Zhutian Liu

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Research Interests

Ph.D. candidate in Computer Science, specializing in performance optimization and system security of computer networks. My research focuses on measurement that bridges application performance with cross-layer network behavior, developing optimization techniques informed by data-driven insights. My areas of expertise include:

- **TCP/IP Networking:** Transport-layer protocols, congestion control, and network measurement
- **5G Cellular Networks:** 5G protocol stack and Open RAN architecture
- **Wireless Security:** 802.11 security analysis and Open RAN system testing
- **Video Streaming:** Adaptive video delivery (DASH/HLS) and real-time streaming (WebRTC)
- **Computer Vision and Image Processing:** Machine learning frameworks for vision-based analysis

Education

Ph.D. in Computer Science and Engineering — Jan 2021 – Present
University of California, Riverside. Advisor: Zhaowei Tan — *Riverside, USA*

B.S. in Computer Science and Technology, Minor in Mathematics — Sep 2016 – Jun 2020
University of Electronic Science and Technology of China — *Chengdu, China*

Professional Experience

Graduate Student Researcher — Jan 2021 - Present
University of California, Riverside — *Riverside, USA*

Student Research Intern — Aug 2018 - Oct 2018
Tencent — *Chengdu, China*

Selected Projects

[P.7] WebRTC Live Streaming Orchestration and Measurement Framework
C/C++, Golang, Python, WebRTC
- An automated experiment and measurement framework that conduct experiment and aggregate information from video QoE, streaming application and network transport layer
- Instrument native WebRTC client, capturing fine-grained frame and packet metrics
- Automate P2P experiments orchestration over machine clusters
- Streamline metrics and video processing for CV model training

[P.6] Cross-Layer Measurement Framework for HTTP Adaptive Streaming over 5G
C/C++, JavaScript, Python, TCP/IP, QUIC, HTTP, 5G
- A DASH measurement framework from video encoding to measurement
- Customize *dash.js* and measure video QoE, ABR internal metrics
- Collect transport layer congestion control metrics and 5G link-layer metrics

[P.5] ARCANE: Model-Based Fuzzing for 5G O-RAN Conformance [C.2]
C/C++, Python, TLA++, Docker
- A systematic test suite leveraging LLM-assisted specification analysis to identify cross interface procedures
- Auto-generate conformance test cases from operation traces for crucial procedures
- Evaluate the F1AP protocol on *OpenAirInterface*; uncovered 149 unique bugs across 9 categories

[P.4] M2HO: An in-depth study on 5G Handover Impact on TCP Performance[C.1]
C/C++, TCP/IP, 5G
- A study into TCP performance anomalies induced by 5G handover mechanisms
- Designed a client-side adaptive TCP enhancement via a Linux Netfilter module
- Developed an Android-based emulator reproducing real handover traces for evaluation

[P.3] Cross-interface spoofing Attack between Wi-Fi Clients [U.1]
C/C++, Python, ARP, 802.11
- A MITM attack that hijack client traffic from other Wi-Fi interfaces
- Successfully perform the attack on enterprise hardwares

[P.2] Proxy for Fast Bulk Downloading over Lossy Networks
C/C++, TCP/IP, HTTP
- An HTTP proxy boosting download speed in metered network with artificial packet loss
- Proposed strategy that utilizes redundancy to skip-ahead while downloading in parallel
- Implemented as a transparent proxy on top of *Squid*

[P.1] Mobile LoRa Gateway for Off-Grid Agricultural Sensing
Docker, C, Python, LoRaWAN
- Designed a portable LoRaWAN gateway setup for off-grid telemetry
- Implemented gateway on a Pi mounted on UAV, collaborated with DAF mentees

Selected Publications

[**U**]: Under Submission, [**C**]: Conference, [**W**]: Workshop

[U.1] **Cross-interface Spoofing Attack in Wi-Fi**
Co-author

[C.2] **Automated Model-Based Fuzzing for 5G O-RAN [P.4]**
MobiCom 25 *Sixu Tan, Zeyu Li, Zhutian Liu, Harsh Patel, Zhaowei Tan*
Conference on Mobile Computing and Networking 2025

[C.1] **M2HO: Mitigating the Adverse Effects of 5G Handovers on TCP [P.3]**
MobiCom 24 *Zhutian Liu, Qing Deng, Zhaowei Tan, Zhiyun Qian, Xinyu Zhang, Ananthram Swami, Srikanth V. Krishnamurthy*
Conference on Mobile Computing and Networking 2024

[W.1] **DU-level UE Context Migration [P.4]**
MobiCom 24 *Presenter: Zhutian Liu*
ACM Open-AI RAN 2024 Workshop

Skills

- **Languages**: C/C++, Python, JavaScript, Golang, Shell, Nix
- **Tools**: Netfilter, eBPF, QXDM, NS3, OpenCV, Android NDK, Pytorch, ZeroMQ, Git
- **Knowledge**: TCP/IP, Congestion Control, 5G Protocol, Open RAN, Linux, Android, Machine Learning

Services

- **Conference Reviewer**: ICPADS 2025
- **Volunteer**: ACM CoNext 2025

Teaching Experience

Mentorship

- UR2PhD: Anthony Padilla, Claire Lu and Sethya Pugal – 5G energy measurement — Aug 2024 – Dec 2024
- DAF: Monse Lopez, Jooahn Park and Sofia Tapia – LoRaWAN sensing — Summer 2024, 2025

Teaching Assistant

- CS 169: Mobile Wireless Networks — Winter 2022, 2023, 2025
- CS 164: Computer Networks — Fall 2024
- CS 153: Design of Operating Systems — Spring 2025
- CS 178A: Project Sequence in CSE — Fall 2025