeng Ying, Jason Midkiff, Sourabh Jain, May H. Hlaing, David Z. Pan, and Ray T. Chen, “Photonic-Electronic Integrated Circuits for High-Performance Computing and AI Accelerator,” in *IEEE Journal of Lightwave Technology (JLT)*, July, 2024 [ [Paper](#); ]
- [I3] Jiaqi Gu, **Hanqing Zhu**, Chenghao Feng, Zixuan Jiang, Ray T. Chen, and David Z. Pan, “M3ICRO: Machine Learning-Enabled Compact Photonic Tensor Core based on PProgrammable Multi-Operand Multimode Interference,” in *APL Machine Learning*, Jan. 2024
- [I2] Harrison Jin, **Hanqing Zhu**, Keren Zhu, Thomas Leonard, Jaesuk Kwon, Mahshid Alamdar, Kwangseok Kim, Jungsik Park, Naoki Hase, David Z. Pan, Jean Anne C. Incorvia, “Domain Wall-Magnetic Tunnel Junction Analog Content Addressable Memory Using Current and Projected Data” in *IEEE Transactions on Nanotechnology*, 2024
- [I1] **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,” in *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, Jun., 2022 [ [Paper](#); ]

## Conference Papers

- [C18] Souradip Poddar, Youngmin Oh, Yao Lai, **Hanqing Zhu**, Bosun Hwang, David Z Pan “INSIGHT: Universal Neural Simulator for Analog Circuits Harnessing Autoregressive Transformers,” in *arXiv:2407.07346*, 2024
- [C17] Chen, Guojin, Keren Zhu, Seunggeun Kim, **Hanqing Zhu**, Yao Lai, Bei Yu, and David Z. Pan. ”LLM-Enhanced Bayesian Optimization for Efficient Analog Layout Constraint Generation.” arXiv preprint arXiv:2406.05250 (2024)
- [C16] Chun-Ju Yang, **Hanqing Zhu**, Shupeng Ning, Chenghao Feng, Jiaqi Gu, David Z Pan, Ray T Chen, “Deep Learning Enhanced Early Detection of Pancreatic Cancer Using Integrated Photonic Chip Based Optical Neural Networks,” in *Conference on Lasers and Electro-Optics (CLEO)*, 2024
- [C15] Shupeng Ning, **Hanqing Zhu**, Chenghao Feng, Christian Uselton, Jiaqi Gu, Rongxing Tang, David Z Pan, Ray T Chen, “Realization of a Compact Photoelectric Platform for Optical Convolution Processing,” in *Conference on Lasers and Electro-Optics (CLEO)*, 2024
- [C14] S Lin, **Hanqing Zhu**, S Clayton, CL Morris, Z Tang, Z Wang, RT Chen, “Sub-micron Ultracold Neutron Position Resolution using Chip Based Optical Neural Network,” in *Conference on Lasers and Electro-Optics (CLEO)*, 2024.

- [C13] Shupeng Ning, Jiaqi Gu, Chenghao Feng, Rongxing Tang, **Hanqing Zhu**, David Z Pan, Ray T Chen, “A hardware-efficient silicon electronic-photonic chip for optical structured neural networks,” in *Optical Interconnects XXIV*, 2024
- [C12] Chenghao Feng, Shupeng Ning, Jiaqi Gu, **Hanqing Zhu**, David Z Pan, Ray T Chen, “Integrated Photonics for Computing and Artificial Intelligence,” in *IEEE Photonics Society Summer Topicals Meeting Series (SUM)*, 2023
- [C11] Zhili Xiong, Rachel Selina Rajarathnam, Zhixing Jiang, **Hanqing Zhu**, David Z Pan. ”DREAMPlaceFPGA-MP: An Open-Source GPU-Accelerated Macro Placer for Modern FPGAs with Cascade Shapes and Region Constraints,” in *arXiv:2311.08582*, 2023
- [C10] Jiaqi Gu, Chenghao Feng, **Hanqing Zhu**, David Z. Pan, and Ray T. Chen, “Light-AI Interaction: The Convergence of Photonic AI and Cross-layer Circuit-Architecture-Algorithm Co-design,” in *Conference on Machine Learning and Systems (MLSys), Workshop on Systems for Next-Gen AI Paradigms (SNAP)*, Jun 4 - Jun 8, 2023
- [C9] Chenghao Feng, Shupeng Ning, Jiaqi Gu, **Hanqing Zhu**, David Z Pan, Ray T Chen, “Light-AI Interaction: The Convergence of Photonic AI and Cross-layer Circuit-Architecture-Algorithm Co-design,” in *SPIE Photonics West*, Jan., 2023
- [C8] Jiaqi Gu, Chenghao Feng, **Hanqing Zhu**, David Z. Pan, and Ray T. Chen, “Light-AI Interaction: The Convergence of Photonic AI and Cross-layer Circuit-Architecture-Algorithm Co-design,” in *SPIE Photonics West*, Jan., 2023
- [C7] Chenghao Feng, Rongxing Tang, Jiaqi Gu, **Hanqing Zhu**, David Z. Pan, and Ray T. Chen, “Optically Interconnected, Hardware-Efficient, Electronic-Photonic Neural Network using Compact Multi-Operand Photonic Devices,” in *SPIE Photonics West*, Jan., 2023
- [C6] Jiaqi Gu, Zhengqi Gao, Chenghao Feng, **Hanqing Zhu**, Ray Chen, Duane S Boning, and David Z. Pan, “NeurOLight: A Physics-Agnostic Neural Operator Enabling Parametric Photonic Device Simulation,” in *Conference on Neural Information Processing Systems (NeurIPS)*, Nov 26 - Dec 4, 2022 (**Spotlight**)
- [C5] Harrison Jin, **Hanqing Zhu**, Keren Zhu, Thomas Leonard, Mahshid Alamdar, David Z. Pan, and Jean Anne C. Incurvia, “Design of Domain Wall-Magnetic Tunnel Junction Analog Content Addressable Memory using Current and Projected Prototype Data,” in *Annual Conference on Magnetism and Magnetic Materials (MMM)*, Minneapolis, MN, October 31 - November 4, 2022
- [C4] 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](#),” in *Smart Photonic and Optoelectronic Integrated Circuits (SPIE)*, Mar., 2022
- [C3] 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](#),” in *Smart Photonic and Optoelectronic Integrated Circuits (SPIE)*, Mar., 2022
- [C2] 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](#),” in *Conference on Lasers and Electro-Optics*, May, 2021
- [C1] 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](#),” in *IEEE Design, Automation & Test in Europe Conference & Exhibition (DATE)*, Mar., 2020

## Journal Papers

- [J5] Feng, Chenghao, Jiaqi Gu, **Hanqing Zhu**, Shupeng Ning, Rongxing Tang, May Hlaing, Jason Midkiff, Sourabh Jain, David Z. Pan, and Ray T. Chen. ”Integrated multi-operand optical neurons for scalable and hardware-efficient deep learning.” *Nanophotonics* 13, no. 12 (2024): 2193-2206
- [J4] Shanny Lin, S Ning, **Hanqing Zhu**, T Zhou, Christopher L Morris, Steven Clayton, Mathew J Cherukara, Ray T Chen, Zhehui Wang, “Neural network methods for radiation detectors and imaging,” in *Frontiers in Physics*, Feb. 2024
- [J3] 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](#),” in *ACS Photonics*, 2022

- [J2] 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](#),” in *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, Jul., 2022
- [J1] 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](#),” in *IEEE Transactions on Circuits and Systems–II: Express Briefs (TCAS-II)*, Apr., 2022