

# Liangkai Liu

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**Research Interests:** Edge Computing, Distributed Systems, Computer Networking

## 1 Professional Preparation

Institution	Major or Area	Degree	Year	GPA
Xidian University	Telecommunication Engineering	B.E.	July '13 – Jul '17	3.25/4.0
Wayne State University	Computer Science	Ph.D.	Jan '18 – present	4.0/4.0

## 2 Skills

1. **Operating System:** ROS, Linux Ubuntu
2. **Libraries and Protocols:** OpenCV, FFmpeg, RTSP, TensorFlow, SDN
3. **Programming Languages:** Python, Android, Go, C/C++, Java, HTML, SQL, PHP

## 3 Research Experiences

### 1. Video Analytics in Public Safety '18 – present

we propose an IoT-Enabled public safety service called AutoVAPS which integrates body-worn cameras and other sensors on the vehicle for public safety. In AutoVAPS, we propose a reference architecture that consists of the data layer for data management, the model layer for edge intelligence, and the access layer for privacy-preserving data sharing and access. Object detection is implemented as a case study of AutoVAPS. The case study is focus on achieving real time analysis on the video streaming from body-worn camera.

### 2. Remote Control of Autonomous Driving Vehicle '18 – present

We developed an in-door vehicle, called Hydra. It is equipped with two cameras and uses NVIDIA Jetson TX2 to process computer vision and machine learning tasks. Hydra chassis has four Mecanum wheels, which makes Hydra can do the omnidirectional movement. An Arduino board is equipped to receive the message from Jetson TX2 and control the chassis. On top of Hydra, we implement Robot Operating system(ROS) to manage the system. We implemented two methods of video sharing: Real Time Streaming Protocol(RTSP) method and ROS publisher-subscriber based method. We use OpenCV to capture and publish the image data from Hydra and use another node to subscribe to the image data. The control module is based on ROS turtlesim.

### 3. SafeShareRide: An Open Vehicular Data Analytics Platform '18 – present

We build an edge-based attack detection in ridesharing services, namely *SafeShareRide*, which can detect dangerous events happening in the vehicle in near real time. The detection of *SafeShareRide*

consists of three stages: speech recognition, driving behavior detection, and video capture and analysis. We implemented SafeShareRide system by leveraging open source algorithms.

#### 4. **OpenVDAP: An Open Vehicular Data Analytics Platform** ’17 – present

Inspired by the promising edge computing paradigm, we propose to build an Open Vehicular Data Analytics Platform (*OpenVDAP*) for Connected and Autonomous Vehicles(CAVs), which is a full-stack edge based platform 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, allowing CAVs to dynamically detect each service’s status, computation overhead and the optimal offloading destination so that each service could be finished within an acceptable latency and limited bandwidth consumption. Most importantly, contrast to the proprietary platform, is an open-source platform that offers free APIs and real-field vehicle data to the researchers and developers in the community, allowing them to deploy and evaluate applications on the real environment.

#### 5. **Scheduling Algorithms for Optical Data Center Network** ’15 – 17

Optical circuit switching has been utilized to satisfy the bandwidth requirements in optical interconnected data center network. The scheduling algorithm can improve the performance of optical circuit switching by flexibly configuring the matching of input ports and output ports of switches. However, the employed scheduling algorithms currently can provide flexible scheduling only by frequent reconfiguration of optical switches. But frequent reconfiguration contributes to a waste of link resources. We propose a Best Effort Scheduling Algorithm called BESA motivated by decreasing the reconfiguration frequency of optical switches.

## 4 Publications

1. **Liangkai Liu**, Xingzhou Zhang, Qingyang Zhang, Andrew Weinert, Yifan Wang, Weisong Shi, AutoVAPS: an IoT-Enabled Public Safety Service on Vehicles, submitted to 4th Workshop on Science of Smart City Operations and Platforms Engineering (**SCOPE 2019**).
2. Xingzhou Zhang, Mu Qiao, **Liangkai Liu**, Weisong Shi, Collaborative Cloud-Edge Computation for Personalized Driving Behavior Modeling, submitted to 25TH ACM SIGKDD Conference on Knowledge Discovery and Data Mining (**KDD 2019**).
3. Jie Tang, Shaoshan Liu, Bo Yu, **Liangkai Liu** and Weisong Shi,  $\pi$ -Edge: A Low-Power Edge Computing System for Real-Time Autonomous Driving Services, submitted to the Web Conference 2019 (**WWW’19**).
4. **Liangkai Liu**, Xingzhou Zhang, Mu Qiao, 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.
5. **Liangkai Liu**, Xingzhou Zhang, Mu Qiao, Weisong Shi, SafeShareRide: Edge-based Attack Detection in Ridesharing Services, in Proceedings of USENIX Workshop on Hot Topics in Edge Computing (**HotEdge**), July 10, 2018. Boston, MA.

6. 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.
7. Pengfei Duan, Kun Wang, Xiaoshan Yu, **Liangkai Liu**, Huaxi Gu, Yantao Guo, Flow Driven Energy-aware Routing Algorithm in Data Center Network, The 17th Parallel and Distributed Computing, Applications and Technologies (**PDCAT**), 2016.
8. Hao Lan, **Liangkai Liu**, Xiaoshan Yu, Huaxi Gu, A Novel Multi-Controller Flow Schedule Scheme for Fat-Tree Architecture, the 15th International Conference on Optical Communications and Networks (**ICOON**), 2016.
9. Jiachen Ma, Xuanzhang Liu, Kun Wang, **Liangkai Liu**, Huaxi Gu, Virtual Optical Network Embedding with SDN Architecture Based on Memetic Algorithm, The 4th International Conference on Computer Science and Network Technology (**ICCSNT**), pp. 1050-1053, 2015

## Journal Papers

1. Lijing Zhu, Kun Wang, Duan Zhou, **Liangkai Liu**, Huaxi Gu, An Optimization Algorithm to Build Low Congestion Multi-Ring Topology for Optical Network-on-Chip, accepted by IEICE Transactions on Information and Systems, 2018.
2. **Liangkai Liu**, Huaxi Gu, Xiaoshan Yu and Kun Wang, MSA: A Multi-mode Scheduling Algorithm for Optical Data Center Networks, Technical Report, May 2017.(submitted)
3. **Liangkai Liu**, Huaxi Gu, Kun Wang and Xiaoshan Yu, BESA: A Scheduling Algorithm for Optical Data Center Network, Technical Report, February 2017.(submitted)

## 5 Reviewer

IEEE Transactions for Vehicular Technology.