

YUAN LI

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RESEARCH INTERESTS

Emerging Hardware Architecture and Technology for High-Performance and Energy-Efficient Computing Systems including:

- AI/ML Hardware Accelerator
- Network-on-Chip (NoC)
- Heterogeneous Manycore Architecture
- Chiplet-based Heterogeneous Integration
- Silicon Photonics
- Non-Volatile Memory (NVM)

EDUCATION

George Washington University

Ph.D. in Computer Engineering

Department of Electrical and Computer Engineering

Washington, D.C.

August 2017 – December 2022

University of Newcastle upon Tyne

M.S. in Microelectronics

School of Electrical, Electronic and Computer Engineering

Newcastle upon Tyne, U.K.

September 2010 – December 2011

University of Science and Technology of China (USTC)

B.S. in Physics

Department of Physics

Hefei, China

September 2006 – June 2010

PUBLICATIONS

My research deliverables include 8 first-authored and 2 co-authored publications in premier computer architecture, circuit, and EDA conferences and journals (*HPCA*, *PACT*, *DAC*, *DATE*, *TPDS*, *TCAS-I*, and *TSUSC*), and 1 U.S. provisional patent.

Conference Papers

[C1] [Link] **Yuan Li**, Ahmed Louri, and Avinash Karanth. "A Silicon Photonic Multi-DNN Accelerator." in *Proceedings of the International Conference on Parallel Architectures and Compilation Techniques (PACT)*, pp. 238-249, Vienna, Austria, October 21-25, 2023.

[C2] [Link] **Yuan Li**, Ahmed Louri, and Avinash Karanth. "Efficient Multicast Communication in Silicon Photonics Enhanced DNN Acceleration." in *Proceedings of the IEEE Photonics Summer Topicals Meeting Series (SUM)*, pp. 1-2, Sicily, Italy, July 17-19, 2023.

[C3] [Link] **Yuan Li**, Ahmed Louri, and Avinash Karanth. "SPACX: Silicon Photonics-based Chiplet Accelerator for DNN Inference." in *Proceedings of the IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, pp. 831-845, Seoul, Korea, April 2-6, 2022.

[C4] [Link] Ke Wang, Hao Zheng, **Yuan Li**, Jiajun Li, and Ahmed Louri. "AGAPE: Anomaly Detection with Generative Adversarial Network for Improved Performance, Energy, and Security in Manycore Systems." in *Proceedings of the Design, Automation & Test in Europe Conference & Exhibition (DATE)*, pp. 849-854, Antwerp, Belgium, March 14-23, 2022.

[C5] [Link] **Yuan Li**, Ahmed Louri, and Avinash Karanth. "Scaling Deep Learning Inference with Chiplet-based Architecture and Photonic Interconnects." in *Proceedings of the ACM/IEEE Design Automation Conference (DAC)*, pp. 931-936, San Francisco, CA, USA, December 5-9, 2021.

Journal Papers

[J1] [Link] **Yuan Li**, Ahmed Louri, and Avinash Karanth. "A High-Performance and Energy-Efficient Photonic Architecture for Multi-DNN Acceleration." in *IEEE Transactions on Parallel and Distributed Systems (TPDS)*, vol. 35, no. 1, pp. 46-58, January 2024.

[J2] [Link] **Yuan Li**, Ke Wang, Hao Zheng, Ahmed Louri, and Avinash Karanth. "ASCEND: A Scalable and Energy-Efficient Deep Neural Network Accelerator with Photonic Interconnects." in *IEEE Transactions on Circuits and Systems I (TCAS-I)*, vol. 69, no. 7, pp. 2730-2741, July 2022.

[J3] [Link] **Yuan Li**, Ahmed Louri, and Avinash Karanth. "SPRINT: A High-Performance, Energy-Efficient, and Scalable Chiplet-based Accelerator with Photonic Interconnects for CNN Inference." in *IEEE Transactions on Parallel and Distributed Systems (TPDS)*, vol. 33, no. 10, pp. 2332-2345, October 2022.

[J4] [\[Link\]](#) Ke Wang, Hao Zheng, **Yuan Li**, and Ahmed Louri. "SecureNoC: A Learning-Enabled, High-Performance, and Secure On-Chip Communication Framework Design." in *IEEE Transactions on Sustainable Computing (TSUSC)*, vol. 7, no. 3, pp. 709-723, July 2022.

[J5] [\[Link\]](#) **Yuan Li** and Ahmed Louri. "ALPHA: A Learning-Enabled High-Performance Network-on-Chip Router Design for Heterogeneous Manycore Architectures." in *IEEE Transactions on Sustainable Computing (TSUSC)*, vol. 6, no. 2, pp. 274-288, April 2021.

Patents

[P1] **Yuan Li** and Ahmed Louri. "SPACX: A Hardware and Algorithm Co-Optimized Photonic Deep Neural Network Computing Architecture." *U.S. Provisional Patent No. 63/456,255*, 2023

HONORS AND AWARDS

- Lin Wen Graduate Scholarship, George Washington University 2021
- NSF I-Corps Site Grant Award, George Washington University 2019
- EECE Postgraduate Scholarship, University of Newcastle upon Tyne 2010
- Outstanding Freshman Scholarship, University of Science and Technology of China 2006

RESEARCH EXPERIENCE

My research is supported in part by *National Science Foundation (NSF)*, and I led and participated in collaborations with various academic institutions, e.g., *Ohio University*, *University of Central Florida*, and *University of North Carolina at Charlotte*.

Silicon Photonics and Chiplet-based Deep Neural Network (DNN) Hardware Accelerators 2020 – 2023

- Explored the use of silicon photonics technology to overcome the communication challenges in DNN hardware accelerators
- Designed and simulated photonic interconnection networks that adapt to various general and tailored dataflows for high-performance and energy-efficient communication in DNN hardware accelerators, with a collection of simulators and tools including *SCALE-Sim*, *Timeloop*, *MAESTRO*, *DRAMSim*, *CACTI*, *DSENT*, and *Synopsys Design Compiler*
- Delivered three conference papers in *PACT' 23*, *HPCA' 22*, and *DAC' 21*, and three journal papers in *TCAS-I* and *TPDS*

DRAM and NVM Integration and Management in Chiplet-based Systems 2019 – 2020

- Developed a data exchange mechanism between DRAM and NVM stacks and corresponding hardware modifications targeting actively moving memory pages with high access count yet short access time frame to DRAM stacks
- Simulated the data exchange mechanism and hardware architecture with *Gem5-GPU*, *DRAMSim*, *CACTI*, and *DSENT*
- Won the **NSF I-Corps Site Grant Award**.

Efficient NoC for Accelerator-Rich Heterogeneous Manycore Systems 2018 – 2019

- Developed an NoC router microarchitecture and an artificial neural network (ANN) based mechanism to alleviate local and global contention for high-throughput and low-latency communication
- Simulated the router microarchitecture and ANN mechanism with *Gem5*, *Gem5-GPU*, *DSENT*, and *Synopsys Design Compiler*
- Delivered one journal paper in *TSUSC*

Intelligent Hardware Trojan (HT) Detection in Secure Network-on-Chip Architectures 2021 – 2022

- Participated in developing runtime accurate HT detection modules in NoC architectures using multilayer perceptron (MLP) and generative adversarial network (GAN) models
- Participated in power and area evaluation of HT detection modules with *DSENT* and *Synopsys Design Compiler*
- Delivered one conference paper in *DATE' 22* and one journal paper in *TSUSC*

TEACHING EXPERIENCE

Graduate Teaching Assistant 2020, 2021

- Data Structures and Algorithms (GWU ECE 1125.30)
- Computer Architecture and Design (GWU ECE 4535.81 / 6005.81)

PROFESSIONAL EXPERIENCE

Postdoctoral Associate

George Washington University

2023 – present

Graduate Research Assistant

George Washington University

2018 – 2022

PRESENTATIONS

[1] "SPACX: Silicon Photonics-based Chiplet Accelerator for DNN Inference", *28th IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, Virtual Conference, April 2022.

[2] "Scaling Deep Learning Inference with Chiplet-based Architecture and Photonic Interconnects", *58th ACM/IEEE Design Automation Conference (DAC)*, San Francisco, CA, December 2021.

SERVICE AND TECHNICAL REVIEWING

Conference Reviewer and Sub-Reviewer

- *ACM/IEEE International Symposium on Computer Architecture (ISCA)* 2019, 2022, 2024
- *IEEE International Symposium on High-Performance Computer Architecture (HPCA)* 2020, 2021
- *ACM Great Lakes Symposium on VLSI (GLSVLSI)* 2024
- *IEEE/ACM International Symposium on Networks-on-Chip (NOCS)* 2018, 2019
- *IEEE International Conference on Computer Design (ICCD)* 2018

Journal Reviewer

- *IEEE Transactions on Parallel and Distributed Systems (TPDS)* 2023, 2024
- *IEEE Transactions on Very Large Scale Integration Systems (TVLSI)* 2023
- *IEEE Transactions on Consumer Electronics (TCE)* 2023
- *IEEE Transactions on Emerging Topics in Computing (TETC)* 2018

RELEVANT TECHNICAL COURSEWORK

Computer Architecture Modeling

- Processor microarchitecture and memory hierarchy modeling with *SimpleScalar*, *Gem5*, *Gem5-GPU*, *CACTI*, *DRAMSim*, etc.
- NoC modeling with *BookSim*, *Garnet*, *DSENT*, *OptiSPICE*, etc.
- DNN hardware accelerator modeling with *Timeloop*, *MAESTRO*, *SCALE-Sim*, *ASTRA-Sim*, etc.

Embedded System Design

- Data acquisition & processing and motion control system development with *NI LabVIEW* and *NI PXI & CompactRIO*
- Data acquisition & processing and waveform generation system development with *Microchip PIC18 controllers* and *MPLAB X IDE*

Printed Circuit Board (PCB) Design

- Signal processing, thermal control, and fiber-optic communication PCBs design with *NI Multisim* and *Altium Designer*

Design for Testability (DFT)

- MIPS processor scan flops synthesis and ATPG with *Synopsys Design Vision* and *Synopsys TetraMAX*

HDL Programming and Synthesis

- Digital filter implementation with *VHDL* and *FLEX EPF10K70 FPGA*
- MIPS processor design and synthesis with *Verilog*, *Cadence SimVision*, *Synopsys Design Vision*, and *Cyclone IV EP4CE115 FPGA*
- Virtual channel NoC router design and synthesis with *Verilog*, *Cadence SimVision*, and *Synopsys Design Vision*

Integrated Circuit Layout Design

- D flip-flop layout design with *Cadence Virtuoso*
- MIPS processor layout design and routing with *Cadence Virtuoso* and *Cadence Encounter*

Device Simulation and Fabrication

- MOS transistor scaling and simulation with *Synopsys TSUPREM-4*
- Device fabrication training with 0.16 μm process technology at *INEX Microtechnology Ltd.*

SKILLS

Programming Languages

- *C / C++, Python, Visual Basic, MATLAB, Assembly, Verilog / VHDL*

Design & Modeling Tools

- *Gem5, Gem5-GPU, SimpleScalar, Timeloop, MAESTRO, SCALE-Sim, DRAMSim, BookSim, Garnet, CACTI, DSENT, OptiSPICE*
- *LabVIEW, MPLAB X IDE, NI Multisim, Altium Designer*
- *Synopsys TetraMAX, Altera Quartus II, Cadence SimVision, Cadence Virtuoso / Encounter, Synopsys Design Vision, Synopsys TSUPREM*