Che-Kai Liu

Curriculum Vitae *last update: 05/08/2024*

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General Research Interests

My research interests lie in building scalable (beyond-) silicon (planar to FinFET) chips tailored for next-generation AI workloads. My research focus extends to designing chips that specifically address real-world industrial challenges (e.g. testing). 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 (Full Time) **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 42^{nd} 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 41^{st} 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 41^{st} 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 Skill (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

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*.