Hanqing (Atlas) Zhu

Ph.D. Candidate ⋄ Department of Electrical and Computer Engineering ⋄ University of Texas at Austin
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RESEARCH INTERESTS

My research aims to develop efficient and scalable AI algorithms and systems. I am particularly excited about redesigning AI algorithms to be both theoretically grounded and practically efficient.

- ▷ **Scalable and Theory-grounded Optimization for Foundation Models: Pre-Training & Post-training (RL)**
- ▷ **Hardware-software Co-design for Efficient AI Deployment**

I was lucky to be advised by Prof. David Z. Pan and work closely with Prof. Atlas Z. Wang.

EDUCATION

The University of Texas at Austin (UT Austin), TX, USA *Aug. 2020 - May 2026*
Ph.D., Electrical and Computer Engineering
First year (2020-2021) conducted part-time in China due to COVID-19

- ▷ GPA: 3.93/4.00
- ▷ Advised by Prof. David Z. Pan(ACM, IEEE, SPIE Fellow);
- ▷ ***Honors:*** **Outstanding Paper Honorable Mention, MLSys'25**; **ML and Systems Rising Stars'25**; **Best Paper Award, CVPR'25 AI4CC Workshop**; **Texas ECE Graduate Achievement Award**

Shanghai Jiao Tong University (SJTU), Shanghai, China *Sept. 2016 - Jun. 2020*
B.E., Microelectronics Science and Engineering

- ▷ Rank: 2nd/57; GPA: 3.81/4.00
- ▷ ***Graduated with Highest Honors***

PROFESSIONAL EXPERIENCE

Meta AI, CA, USA *May 2025 – Dec 2025*
Research Scientist Intern & Student Researcher, ***Theory-driven Efficient and Scalable Learning for RLVR***
Mentor: Dr. Yuandong Tian (FAIR), Dr. Zechun Liu(Core AI), Dr. Kai Sheng Tai (Core AI)

- ▷ The first systematic study of RLVR training dynamics toward **a "white-box" understanding and better learning algorithm of reinforcement learning for reasoning models** (submitted to ICLR'26 [M7]; preliminary version accepted to the NeurIPS 2025 Workshop on Efficient Reasoning, **Spotlight**, X post).
- ▷ Ongoing work on theory-driven effective and scalable learning for RLVR

Meta AI, CA, USA *May 2024 – Oct 2024*
Research Scientist Intern, ***Efficient and Scalable Large-scale Pre-Training***
Mentor: Dr. Jinwon Lee

- ▷ The State-of-the-art Memory-efficient training for large language models (MLSys'25 Outstanding Paper Honorable Mention); integrated into HuggingFace, LLaMA-Factory, Axolotl, and FluxML [M4].
- ▷ Communication-efficient methods for large-scale ads model training

Lightelligence Inc., MA, USA *May 2023 – Sept 2023*
Software Research Intern, ***Low-bit Chip-aware Training***
Mentor: Dr. Weifeng Zhang

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

Google Brain (now Google Deepmind), CA, USA *Jul 2022 – Nov 2022*
Student Researcher, ***RL-based Chip Placement***
Mentor: Dr. Joe Jiang

- ▷ Chip placement with reinforcement learning. Integrate and tune DREAMPlace for the RL chip placer.

AWARDS AND HONORS

Best Paper Award [M6]	CVPR AI4CC Workshop	2025
ICLR notable reviewer	ICLR	2025
Outstanding Paper Honorable Mention [M4]	MLSys	2025
DAC Ph.D. Forum	DAC	2025
MLSys Student Travel Award	MLSys	2025
ML and Systems Rising Stars (38 worldwide)	MLCommons	2025
Texas ECE Graduate Achievement Award	UT Austin	2024
UT Graduate School Continuing Fellowship Nomination (1 of 2 nominees in the entire ECE department)	UT Austin	2024

1st Place in IEEE/ACM MLCAD FPGA Macro-Placement Contest	MLCAD	2023
MLSys Student Travel Award	MLSys	2023
Winner of Robert S. Hilbert Memorial Optical Design Competition	Synopsys	2022
DAC Young Fellow	DAC	2021
Shanghai Outstanding Graduate	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
1st Prize, National Mathematical Contest in Modeling	Shanghai Division	2018
Academic Excellence Scholarship	SJTU	2017-2019

INVITED TALKS

- "Scaling Intelligence from Co-design to Efficient Algorithms", XAI, 2025
- "Towards Reliable and Self-Learnable Photonic Neural Network from the Lens of Software-Hardware Co-design", Lightelligence, 2023

PROFESSIONAL SERVICE

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

PUBLICATIONS

I have published papers in top conferences in machine learning/ system/computer architecture/design automation, including MLSys, HPCA, NeurIPS, ICCV, COLM, DAC, ICCAD, and TCAD.

Representative publications that I am a primary author of. (* denoted co-first author ; ♠ denote equal advisory)

Efficient, Scalable, Hardware-aware AI Algorithms

[M8] **Hanqing Zhu**, Zhenyu Zhang, Hanxian Huang, DiJia Su, Zechun Liu, Jiawei Zhao, Igor Fedorov, Hamed Pirsiavash, Jinwon Lee, David Z. Pan, Zhangyang Wang♠, Yuandong Tian♠, Kai Sheng Tai♠, " The Path Not Taken: RLVR Provably Learns Off the Principals " In submission to ICLR'26. Preliminary version accepted by NeurIPS 2025 Workshop on Efficient Reasoning (**Spotlight**). [Paper; X post; 量子位 ; 新智元 ; First theory-driven RLVR study and guidance for geometry-aligned RL optimization]

[M7] Wenyan Cong, **Hanqing Zhu**, Kevin Wang, Jiahui Lei, Colton Stearns, Yuanhao Cai, Dilin Wang, Rakesh Ranjan, Matt Feiszli, Leonidas Guibas, Zhangyang Wang, Weiyao Wang, Zhiwen Fan " VideoLifter: Lifting Videos to 3D with Fast Hierarchical Stereo Alignment " in *International Conference on 3D Vision*, 2026; CVPR 2025 Workshop on AI for Content Creation (**Oral Presentation**; 🏆**Best Paper Award**) [Paper; Code; Efficient video-3D reconstruction.]

[M6] Wenyan Cong*, **Hanqing Zhu***, Peihao Wang, Bangya Liu, Dejia Xu, Kevin Wang, David Z. Pan, Yan Wang, Zhiwen Fan, Zhangyang Wang, " Can Test-Time Scaling Improve World Foundation Model? " In *Conference on Language Modeling (COLM)*, 2025. [Paper; Code; First efficient test-time scaling for world foundation model]

[M5] **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 [🏆**Outstanding Paper Honorable Mention**; Paper; Code, 250+ stars; Hacker News; Huggingface Transformers; LLaMA-Factory; FluxML; axolotl; 机器之心 ; Theory-driven scalable memory-efficient training with new-recording memory efficiency]

[M4] **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; Theory-grounded efficient and fast operator model for scientific simulation]

[M3] 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; Theory-grounded efficient Pre-LN implementation]

[M2] 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; Hardware-aware efficient on-chip training]

[M1] 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; Low-rank decomposition for memory-efficiency]

Hardware-software Co-design for Efficient AI Hardware/Systems

[I10] **Hanqing Zhu**, Zhican Zhou, Shupeng Ning, Xuhao Wu, Ray Chen, Yating Wan and David Z. Pan, " ENLighten: Lighten the Transformer, Enable Efficient Optical Acceleration " In *IEEE/ACM Asia and South Pacific Design Automation Conference (ASP-DAC)*, 2026. [Paper; Low-rank plus hardware-aware sparsity decomposition]

[I9] **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; Hardware-software Co-design]

[I8] **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

[I7] **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; NAS with mixed activation precision]

[I6] **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; Hardware-software Co-design]

[I5] 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; NAS for automatic efficient hardware search]

[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 PRogrammable 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

[C19] Seunggeun Kim, Ziyi Wang, Sungyoung Lee, Youngmin Oh, **Hanqing Zhu**, Doyun Kim and David Z. Pan, "PPAAS: PVT and Pareto Aware Analog Sizing via Goal-conditioned Reinforcement Learning," in *IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*, 2025

[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 *ACM/IEEE Design Automation Conference (DAC)*, 2025

[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. Incorvia, "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

MENTORING & TEACHING & VOLUNTEER EXPERIENCES

- ▷ Mentor for junior PhD students: Seunggeun Kim (1 ICCAD [C19]) Souradip Poddar (1 DAC [C18]))
- ▷ 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