Kaiyu Hou

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I am currently a 4th 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: Network Protocols, Cloud Networking GPA: 3.97/4.00
- **Master's** in **Computer Science** 2014 – 2017
  Xi'an Jiaotong University Shaanxi, China
  - Advisor: Prof. Chengchen Hu Area: SDN Rank: 1st/89 GPA: 3.81/4.00 Average: 91.7
- **B.E.** in **Software Engineering** 2010 – 2014
  Xi'an Jiaotong University Shaanxi, China
  - Rank: 1st/78 GPA: 3.94/4.00 Average: 92.4 (in Junior and Senior years)

Work Experiences

- **SRI International** Menlo Park, CA
  Research Intern, at Computer Science Laboratory, Jun. 2020 – Sep. 2020
  - 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
  - Microservices/Serverless architectures bring flexibility but introduce network communication delay
  - Designed systematic metrics to provide a benchmark for the microservices 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**
- **Routing Policy for Solving Reactive Model Overhead of SDN** 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/P4 white-box switch with Xilinx FPGA

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) for real-world verification
  - Discovered serious availability and security issues in real world, **acknowledged by major carriers**

- **Formal Secure Configuration Search for Network Protocols** 2020 - 2021
  - 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

Selected Publications

- You Li*, **Kaiyu Hou***, Yan Chen, Hai Zhou (*equal contribution), ***Property Guided Secure Configuration Space Search***, Under Review, CAV'21
- **Kaiyu Hou***, You Li*, Yinbo Yu, Yan Chen, Hai Zhou (*equal contribution), ***Discovering Emergency Call Pitfalls for Cellular Networks with Formal Methods***, Under Review, MobiSys'21
- You Li*, **Kaiyu Hou***, Hai Zhou, Yan Chen (*equal contribution), ***Network Protocol Safe Configuration Search in One Shot***, SIGCOMM'20, Poster
- Xiaochun Wu, **Kaiyu Hou**, Xue Leng, Xing Li, Yinbo Yu, Bo Wu, Yan Chen, ***State of the Art and Research Challenges in the Security Technologies of Network Function Virtualization***, Internet Computing, 2020
- Yinbo Yu, You Li, **Kaiyu Hou**, Yan Chen, Hai Zhou, Jianfeng Yang, ***CellScope: Automatically Specifying and Verifying Cellular Network Protocols***, SIGCOMM'19, Poster
- Xue Leng, **Kaiyu Hou**, Yan Chen, Kai Bu, Libin Song, ***SDNKeeper: Lightweight Resource Protection and Management System for SDN-based Cloud***, IWQoS'18
- Chengchen Hu, **Kaiyu Hou** (1st student author), Hao Li, Ruilong Wang, Peng Zheng, Peng Zhang, Huanzhao Wang, ***SoftRing: Taming the Reactive Model for Software Defined Networks***, ICNP'17
- Xiuwen Sun, **Kaiyu Hou**, Hao Li, Chengchen Hu, ***Towards A Fast Packet Inspection over Compressed HTTP Traffic***, IWQoS'17

Awards & Honor

- **Best Teaching Assistant Award**, *Northwestern University* 2020
- **Outstanding Graduate Award**, *Xi'an Jiaotong University* 2014, 2017
- **Excellent Student Award**, *Xi'an Jiaotong University* 2011, 2012, 2013, 2015, 2016
- **Google Excellence Scholarship,** *Awarded to 3 students from each of 20 top Chinese universities* 2013
- **Meritorious Winner**, Mathematical Contest in Modeling (MCM) 2013
- **Silver Medal**, ACM-ICPC China Province Contest 2012, 2013

Activities & Experiences

- **Reviewer/Sub-reviewer** of CCS (18', 19'), ICDCS ('18), IEEE ToN
- **Teaching Assistant**, *Northwestern University*
  - CS 212: Discrete Mathematics (Rating: 5.1/6.0), CS 214: Data Structures (Rating: 5.3/6.0)
  - CS 340: Introduction to Networking (Rating: 5.4/6.0)
- **Student President of Computer Science Dept**. (Class 2017), *Xi'an Jiaotong University* 2014 - 2017
- **Chair, the ACM-ICPC Club**, *Xi'an Jiaotong University* 2012 - 2013

Skills

- Serverless Platforms, Microservices Networks, Cloud Networks, SDN | Python, Go-lang
- L2/L3/L4, 3GPP, 802.11, and QUIC Protocols | Formal Methods for Network Protocols