

Liangkai Liu

Research Fellow, University of Michigan

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RESEARCH INTERESTS

Cyber-Physical Systems, Embedded AI, Autonomous Driving, Edge Computing, Robotics.

EXPERIENCE

- University of Michigan *September 2023 - Present*
Research Fellow
Ann Arbor, MI, USA
 - Mentor: Prof. Kang G. Shin
- University of Delaware *May 2023 - August 2023*
Postdoctoral Researcher
Newark, DE, USA
 - Mentor: Prof. Weisong Shi
- Argonne National Laboratory *May 2021 - August 2021*
Research Intern
Lemont, IL, USA
- Argonne National Laboratory *May 2020 - August 2020*
Research Intern
Lemont, IL, USA

EDUCATION

- Wayne State University *January 2018 - May 2023*
Ph.D. in Computer Science
Detroit, MI, USA
 - Advisor: Prof. Weisong Shi
 - Dissertation: *Predictable DNN Inference for Autonomous Driving.*
- Xidian University *August 2013 - June 2017*
B.S. in Telecommunication Engineering
Xi'an, China

AWARDED GRANT

- **NSF CSR: Small: Predictable Multi-Tenant DNN Inference for Autonomous Driving**
My Role: **Co-Principal Investigator** (My share: \$300,000)
PI: Weisong Shi
Awarded amount: \$600,000 (10/1/2024 - 9/30/2027)
Grant number: **2343601**

PUBLICATIONS

C=CONFERENCE, J=JOURNAL, B=BOOK, S=IN SUBMISSION

- [Google Scholar](#) (as of July 28, 2025): **2,352** citations, H-Index: **18**, i10-Index: **22**.
- **25** research papers in prestigious conferences/journals, **15** first-authored papers
- 1 book

Books

[B1] Weisong Shi and **Liangkai Liu**. *Computing Systems for Autonomous Driving*. November 2021, Springer.

Journals

[J6] **Liangkai Liu**, Sidi Lu, Ren Zhong, Baofu Wu, Yongtao Yao, Qingyang Zhang, and Weisong Shi, "Computing Systems for Autonomous Driving: State-of-the-Art and Challenges", in *IEEE Internet of Things Journal (IoTJ)*, Vol. 8, No. 8, pp. 6469-6486, December 2020. (**450+ citations**)

[J5] Shaoshan Liu, **Liangkai Liu**, Jie Tang, Bo Yu, Yifan Wang, and Weisong Shi, "Edge Computing for Autonomous Driving: Opportunities and Challenges," *Proceedings of the IEEE*, Vol. 107, No. 8, pp. 1697-1716, August 2019. (**800+ citations**)

[J4] **Liangkai Liu**, Yanzhi Wang, and Weisong Shi, "CPT: A Configurable Predictability Testbed for DNN Inference in AVs," in *Tsinghua Science and Technology*, September 2024.

[J3] **Liangkai Liu**, Wei Li, Dawei Wang, Yi Wu, Ruigang Yang, and Weisong Shi, "Fuel Rate Prediction for Autonomous Heavy-Duty Trucks," in *IEEE Transactions on Intelligent Transportation Systems (TITS)*, 2023.

[J2] **Liangkai Liu**, Shaoshan Liu, and Weisong Shi, "4C: A Computation, Communication, and Control Co-Design Framework for CAVs," in *IEEE Wireless Communications (IWC)*, Vol. 28, No. 4, pp. 42-48, August 2021.

[J1] Tianze Wu, Baofu Wu, Sa Wang, **Liangkai Liu**, Shaoshan Liu, Yungang Bao, and Weisong Shi, "Oops! It's Too Late. Your Autonomous Driving System Needs a Faster Middleware," *IEEE Robotics and Automation Letters (RA-L)*, Vol. 6, No. 4, pp. 7301-7308, July 2021.

RESEARCH PROJECTS

- **Safe and Predictable Perception Pipeline for Autonomous Vehicles** *September 2023 - present*
University of Michigan
Mentor: Kang G. Shin
 - RT-BEV: the first framework co-optimizes message communication and object detection with dynamic region of interests (ROIs) for improving real-time e2e BEV perception without sacrificing accuracy. (RTSS'24)
 - PP-DNN: models critical regions into variable sizes ROIs to achieve predictable perception pipeline.
- **Energy-Efficient Cyber Physical Systems** *September 2023 - present*
University of Michigan
Mentor: Kang G. Shin
 - pNav: a novel power-management system designed to enhance the power/energy-efficiency of Autonomous Mobile Robots (AMRs) by jointly optimizing their physical/mechanical and cyber subsystems.
 - eXR: an energy-efficient middleware designed for extended reality application based on coordinated management of feature extraction, resource scheduling, and DVFS configurations.
- **DNN Inference Time Variations for Autonomous Vehicles** *January 2020 - August 2023*
Wayne State University, University of Delaware
Mentor: Weisong Shi
 - PDNN Grant: Awarded a research grant from NSF for studying predictable multi-tenant DNNs inference time variations for autonomous vehicles. (**NSF Grant**)
 - Prophet: identify root causes for DNN inference time variations and propose an early-exit coordination system to optimization the inference pipeline for autonomous vehicles. (RTSS'22, RTAS'23)
 - CPT: propose a reconfigurable testbed for profiling the DNN inference time and accuracy variations for autonomous vehicles under various traffic environments. (Tsinghua Science and Technology, 2023)
 - Analyze the time variation in DNN inference in fine granularity from six perspectives: data, I/O, model, runtime, hardware, and end-to-end perception system. (MLBench'23)

- **Energy/Fuel Efficient Autonomous Trucking/Driving** *May 2019 - May 2023*
Wayne State University
Mentor: Weisong Shi
 - Create a fuel dataset using the truck's engine management system (EMS) and Instant Fuel Meter (IFM) and propose ML-based prediction model for real-time fuel prediction and integrated into predictive planning for autonomous trucking. (IEEE TITS, 2023)
 - Develop a customized AMR called Donkey, which has the capability for millisecond-level end-to-end power profiling. Propose a comprehensive energy prediction model that provides real-time energy consumption for each component of the autonomous mobile robots. (ICRA'23)
 - E2M: an energy-efficient middleware software stack for optimizing the computing stack of autonomous mobile robots. (SEC'19)
- **Open Platforms for Connected and Autonomous Vehicles** *May 2018 - December 2021*
Wayne State University
Mentor: Weisong Shi
 - Led the development of a level-4 autonomous driving vehicle (**Hydra**) based on Autoware and DriveWorks with a complete sensor suite (LiDAR, camera, radar, GNSS, etc.).
 - Designed and implemented **Equinox**, a Road Side Unit (RSU) with heterogeneous computation and communication resources. Developed a vehicular edge computing (**VEC**) prototype supporting WiFi, DSRC, and LTE; compared their performance using real CAV applications. (HotEdge'20, MeterCAD'20)
 - Designed **HydraOne** from scratch, an indoor research and education platform. (HotEdge'19)
- Edge Computing Enabled Applications for Public Safety *January 2018 - December 2018*
Wayne State University
Mentor: Weisong Shi
 - SafeShareRide: an edge-based real-time attack detection system in ridesharing services. (HotEdge'18, SEC'18)
 - AutoVAPS: an edge-based reference architecture for privacy-preserving data sharing and access on law enforcement vehicles. (CPS WEEK'18 Workshop)

HONORS AND AWARDS

- Department Travel Award for Outstanding Conference Publications 2023
Wayne State University
- RTSS Student Travel Grant 2022
IEEE Real-Time Systems Symposium
- Department Travel Award for Outstanding Conference Publications 2022
Wayne State University
- NSF ACM/IEEE Symposium on Edge Computing Student Travel Grant 2021, 2019, 2018
National Science Foundation
- Top Ten Seniors Award 2016
Xidian University
- First Prize, CETC-10 Literature Review Contest 2016
CETC-10, Xidian University

TEACHING EXPERIENCE

- Guest lecture, Building Predictable and Power-Efficient Autonomous Cyber-Physical Systems 2024
University of Michigan, Oakland University
- Guest lecture, Robot Platforms for CPS Research 2024
University of Michigan, EECS-571
- Guest lecture, Building Predictable and Efficient System for Autonomous Vehicles/Robots 2024
University of Michigan, University of North Texas, California Polytechnic State University

- Seminar talk: Introduction to Autonomous Driving
HensHack at University of Delaware 2023
- Computing systems for connected and autonomous driving
UIUC physical AI group 2022
- Teaching Assistant, Introduction to Java Programming
Wayne State University 2018

MENTORING EXPERIENCE

- Sanjith Udupa
Novi High School student; now undergraduate at MIT *Mentored: 2022/2023*
first-authored paper
- Mingyu Guo
Undergraduate at the University of Wisconsin–Madison; now Ph.D. at University of Delaware *Mentored: 2023*
- Yuchen Chueh
Admitted to Master's Program at Carnegie Mellon University, now at Nvidia *Mentored: 2020*
- Justin Baskaran
Backend Software Engineer at General Motors *Mentored: 2018*

PROFESSIONAL SERVICES

- Grant proposal reviewer, AAPG 2025, French National Research Agency's (ANR)
- Publication Chair, ACM/IEEE Symposium on Edge Computing, 2025.
- Program Committee, IEEE Conference on Dependable and Secure Computing (DSC), 2025
- Program Committee, IEEE International Conference on Mobility: Operations, Services, and Technologies (MOST), 2024/2025
- Program Committee, Workshop on Compute Platforms for Autonomous Vehicles (CAV), ASPLOS 2024
- Program Committee, The 21th ACM Conference on Embedded Networked Sensor Systems (SenSys 2023) Posters & Demos
- Reviewer, International Conference on Computer Vision (ICCV), 2025
- Reviewer, IEEE/CVF Computer Vision and Pattern Recognition Conference (CVPR), 2024/2025
- Reviewer, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2022/2023/2024
- Reviewer, IEEE International Conference on Robotics and Automation (ICRA), 2023
- Web Chair, The 30th Annual International Conference on Mobile Computing and Networking (MobiCom 2024)
- Committee Member, Technical Steering Committee of the Autoware Foundation, October 2022 - December 2023
- Verified and Recognized Journal Reviewer: IEEE Communications Magazine, Proceedings of the IEEE, IEEE Transactions on Vehicular Technology, IEEE Vehicular Technology Magazine, IEEE Transactions on Services Computing, IEEE Internet of Things Journal, IEEE Network Magazine, IEEE Internet Computing, IEEE Open Journal of Circuits and Systems, IEEE Transactions on Network Science and Engineering, IEEE Transactions on Intelligent Transportation Systems, and IEEE Robotics and Automation Letters.