

Liangkai Liu

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EMPLOYMENT

University of Michigan

Research Fellow

MI, USA

Sep. 2023 - present

University of Delaware

Postdoctoral Researcher

DE, USA

May 2023 - Aug. 2023

EDUCATION

Wayne State University

Ph.D of Computer Science, GPA: 3.98/4.0

Detroit, USA

Jan. 2018 - May. 2023

Xidian University

Bachelor of Telecommunication Engineering, GPA: 3.25/4.0

Xi'an, China

Aug. 2013 - Jun. 2017

RESEARCH INTERESTS

Topic: Edge Computing, Distributed Systems, Connected and Autonomous Vehicles

Advisor: Professor Weisong Shi.

TECHNICAL SKILLS

- **Systems:** ROS, ROS2, Autoware, Linux Ubuntu, Docker
- **Libraries and Protocols:** PyTorch, TensorFlow, CUDA, OpenCV, FFmpeg, RTSP
- **Programming Languages:** Python, C/C++, SQL, PHP

AWARDS AND ACHIEVEMENTS

- Department Travel Award for Outstanding Conference Publications, 2023.
- RTSS Student Travel Grant, 2022.
- Department Travel Award for Outstanding Conference Publications, 2022.
- NSF ACM/IEEE Symposium on Edge Computing (SEC) Student Travel Grant, 2021/2019/2018.
- Top Ten Seniors Award, School of Telecommunication Engineering, Xidian University, 2016.
- First Prize, CETC-10 Literature Review Contest, 2016.

ACADEMIC PROJECTS

Edge Computing for Connected and Autonomous Vehicles

May 2018 - Present

- Design [HydraOne](#) from scratch, which is an indoor research and education platform. (HotEdge'19)
- Lead to develop a level-4 autonomous driving vehicles (called [Hydra](#)) based on Autoware and DriveWorks.
- Design and implement OpenVDAP, which is the first full-stack edge based platform for connected and autonomous vehicles.
- DNN time variations profiling and optimization for autonomous driving vehicles. (RTSS'22, RTAS'23)
- Energy-efficient autonomous mobile robots. (SEC'19, ICRA'23)
- Design and implement Equinox from scratch, which is a typical design of Road Side Unit (RSU) with heterogeneous computation, storage, and communication resources.
- Implement a V2X communication prototype which can support WiFi, DSRC, and LTE; compare their performance, energy efficiency, system overhead using real CAVs applications.

Fuel Rate Modeling for Energy Efficient Autonomous Trucking

Mar. 2020 - Mar. 2021

- Collect a three-month Engine Management System (EMS) and Instant Fuel Meter (IMF) dataset.
- Fine-grained real-time fuel rate prediction model.

OpenVDAP: An Open Vehicular Data Analytics Platform

Jan 2018 - Present

- Design and implement OpenVDAP, which is the first full-stack edge based platform for connected and autonomous vehicles.
- Implement OpenVDAP including an on-board computing/communication unit, an isolation-supported and security & privacy-preserved vehicle operation system, an edge-aware application library, as well as an optimal workload offloading and scheduling strategy.

Edge Computing Enabled Applications for Public Safety

Jan 2018 - Dec 2018

- Propose edge-based attack detection called SafeShareRide in ridesharing services; leverage smartphones as the edge computing platform and it consists of three stages: speech recognition, driving behavior detection, and video capture and analysis. (SEC'18, HotEdge'18)
- Propose a reference architecture called AutoVAPS consisting of the data layer for data management, the model layer for edge intelligence, and the access layer for privacy-preserving data sharing and access.

EXPERIENCE

Argonne National Laboratory

USA

Research Intern

May 2021 - Aug. 2021

- SAGE: Cyberinfrastructure for AI at the Edge
 - Evaluate the performance of different DNN optimization techniques for ML at the edge
 - Work on anything DNNs for real-time DNN inference.

Argonne National Laboratory

USA

Research Intern

May 2020 - Aug. 2020

- SAGE: Cyberinfrastructure for AI at the Edge
 - Evaluate the performance of ML applications using TensorFlow on RT and generic Linux kernel
 - Evaluate the performance of data communications in ROS and ROS2 on NVIDIA Jetson AGX/NX/TX2.

NetEase Hangzhou Research Center

Hangzhou, China

Research Intern

Jul. 2017 - Oct. 2017

- NetEase's Distributed File System
 - Evaluate some distributed file systems including GFS and HDFS.
 - Design and implement the uniform-blob based DFS for cloud service in NetEase.

REFERRED PUBLICATION

Conference Papers.....

1. Chao Wu*, Yifan Gong*, **Liangkai Liu***, Mengquan Li, Yushu Wu, Xuan Shen, Zhimin Li, Geng Yuan, Weisong Shi, and Yanzhi Wang, AyE-Edge: Automated Deployment Space Search Empowering Accuracy yet Efficient Real-Time Object Detection on the Edge, in International Conference on Computer-Aided Design (ICCAD), 2024. (* means equal contribution)
2. Yifan Gong, Yushu Wu, Zheng Zhan, **Liangkai Liu**, Chao Wu, Xulong Tang, Yanzhi Wang, LOTUS: Learning-Based Online Thermal and Latency Variation Management for Two-Stage Detectors on Edge Devices, in Design Automation Conference (DAC), 2024.
3. **Liangkai Liu**, Ren Zhong, Aaron Willcock, Nathan Fisher, and Weisong Shi, An Open Approach to Energy-Efficient Autonomous Mobile Robots, in Proceedings of 2023 IEEE International Conference on Robotics and Automation (ICRA), May 29 - June 2, 2023, London, UK. (**top conference in robotics listed in csranking**)
4. Abdullah Al Arafat, Sudharsan Vaidhun, **Liangkai Liu**, Kecheng Yang, and Zhishan Guo, Compositional Mixed-Criticality Systems with Multiple Executions and Resource-Budgets Model, in Proceedings of the 29th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS), 2023. (**top conference in embed and real-time systems listed in csranking**)

5. **Liangkai Liu**, Zheng Dong, Yanzhi Wang, and Weisong Shi, Prophet: Realizing a Predictable Real-time Perception Pipeline for Autonomous Vehicles, in Proceedings of the 43rd IEEE Real-Time Systems Symposium (RTSS), 2022. (**top conference in embedded and real-time systems listed in csrcranking**)
6. **Liangkai Liu**, Baofu Wu, and Weisong Shi, A Comparison of Communication Mechanisms in Vehicular Edge Computing, in Proceedings of the 3rd USENIX Workshop on Hot Topics in Edge Computing (**HotEdge**), July 14, 2020, Boston, MA, USA.
7. **Liangkai Liu**, Yongtao Yao, Ruijun Wang, Baofu Wu, and Weisong Shi, Poster: Equinox: A Road-Side Edge Computing Experimental Platform for CAVs, in Proceedings of third IEEE International Conference on Connected and Autonomous Driving (**MetroCAD**), Feb. 27-28, 2020, Detroit, MI.
8. **Liangkai Liu**, Jiamin Chen, Marco Brocanelli, and Weisong Shi, E2M: An Energy-Efficient Middleware for Computer Vision Applications on Autonomous Mobile Robots, in Proceedings of the fourth ACM/IEEE Symposium on Edge Computing (**SEC**), November 7-9, 2019, Arlington, VA, USA.
9. **Liangkai Liu**, Xingzhou Zhang, Qingyang Zhang, Andrew Weinert, Yifan Wang, and Weisong Shi, AutoVAPS: an IoT-Enabled Public Safety Service on Vehicles, in Proceedings of 4th Workshop on Science of Smart City Operations and Platforms Engineering (**SCOPE**), April 15-18, 2019.
10. **Liangkai Liu**, Xingzhou Zhang, Mu Qiao, and Weisong Shi, SafeShareRide: Edge-based Attack Detection in Ridesharing Services, in Proceedings of the third ACM/IEEE Symposium on Edge Computing (**SEC**), Oct. 25-27, 2018. Bellevue, WA.
11. **Liangkai Liu**, Xingzhou Zhang, Mu Qiao, and Weisong Shi, SafeShareRide: Edge-based Attack Detection in Ridesharing Services, in Proceedings of the 1st USENIX Workshop on Hot Topics in Edge Computing (**HotEdge**), July 10, 2018. Boston, MA.
12. Yifan Wang, **Liangkai Liu**, Xingzhou Zhang, and Weisong Shi, HydraOne: An Indoor Experimental Research and Education Platform for CAVs, in Proceedings of the 2nd USENIX Workshop on Hot Topics in Edge Computing (**HotEdge**), July 9, 2019, Renton, USA.
13. Xingzhou Zhang, Yifan Wang, Sidi Lu, **Liangkai Liu**, Lanyu Xu, and Weisong Shi, OpenEI: An Open Framework for Edge Intelligence, in Proceedings of the 39th IEEE International Conference on Distributed Computing Systems (**ICDCS**), Vision/Blue Sky Track, July 7-10, 2019, Dallas, USA.
14. Xingzhou Zhang, Mu Qiao, **Liangkai Liu**, and Weisong Shi, Collaborative Cloud-Edge Computation for Personalized Driving Behavior Modeling, in Proceedings of the fourth ACM/IEEE Symposium on Edge Computing (**SEC**), November 7-9, 2019, Arlington, VA, USA.
15. Qingyang Zhang, Yifan Wang, Xingzhou Zhang, **Liangkai Liu**, Xiaopei Wu, Weisong Shi and Hong Zhong, OpenVDAP: An Open Vehicular Data Analytics Platform for CAVs, in Proceedings of the 38th IEEE International Conference on Distributed Computing Systems (**ICDCS**), Vision/Blue Sky Track, July 2-5, 2018, Vienna, Austria.

Journal Papers.....

1. **Liangkai Liu**, Yanzhi Wang, and Weisong Shi, CPT: A Configurable Predictability Testbed for DNN Inference in AVs, Tsinghua Science and Technology, March 2024.
2. **Liangkai Liu**, Wei Li, Dawei Wang, Yi Wu, Ruigang Yang, and Weisong Shi, Fuel Rate Prediction for Autonomous Heavy-Duty Trucks, accepted to **IEEE Transactions on Intelligent Transportation Systems**. (**Impact Factor: 9.551**)
3. **Liangkai Liu** and Weisong Shi, 4C: A Computation, Communication, and Control Co-Design Framework for CAVs, **IEEE Wireless Communications**, Vol. 28, No. 4, pp. 42-48, August 2021. (**Impact Factor: 12.777**)
4. **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, **IEEE Internet of Things Journal**, Vol. 8, No. 8, pp. 6469-6486, December 2020. (**Impact Factor: 10.238**)
5. 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. (**Impact Factor: 14.91**)
6. 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, Vol. 6, No. 4, pp. 7301-7308, July 2021. (**Impact Factor: 4.3**)

7. Congfeng Jiang, Tiantian Fan, Honghao Gao, Weisong Shi, **Liangkai Liu**, Christophe Cerin, Jian Wan, Energy-Aware Edge Computing: A Survey, **Computer Communications**, Vol. 151, No. 1, pp. 556-580, February 2020. **Impact Factor: 5.047**

Books.....

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

Verified and Recognized Reviewer

- IEEE/RSJ IROS 2024
- IEEE / CVF CVPR 2024
- IEEE/RSJ IROS 2023
- IEEE/RSJ IROS 2022
- IEEE ICRA 2023
- IEEE Communications Magazine
- Proceedings of the IEEE
- IEEE Transactions for 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
- IEEE Robotics and Automation Letters

PROFESSIONAL SERVICES

- Program Committee, Workshop on Compute Platforms for Autonomous Vehicles (CAV), ASPLOS 2024.
- Program Committee, IEEE MOST 2024.
- Program Committee, SenSys'23 Posters & Demos.
- Web Chair, The 30th Annual International Conference On Mobile Computing And Networking (MobiCom 2024).
- Technical Steering Committee Member of the Autoware Foundation.
- Webmaster, ACM/IEEE Symposium on Edge Computing (SEC'20, SEC'21, SEC'22)
- Webmaster, International Conference on Connected and Autonomous Driving (MetroCAD'20, MetroCAD'21, MetroCAD'22)