

General Research Interests

My research interests lie in building scalable (beyond-) silicon (planar to FinFET) system-on-chips tailored for next-generation AI workloads. I have the experience of designing and integrating custom/RTL blocks in TSMC 65GP and 40ULP nodes with industrial standard tapeout flow, from design to top-level integration.

Education

- Aug.'23–present **PhD Student, Electrical & Computer Engineering**, Georgia Institute of Technology, Atlanta, GA, USA.
Advisor: Steve W. Chaddick school chair and Prof., Arijit Raychowdhury
- Aug.'19–July'23 **Bachelor of Engineering, Electrical & Computer Engineering**, Zhejiang University, Hangzhou, Zhejiang, PRC.

Professional Experience

- June'24–present **Design Research Intern**, Corporate Research TSMC, San Jose, CA, USA.
Research focus: Design proof-of-concept large-scale SoC tapeouts with the focus on comp. arch.
Division: Corporate Research Design Solution (CRDSN) Division.
Supervisor: Dr. Win-San (Vince) Khwa, Technical Manager.
- Aug.'23–Present **Graduate Research Assistant**, Georgia Institute of Technology, Atlanta, GA, USA.
Research focus: Mixed-signal circuit and architecture tapeouts for next-gen AI applications.

Publications *: Equal Contributions.

- DATE 2024 Zishen Wan*, **Che-Kai Liu***, Mohamed Ibrahim, Hanchen Yang, Samuel Spetalnick, Tushar Krishna, and Arijit Raychowdhury. H3dfact: Heterogeneous 3d integrated cim for factorization with holographic perceptual representations. In *Design Automation and Test in Europe*. Acceptance rate: 25%. ACM/IEEE, DATE 2024.
- ISPASS 2024 Zishen Wan, **Che-Kai Liu**, Hanchen Yang, Ritik Raj, Chaojian Li, Haoran You, Yonggan Fu, Cheng Wan, Yingyan (Celine) Lin, Tushar Krishna, and Arijit Raychowdhury. Towards cognitive ai systems: Workload and characterization of neuro-symbolic ai. In *IEEE International Symposium on Performance Analysis of Systems and Software*. Acceptance rate: 34%. IEEE, ISPASS 2024.
- JATS 2024 Zhenkun Fan*, Zishen Wan*, **Che-Kai Liu**, Anni Lu, Kshitij Bhardwaj, and Arijit Raychowdhury. Benchmarking test-time dnn adaptation at edge with compute-in-memory. In *ACM Journal on Autonomous Transportation Systems*. ACM, JATS 2024.
- TCAS-I 2024 Hamza E. Barkam, Sanggeon Yun, Paul R. Genssler, **Che-Kai Liu**, Zhuowen Zou, Hussam Amrouch, and Mohsen Imani. In-memory acceleration of hyperdimensional genome matching on unreliable emerging technologies. In *IEEE Transactions on Circuits and Systems I: Regular Papers*. IEEE, TCAS-I 2024.
- DATE 2024 Zhicheng Xu, **Che-Kai Liu**, Chao Li, Ruibin Mao, Jianyi Yang, Thomas Kämpfe, Mohsen Imani, Can Li, Cheng Zhuo, and Xunzhao Yin. Ferex: A reconfigurable design of multi-bit ferroelectric compute-in-memory for nearest neighbor search. In *Design Automation and Test in Europe*. Acceptance rate: 25%. ACM/IEEE, DATE 2024.

- ICCAD 2023 Shengxi Shou, **Che-Kai Liu**, Sanggeon Yun, Zishen Wan, Kai Ni, Mohsen Imani, X Sharon Hu, Jianyi Yang, Cheng Zhuo, and Xunzhao Yin. See-mcam: A scalable multi-bit fefet content addressable memory for energy efficient associative search. In *42nd IEEE/ACM International Conference on Computer-Aided Design*. Acceptance rate: 23%, ICCAD 2023.
- MLSys 2023 Zishen Wan, **Che-Kai Liu***, Hanchen Yang*, Chaojian Li*, Haoran You*, Yonggan Fu, Cheng Wan, Tushar Krishna, Yingyan Lin, and Arijit Raychowdhury. Towards cognitive ai system: A survey and prospective on neuro-symbolic ai. In *Workshop on Systems for Next-Gen AI Paradigms, Sixth Conference on Machine Learning and Systems*, MLSys 2023.
- DATE 2023 Hamza E. Barkam, Sanggeon Yun, Paul R. Genssler, Zhuowen Zou, **Che-Kai Liu**, Hussam Amrouch, and Mohsen Imani. Hdgim: Hyperdimensional genome sequence matching on unreliable highly-scaled fefet. In *Proceedings of the IEEE/ACM Design Automation and Test in Europe*. Acceptance rate: 25%. IEEE/ACM, DATE 2023.
- ICCAD 2022 **Che-Kai Liu**, Haobang Chen, Mohsen Imani, Kai Ni, Arman Kazemi, Ann Franchesca Laguna, Michael Niemier, Xiaobo Sharon Hu, Liang Zhao, Cheng Zhuo, and Xunzhao Yin. Cosime: Fefet based associative memory for in-memory cosine similarity search. In *41st IEEE/ACM International Conference on Computer-Aided Design*. Acceptance rate: 22%, ICCAD 2022.

Talks

- 2024 Mar. H3DFact: Heterogeneous 3D Integrated CIM for Factorization with Holographic Perceptual Representations, 2024 IEEE Design Automation and Test in Europe (DATE), Valencia, Spain.
- 2024 Mar. Heterogeneous 3D Integrated CIM for Factorization, 2024 Center for the Co-Design of Cognitive Systems (CoCoSys), Annual Review, Atlanta, USA
- 2023 Oct. SEE-MCAM: A Scalable Multi-bit FeFET Content Addressable Memory for Energy Efficient Associative Search, IEEE/ACM 42nd International Conference on Computer-Aided Design (ICCAD), San Francisco, CA, USA.
- 2023 May "When Vector Symbolic Architecture meets Compute-in-Memory", ICSR Lab, Georgia Institute of Technology, Virtual
- 2022 Oct. Student Research Competition, IEEE/ACM 41st International Conference on Computer-Aided Design (ICCAD), San Diego, CA, USA.
- 2022 Nov. Cosime: Fefet based associative memory for in-memory cosine similarity search, IEEE/ACM 41st International Conference on Computer-Aided Design (ICCAD), 2023, San Diego, CA, USA.
- 2022 Oct. "Compute-in-Memory: A Cross-Layer Perspective", Bias Lab, University of California, Irvine, CA, USA.
- 2022 Sep. "An efficient Associative Memory Engine for Cosine Similarity-Based Nearest Neighbor Search", ACM/IEEE Embedded System Week (ESWEEK), Edge Intelligent Computing workshop, virtual.

Skills

Technical (System) Verilog, Synopsys VCS/DC/ICC/PrimeTime (QTM)/StarRC, Cadence Virtuoso/Calibre/Innovus/PVS/AMS, Python, C, MATLAB, Intel Quartus, TCL for ASIC

Reviewer for

- 2024 **2024 IEEE/ACM International Conference on Computer-Aided Design (ICCAD)**.
- 2023 **2024 IEEE International Symposium on Circuits and Systems (ISCAS)**.
- 2022-2023 **IEEE J. on Emerging and Selected Topics in Circuits & Systems (JETCAS)**.
- 2023-2024 **ACM Journal on Autonomous Transportation Systems (JATS)**.

Research Agencies Participated

2023–present **CoCoSys: Center for the Co-Design of Cognitive Systems**, *Center director: Prof. Arijit Raychowdhury*, A Semiconductor Research Co. (SRC) sponsored by Defense Advanced Research Projects Agency (DARPA).

Courses Participated during Ph.D. @ GaTech ECE

Spring, 2024: **ECE8824: Silicon Validation (Chip Testing)**, *Instructor: Prof. Visvesh S. Sathe.*

Spring, 2024: **ECE6412: Analog Integrated Circuit Design**, *Instructor: Prof. Gabriel A. Rincon-Mora.*

Fall, 2023 : **ECE8903: Special Problems**, *Instructor: Prof. Arijit Raychowdhury.*

Fall, 2023 : **ECE6130: Advanced VLSI Systems**, *Instructor: Prof. Arijit Raychowdhury.*

Fall, 2023 : **CS6290/ECE6100: Advanced Computer Architecture**, *Instructor: Prof. Cong (Callie) Hao.*

Fall, 2023 : **ECE4804: VLSI Theory to Tape-out**, *Instructor: Prof. Visvesh S. Sathe.*