

Kaiyu Hou

Curriculum Vitae

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I am currently a fourth year Ph.D. candidate in the Computer Science Department at Northwestern University, advised by Prof. Yan Chen. I have a broad interest in various aspects of cloud networks and network protocols. My current research focuses on network optimization of microservices/serverless based cloud. I am also working for introducing formal methods into network protocol verification.

Education

- **Ph.D. Student in Computer Science** 2017 – (2022)
Northwestern University Evanston, IL
 - Advisor: Prof. [Yan Chen](#)
 - Area: Networked System, Cloud Networking
 - GPA: 3.97/4.0
- **Master's in Computer Science** 2014 – 2017
Xi'an Jiaotong University Shaanxi, China
 - Advisor: Prof. [Chengchen Hu](#)
 - Area: Software Defined Networking (SDN)
 - Rank: 1st/89 GPA: 3.81/4.0 Average: 91.7
- **B.E. in Software Engineering** 2010 – 2014
Xi'an Jiaotong University Shaanxi, China
 - Rank: 1st/78 GPA: 3.94/4.0 Average: 92.4 (in Junior and Senior year)

Work Experiences

- **SRI International** Menlo Park, CA
Research Intern, at Computer Science Laboratory Jun. 2020 – Sep. 2020
 - Advisor: Dr. [Vinod Yegneswaran](#)
 - Designed and implemented an enterprise-wide radio situational awareness system
 - Passively collected radio traffics, including Wi-Fi and Bluetooth, analyzed by deep learning

Research: Cloud Networks & SDN

- **Network Optimizing for Microservices/Serverless Cloud** (work in progress) 2020 – Present
 - Microservice/serverless architecture brings flexibility but introduces network communication delay
 - Aim to design systematic metrics to provide a benchmark for the microservice network performance
 - Integrated QUIC into **OpenFaaS/Kubernetes** to improve serverless network performance

- **Generic Security Policy Enforcement System for SDN-based Cloud** 2017 – 2018
 - Designed a **policy language** for resource protection and management of SDN-based Cloud
 - Implemented in the **OpenDaylight** controller, and deployed on **OpenStack**

Publication: [IWQoS'18] Lightweight Resource Protection and Management System for SDN-based Cloud
- **Routing Policy for Solving Reactive Model Overhead of Software Defined Networks** 2016 – 2017
 - Proposed a routing policy to reduce the control channel bandwidth consumption up to 80%
 - Implemented in the **Floodlight** controller under the **OpenFlow** protocol with **Open vSwitch**
 - Deployed on the ONetSwitch, an OpenFlow white-box switch with Xilinx FPGA

Publication: [ICNP'17] SoftRing: Taming the reactive model for software defined networks

Research: Formal Methods for Network Protocols

- **Formal Verification and Vulnerability Detection of LTE/5G Protocols** 2019 - 2020
 - Used **TLA+** to formally specify the emergency call systems in **4G/5G** cellular network protocols
 - Built a **complete cellular network testbed** (USRP, OpenAirInterface) and verified these issues
 - Discovered serious availability and security issues in real-world, **acknowledged by major carriers**

Publication: [Under Review] Discovering Emergency Call Pitfalls for Cellular Networks with Formal Methods
- **Formal Secure Configuration Search for Network Protocols** (work in progress) 2020 - Present
 - Traditionally, researchers use secure properties to verify a protocol is safe or find counterexamples
 - We convert this decision problem into a search problem. Given the model and the properties, we aim to search the boundaries of the configuration space where the system is always secure and reliable.
 - We employ inductive generalization and improved IC3 algorithm to determine the space.

Publication: [Sigcomm'20 Poster] Network Protocol Safe Configuration Search in One Shot

Publication List

- **Discovering Emergency Call Pitfalls for Cellular Networks with Formal Methods**
Kaiyu Hou*, You Li*, Yinbo Yu, Yan Chen, Hai Zhou (*equal contribution)
 Under Review
- **Network Protocol Safe Configuration Search in One Shot**
 You Li*, **Kaiyu Hou***, Hai Zhou, Yan Chen (*equal contribution)
 ACM Special Interest Group on Data Communication (SIGCOMM, Poster), 2020.
- **State of the Art and Research Challenges in the Security Technologies of Network Function Virtualization**
 Xiaochun Wu, **Kaiyu Hou**, Xue Leng, Xing Li, Yinbo Yu, Bo Wu, Yan Chen
 IEEE Internet Computing, 2020
- **CellScope: Automatically Specifying and Verifying Cellular Network Protocols**
 Yinbo Yu, You Li, **Kaiyu Hou**, Yan Chen, Hai Zhou, Jianfeng Yang
 ACM Special Interest Group on Data Communication (SIGCOMM, Poster), 2019

- ***A Lightweight Policy Enforcement System for Resource Protection and Management in the SDN-based Cloud***
Xue Leng, **Kaiyu Hou**, Yan Chen, Kai Bu, Libin Song, You Li
Computer Networks, Elsevier, 2019
- ***COIN: A fast packet inspection method over compressed traffic***
Xiuwen Sun, Hao Li, Dan Zhao, Xingxing Lu, **Kaiyu Hou**, Chengchen Hu
Journal of Network and Computer Applications, Elsevier, 2019
- ***SDNKeeper: Lightweight Resource Protection and Management System for SDN-based Cloud***
Xue Leng, **Kaiyu Hou**, Yan Chen, Kai Bu, Libin Song
IEEE/ACM 26th International Symposium on Quality of Service (IWQoS), 2018
- ***SoftRing: Taming the reactive model for software defined networks***
Chengchen Hu, **Kaiyu Hou** (1st student author), Hao Li, Ruilong Wang, Peng Zheng, Peng Zhang, Huanzhao Wang
IEEE 25th International Conference on Network Protocols (ICNP), 2017
- ***Towards A Fast Packet Inspection over Compressed HTTP Traffic***
Xiuwen Sun, **Kaiyu Hou**, Hao Li, Chengchen Hu
IEEE/ACM 25th International Symposium on Quality of Service (IWQoS), 2017

Teaching Experiences

- CS 214: Data Structure and Data Management Winter, 2021
Teaching Assistant, Northwestern University
- CS 214: Data Structure and Data Management Fall, 2020
Teaching Assistant, Northwestern University
- CS 212, Mathematical Foundations of Computer Science Spring, 2020
Teaching Assistant, Northwestern University
- CS 340, Introduction to Networking (**Best Teaching Assistant Award**) Winter, 2020
Teaching Assistant, Northwestern University
- CS 214, Data Structure and Data Management Fall, 2019
Teaching Assistant, Northwestern University
- EECS 343, Operating Systems Spring, 2019
Teaching Assistant, Northwestern University
- EECS 340, Introduction to Networking Winter, 2019
Assistant Lecturer, Northwestern University
- EECS 340, Introduction to Networking Fall, 2018
Teaching Assistant, Northwestern University
- IT 458, Information Security and Assurance Winter, 2018
Teaching Assistant, Northwestern University

- Computer Programming (C++) for CS Honored Class Fall, 2016
Teaching Assistant, Xi'an Jiaotong University

Professional Services

- Sub-reviewer of ACM CCS (2018, 2019)
- Sub-reviewer of IEEE ICDCS (2018)
- Reviewer of IEEE/ACM Transactions on Networking (ToN)

Awards

- **Bronze Medal**, ACM-ICPC Asia Regional Contest 2012, 2013, 2014
- **Silver Medal**, ACM-ICPC China Province Contest, Chengdu 2012, 2013
- **Meritorious Winner**, Mathematical Contest in Modeling (MCM) 2013

Honor

- **Best Teaching Assistant Award** (*Peter and Adrienne Barris Outstanding TA*) 2020
Northwestern University
- **Graduate (Cadre) with Honor** 2017
Xi'an Jiaotong University
- **Excellent Postgraduate Student Leader Award** 2015, 2016
Xi'an Jiaotong University
- **Graduate with Honor** 2014
Xi'an Jiaotong University
- **Excellent Student Model Nomination** (16/13000) 2013
Xi'an Jiaotong University
- **Google Excellence Scholarship** 2013
Awarded to 3 students from each of 20 top Chinese universities
- **Excellent Student Award** 2011, 2012, 2013
Xi'an Jiaotong University

Social Activities

- **Student President** of Computer Science Dept., (Class 2017) 2014 – 2017
Xi'an Jiaotong University
- **Student Councilor**, the Student Congress of ChungYing College 2013 - 2014
Xi'an Jiaotong University
- **Chair**, the ACM-ICPC Club 2012 - 2013
Xi'an Jiaotong University

- **Science and Education Minister** of Student Union 2011-2012
Xi'an Jiaotong University
- **Co-Founder & the 2nd Store Manager** of *Bingo Cafe* 2010-2013
ChungYing College, Xi'an Jiaotong University

Skills

- L2/L3/L4 Protocols, 3GPP Cellular Network Protocols (NAS layer), 802.11 Protocols, QUIC Protocols
- Serverless Platforms, Microservice Networks, Cloud Networks, SDN
- Formal Methods for Network Protocols
- Python, Go-lang