

General Research Interests

INDEX: Analog/Mix-signal chip design. Compute-In-memory device (RRAM & FeFET), circuit (robust analog sensing, low-power (power/clk-gating) method, etc.), and architecture (3D integration, mix-signal design, etc.). Algorithms benchmarking and their hardware design (vector-symbolic arch., factorization, graph representations, sequence matching, etc.).

Education

Aug.'23–present **PhD Student, Electrical & Computer Engineering**, Georgia Institute of Technology, Atlanta, GA, USA.

Research Focus: Mix-signal in-memory chip for edge applications.

Advisor: Steve W. Chaddick school chair and Prof., Arijit Raychowdhury

2019–July'23 **Bachelor of Engineering, Electrical & Computer Engineering**, Zhejiang University, Hangzhou, Zhejiang, P.R.China.

Publications *: Equal Contributions.

- 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.
- 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.
- 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.
- 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 *Proceedings of the IEEE/ACM International Conference on Computer-Aided Design*. Acceptance rate: 23%. IEEE/ACM, ICCAD 2023.
- DATE 2023 Hamza E. Barkam, Sanggeon Yun, Paul R. Genssler, Zhuowen Zou, **Che-Kai Liu**, Hussam Amrouch, and Mohsen Imani. Hdglm: 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 *Proceedings of the 41st IEEE/ACM International Conference on Computer-Aided Design*. Acceptance rate: 22%. IEEE/ACM, ICCAD 2022.

Professional Experience

Georgia Institute of Technology, USA

Aug, 2023 – Present **Graduate Research Assistant**, *Integrated Circuits and Systems Research Lab (ICSRL)*.

Fellowships & Awards

- 2023 ACM Student Research Competition **Finalist (Ranked 4th worldwide)**.
- 2023 Outstanding undergraduate thesis award. Thesis title: "Cross-Layer Optimization for Computing-in-Memory Circuits, Architectures and Applications".
- 2022 **First Place**, ACM Student Research Competition at ACM/IEEE Int'l Conference on Computer-Aided Design (ICCAD), 2022.
- 2022 **Best** presentation award at ACM/IEEE ESWEEK EIC workshop, 2022.
- 2022 Research sponsorship from Fellow of IEEE/ACM Prof. X. Sharon Hu, 2022.
- 2022 Research scholarship from the University of Notre Dame, IN, 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.
- 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 Skill (System) Verilog, Synopsys Digital Tape-out Flow and Cadence Analog Tape-out Flow from schematic (functional), LVS/DRC (synthesis), PnR (APnR), to Post-layout, Python, C, MATLAB

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 **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: Special Topics (Chip Testing)**, *Instructor: Prof. Visvesh S. Sathe.*

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

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, Audit.*