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Research Statement

My research develops **measurement, resource-scheduling, intelligent-operations and security** technologies for **AI and network infrastructure**: the Internet (BGP, RPKI, DNS, Web PKI), carrier backbones and metropolitan networks, the **FITI / CERNET / CERNET2** national testbeds, and AI data centers. The work is driven by national needs, built with industry, and organised along three directions that serve one goal — *AI and network infrastructure that is observable, efficiently scheduled, well operated and secure*:

1. **AI & Network Infrastructure Measurement.** Making production infrastructure observable at line rate and with zero application changes: zero-code distributed tracing with eBPF (SIGCOMM'23, SIGCOMM'25, ICSE'26); SRv6 probing and latency-bottleneck diagnosis (ICNP'25, ToN'26); flow measurement on programmable switches (TPDS'22); and Internet-scale measurement of Looking-Glass services, AS relationships and interdomain routing (WWW'26, ToN'25, ICNP'26).
2. **AI & Network Infrastructure Resource Scheduling.** Turning measurements into efficient, failure-resilient use of bandwidth and compute: reliability-aware routing with hybrid link protection (IPCCC'14, ICC'15, JCN'20), deployed in China Telecom's metropolitan networks; inter-DC WAN traffic engineering with availability guarantees (CoNEXT'21, ToN'22); resource scheduling and experiment services for the FITI testbed; centralised network utility maximisation (ICNP'22, ToN'25); routing algebra (INFOCOM'25); in-network acceleration on programmable switches (INFOCOM'24, TPDS'22); FaaS platforms for network functions (TPDS'23); service-function-chain embedding and scheduling (TPDS'26); and plug-and-play network management for enterprise clouds (NSDI'27).
3. **AI & Network Infrastructure Intelligent Operations & Security.** Verifying configurations, diagnosing failures and detecting attacks before they spread: configuration verification at carrier scale (TIFS'24, CoNEXT'25, INFOCOM'26); inline intrusion detection on programmable switches, in production at ISPs (SIGCOMM'25, SIGCOMM'26); interpretable and shift-aware anomaly detection (CCS'21, NDSS'23); provenance-based APT and serverless Denial-of-Wallet detection (TIFS'22, TIFS'25, CCS'22, ToN'26); and situational awareness of Internet trust infrastructure — certificates, Web PKI and routing (WWW'25, CCS'26).

Bibliometrics

1,730	17	29	∼100	13
Citations	h-index	i10-index	Papers	Advisees

Google Scholar, 2026. Nearly 100 papers in top-tier venues including ACM SIGCOMM, USENIX NSDI, ACM CCS, NDSS, ACM CoNEXT, ACM WWW, ACM ICSE, IEEE INFOCOM, IEEE/ACM Transactions on Networking, IEEE TIFS and IEEE TPDS.

Education

Sep. 2013 – Jul. 2018 **Ph.D.**, Computer Science and Technology
Tsinghua University, Beijing, China Advisor: Prof. Xia Yin

Sep. 2009 – Jul. 2013 **B.Eng.**, Computer Science and Technology
Jilin University, Changchun, China

Academic Appointments

Current **Associate Professor**, Doctoral Supervisor
Institute for Network Sciences and Cyberspace, Tsinghua University

Previously **Assistant Professor**
Institute for Network Sciences and Cyberspace, Tsinghua University

Selected Awards & Honours

- **World Internet Conference Leading Technology Award** (世界互联网大会领先科技奖), 2026. International
- **Applied Networking Research Prize (ANRP)**, IRTF / Internet Society — Certificate of Award, 2023. International
- **First Prize, Science and Technology Award**, China Institute of Communications — *"Key Technologies and Large-Scale Applications of Metropolitan Area Cloud Networks"* (城域云网关键技术及规模应用), 2025. National
- **NSGA Best Researcher Award**, 2025.
- **ACM TURC SIGCSE China Rising Star Award**, 2023.
- **Excellent Service Award**, IEEE/ACM ICA3PP 2023.

Selected Publications

Bold = author; * = corresponding author. Full list by year follows.

AI & Network Infrastructure Measurement

[1] Junxian Shen, **Han Zhang***, Yang Xiang, Xingang Shi, Xinrui Li, Yunxi Shen, Zijian Zhang, Sicheng Wang, Yanhui Yang, Yu Zhou, Mingwei Xu, Jilong Wang. "Network-Centric Distributed Tracing with DeepFlow: Troubleshooting Your Microservices in Zero Code." *ACM SIGCOMM 2023*, pp. 420–437.
↪ Network-centric tracing plane with implicit context propagation — zero application code change. Open-sourced as a de-facto standard for cloud-native observability (CNCF Sandbox, 4,000+ stars, tens of thousands of hosts).

[2] Yantao Geng, **Han Zhang***, Zhiheng Wu, Yahui Li, Jilong Wang, Xia Yin. "Low-Overhead Distributed Application Observation with DeepTrace: Achieving Accurate Tracing in Production Systems." *ACM SIGCOMM 2025*, pp. 1056–1069.
↪ Transaction-based non-intrusive tracing: API endpoints and transaction fields in request content group requests into transactions, so traces are not merged by mistake; >95% accuracy under high concurrency; used in production by dozens of companies.

[3] Yantao Geng, **Han Zhang***, Zhiheng Wu, Yahui Li, Jilong Wang, Xia Yin. "Non-Intrusive Distributed Tracing with Method-Level Delay Estimation for Microservices Troubleshooting." *ACM/IEEE ICSE 2026*, pp. 1661–1673.
↪ FlowScope estimates method-level causal delay distributions by cross-correlation and rebuilds traces iteratively under multiple constraints, improving tracing accuracy by 51% over DeepFlow and TraceWeaver.

[4] Kaiyang Zhao, **Han Zhang***, Yao Tong, Yahui Li, Xingang Shi, Zhiliang Wang, Xia Yin, Jianping Wu. "SRmesh: Deterministic and Efficient Diagnosis of Latency Bottleneck Links in SRv6 Networks." *IEEE ICNP 2025*, pp. 1–12.
↪ SR-based probes on deterministic paths, latency-based multipath inference and progressive diagnosis locate latency-bottleneck links in SRv6 networks with up to 91.9% less probe overhead.

[5] Yunze Wei, Xingang Shi, **Han Zhang***, Tianyu Zhang, Yahui Li, Xia Yin. "GlassMiner: Mining Looking Glass Services via Structure-Semantics Fusion for Web Observability." *ACM WWW 2026*, pp. 7576–7587.
↪ Structure-semantics fusion with LLM-based classification uncovers 3,867 Looking-Glass webpages and 7,558 vantage points missing from public lists — 1.82× more discoveries at 3.43× the mining efficiency — and uses them to study routing detours in two large CDNs.

AI & Network Infrastructure Resource Scheduling

[6] Kaiyang Zhao, **Han Zhang***, Tianpeng Zhang, Yantu Tong, Zeji Xiao, Xuefeng Liu, Xia Yin, Jianping Wu. "Kuiper: Enterprise Cloud Plug-and-Play Network Management Platform." *USENIX NSDI 2027*.
↪ Unified AIOps control plane for enterprise clouds — fault management, security-event response and configuration management over one telemetry and verification substrate.

[7] **Han Zhang**, Xingang Shi*, Xia Yin, Jilong Wang, Zhiliang Wang, Yingya Guo, Tian Lan. "Boosting Bandwidth Availability over Inter-DC WAN." *ACM CoNEXT 2021*, pp. 297–312.
↪ Bandwidth-availability traffic engineering for inter-DC WANs: online admission control 30× faster than the optimal strategy (<4% false rejections), and 23–60% more demands meeting their availability targets than FFC and TEAVAR.

[8] Yi Qiao, **Han Zhang***, Jilong Wang. "NetFEC: In-Network FEC Encoding Acceleration for Latency-Sensitive Multimedia Applications." *IEEE INFOCOM 2024*, pp. 2348–2357.
↪ Offloads the entire FEC encoding of latency-sensitive media to programmable switching ASICs; a ghost-packet mechanism preserves congestion control, pacing and statistics. Integrated with WebRTC, it removes the server CPU burden at negligible overhead.

[9] Heng Yu, **Han Zhang***, Junxian Shen, Yantao Geng, et al. "Serpens: A High-Performance FaaS Platform for Network Functions." *IEEE Transactions on Parallel and Distributed Systems*, vol. 34, no. 8, pp. 2448–2463, 2023.
↪ FaaS platform for network functions with a reusable NF runtime, local state access and improved service chaining: more than 10× the throughput and over 90% lower latency than NFs and SFCs on existing FaaS platforms.

[10] Ying Tian, Zhiliang Wang*, Xia Yin, Xingang Shi, Jiahai Yang, **Han Zhang***. "Centralized Network Utility Maximization with Accelerated Gradient Method." *IEEE Transactions on Networking*, 2025.
↪ Smooth utility and penalty functions make Nesterov's accelerated gradient method applicable to centralised NUM: an $O(d/t^2)$ convergence rate that scales with the number of flows, including prioritised flows on multiple paths.

AI & Network Infrastructure Intelligent Operations & Security

[11] **Han Zhang**, Xuefeng Liu, Linqiang Qian, Guyue Liu, Tianyu Zhang, Kaiyang Zhao, Yantu Tong, Zeji Xiao, Dongbiao He, Yahui Li, Ke Ruan, Jilong Wang, Yongqing Zhu, Xia Yin. "Towards High-Performance Intrusion Detection with Robustness Guarantees on Programmable Switches at ISP Scale." *ACM SIGCOMM 2026*, pp. 1282–1298.
↪ Inline NIDS on programmable switches protecting enterprise campus sites connected to ISPs: dual-plane feature extraction, a one-class model trained on benign traffic only, and online updates; in production for more than three years, detecting malicious traffic with ∼90% accuracy within minutes.

[12] **Han Zhang**, Guyue Liu*, Xingang Shi, Yahui Li, Jilong Wang, Yongqing Zhu, Ke Ruan, Jie Liang, Xia Yin. "Achieving High-Speed and Robust Encrypted Traffic Anomaly Detection with Programmable Switches." *ACM SIGCOMM 2025*, pp. 1254–1256.
↪ Dual-plane feature extraction plus a lightweight one-class model resolves the tension between deep-learning accuracy and switch-ASIC constraints; two years in production, 10+ critical attack events found, 10M+ servers protected for two ISPs.

[13] Yunze Wei, Xingang Shi, Minghao Zhang, Zhaozhen Wang, Qiang Ma, **Han Zhang**, Yahui Li, Xia Yin. "Parade: Unified and Data-Driven Prefix-AS Semantics for BGP Anomaly Detection." *ACM CCS 2026*.
↪ A unified, data-driven prefix-to-AS semantic model that turns fragmented BGP observations into consistent ground truth for anomaly detection.

[14] Junxian Shen, **Han Zhang***, Yantao Geng, Jiawei Li, Jilong Wang, Mingwei Xu. "Gringotts: Fast and Accurate Internal Denial-of-Wallet Detection for Serverless Computing." *ACM CCS 2022*, pp. 2627–2641.
↪ Real-world Denial-of-Wallet attacks on commodity serverless platforms, detected by a metrics-collection agent plus Mahalanobis-distance analysis: <1.1% overhead, 1.86 s mean detection delay, >95.75% accuracy.

[15] Dongqi Han, Zhiliang Wang*, Wenqi Chen, Ying Zhong, Su Wang, **Han Zhang**, Jiahai Yang, Xingang Shi, Xia Yin. "DeepAID: Interpreting and Improving Deep Learning-based Anomaly Detection in Security Applications." *ACM CCS 2021*, pp. 3197–3217.
↪ Interpretation framework for *unsupervised* deep anomaly detectors in security domains, enabling operators to diagnose model mistakes and cut false positives.

[16] Dongqi Han, Zhiliang Wang*, Wenqi Chen, Kai Wang, Rui Yu, Su Wang, **Han Zhang**, et al. "Anomaly Detection in the Open World: Normality Shift Detection, Explanation, and Adaptation." *NDSS 2023*.

↪ Detects, explains and adapts to normality shift in zero-positive anomaly detection, where models trained only on benign data suffer most when normal behaviour drifts.

[17] Tianyu Zhang, **Han Zhang***, Yunze Wei, Yahui Li, Xingang Shi, Jilong Wang, Xia Yin. "ACME++: A Secure Authorization Mechanism for ACME Clients in the Web PKI Ecosystem." *ACM WWW 2025*, pp. 1058–1067.
↪ Discloses the *ACME Authz Cache Attack* — fraudulent certificates without domain control, demonstrated against Let's Encrypt — and proposes an account-binding mitigation with negligible CA-side overhead.

[18] XinZhe Liu, Yahui Li*, **Han Zhang**, Xia Yin, Xingang Shi, Zhiliang Wang, Gang Ren, Jilong Wang, Jiangyuan Yao. "Scalable and Interpretable Overlay Network Checking via Ensemble Verification." *ACM CoNEXT 2025*.
↪ First control-plane verifier for overlay/underlay networks; deployed on the nationwide FITI testbed where it found 22 misconfigurations, with up to 102× speedup over Batfish+.

[19] Yahui Li, **Han Zhang***, Jilong Wang, Xingang Shi, Xia Yin, Zhiliang Wang, Jiankun Hu, Congcong Miao, Jianping Wu. "Proactively Verifying Quantitative Network Policy across Unsafe and Unreliable Environments." *IEEE Transactions on Information Forensics and Security*, vol. 19, pp. 10099–10113, 2024.
↪ Quantitative network verification (QNV) checks quantitative policies such as link overload, not only Boolean ones such as reachability, across failures, using a symbolic model of converged forwarding; large networks are verified within minutes.

Publications by Year

Bold = author; * = corresponding author.

2027

[1] Kaiyang Zhao, **Han Zhang***, Tianpeng Zhang, Yantu Tong, Zeji Xiao, Xuefeng Liu, Xia Yin, Jianping Wu. "Kuiper: Enterprise Cloud Plug-and-Play Network Management Platform." *USENIX NSDI 2027*. (to appear)

2026

[1] **Han Zhang**, Xuefeng Liu, Linqiang Qian, Guyue Liu, Tianyu Zhang, Kaiyang Zhao, Yantu Tong, Zeji Xiao, Dongbiao He, Yahui Li, Ke Ruan, Jilong Wang, Yongqing Zhu, Xia Yin. "Towards High-Performance Intrusion Detection with Robustness Guarantees on Programmable Switches at ISP Scale." *ACM SIGCOMM 2026*, pp. 1282–1298.

[2] Yunze Wei, Xingang Shi, Minghao Zhang, Zhaozhen Wang, Qiang Ma, **Han Zhang**, Yahui Li, Xia Yin. "Parade: Unified and Data-Driven Prefix-AS Semantics for BGP Anomaly Detection." *ACM CCS 2026*. (to appear)

[3] Yunze Wei, Xingang Shi, **Han Zhang***, Tianyu Zhang, Yahui Li, Xia Yin. "GlassMiner: Mining Looking Glass Services via Structure-Semantics Fusion for Web Observability." *ACM WWW 2026*, pp. 7576–7587.

[4] Yantao Geng, **Han Zhang***, Zhiheng Wu, Yahui Li, Jilong Wang, Xia Yin. "Non-Intrusive Distributed Tracing with Method-Level Delay Estimation for Microservices Troubleshooting." *ACM/IEEE ICSE 2026*, pp. 1661–1673.

[5] Junxian Shen, **Han Zhang***, Wenxue Lin, Yantao Geng, Jiawei Li, Jilong Wang, Mingwei Xu. "Clover: Workload Verification for Real-Time Detection of Contention-Induced Slowdowns in Serverless Platforms." *IEEE/ACM Transactions on Networking*, vol. 34, pp. 4700–4715, 2026.

[6] Kaiyang Zhao, **Han Zhang***, Yao Tong, Yahui Li, Xingang Shi, Zhiliang Wang, Xia Yin, Jianping Wu. "Efficient Slice-Parallel Distributed Probing in SRv6 Networks." *IEEE/ACM Transactions on Networking*, vol. 34, pp. 5588–5600, 2026.

[7] XinZhe Liu, Yahui Li, **Han Zhang**, Renrui Tian, Xia Yin, Xingang Shi, Zhiliang Wang, Gang Ren, Jilong Wang, Jiangyuan Yao. "Comprehensive Network Configuration Verification via Effective Environment Reduction." *IEEE INFOCOM 2026*, pp. 1–10.

[8] Letong Sun, Xingang Shi, Fengyan Han, Liyuan Chang, Xia Yin, Zhiliang Wang, **Han Zhang**. "A Comparative Approach for Studying Control-Plane and Data-Plane Mismatch in Interdomain

Routing." *IEEE ICNP 2026*. (to appear)

[9] Letong Sun, Xingang Shi, Fengyan Han, Xia Yin, Zhiliang Wang, **Han Zhang**. "The Anatomy of ROV Rollout: A Sub-AS and Longitudinal Perspective." *IEEE ICNP 2026*. (to appear)

[10] Weihan Chen, Zhiliang Wang, **Han Zhang**, Xia Yin, Xingang Shi. "Delay-Aware Service Function Chain Embedding and Scheduling in Edge Clouds." *IEEE Transactions on Parallel and Distributed Systems*, vol. 37, no. 11, pp. 2539–2553, 2026.

[11] Shuhuan Wang, Zhiyu Wang, Hao Sun, Zhi Jiang, Xia Yin, Dongbin Han, **Han Zhang**, Xingang Shi, Jiahai Yang. "The Evolution of Provenance-Based Intrusion Detection Systems: A Review of Approaches, Limitations, and Future Directions." *IEEE Network*, 2026.

[12] Qiuxiang Li, **Han Zhang***, Yubin Qu, Jianping Wu. "MASTER: A Large Language Model Framework for Proof of Concept Generation Via Knowledge Injection and Intention Reinforcement." *Acta Electronica Sinica* (in Chinese), vol. 54, no. 4, pp. 1802–1822, 2026.

2025

[1] Tianyu Zhang, **Han Zhang***, Yunze Wei, Yahui Li, Xingang Shi, Jilong Wang, Xia Yin. "ACME++: A Secure Authorization Mechanism for ACME Clients in the Web PKI Ecosystem." *ACM WWW 2025*, pp. 1058–1067.

[2] Yantao Geng, **Han Zhang***, Zhiheng Wu, Yahui Li, Jilong Wang, Xia Yin. "Low-Overhead Distributed Application Observation with DeepTrace: Achieving Accurate Tracing in Production Systems." *ACM SIGCOMM 2025*, pp. 1056–1069.

[3] **Han Zhang**, Guyue Liu*, Xingang Shi, Yahui Li, Jilong Wang, Yongqing Zhu, Ke Ruan, Jie Liang, Xia Yin. "Achieving High-Speed and Robust Encrypted Traffic Anomaly Detection with Programmable Switches." *ACM SIGCOMM 2025*, pp. 1254–1256.

[4] XinZhe Liu, Yahui Li*, **Han Zhang**, Xia Yin, Xingang Shi, Zhiliang Wang, Gang Ren, Jilong Wang, Jiangyuan Yao. "Scalable and Interpretable Overlay Network Checking via Ensemble Verification." *ACM CoNEXT 2025*.

[5] Renrui Tian, Yahui Li*, **Han Zhang**, XinZhe Liu, Xia Yin, Xingang Shi, Zhiliang Wang, Jilong Wang. "Poster: ERIS — Evaluating ROV via ICMPv6 Rate Limiting Side Channels." *ACM CCS 2025*.

[6] Kaiyang Zhao, **Han Zhang***, Yao Tong, Yahui Li, Xingang Shi, Zhiliang Wang, Xia Yin, Jianping Wu. "SRmesh: Deterministic and Efficient Diagnosis of Latency Bottleneck Links in SRv6 Networks." *IEEE ICNP 2025*, pp. 1–12.

[7] Zhaozhen Wang, Xingang Shi*, Haijun Geng, **Han Zhang**, Xia Yin, Zhiliang Wang. "On Non-Commutative Routing." *IEEE INFOCOM 2025*, pp. 1–10.

[8] Zhiyun Tang, Yahui Li, Xingang Shi, Jilong Wang, Yongqing Zhu, Ke Ruan, Xia Yin, **Han Zhang***. "Probabilistic Analysis of Overload-Free Property for Critical Traffic." *IEEE/ACM IWQoS 2025*, pp. 1–6.

[9] Su Wang, Hongbin Sun, Zhiliang Wang, Tao Zhou, Xia Yin, Dongqi Han, **Han Zhang**, Xingang Shi, Jiahai Yang. "End-to-End Attack Scene Reconstruction in a Host with Rules and Anomaly-Based Detection Models." *IEEE Transactions on Information Forensics and Security*, 2025.

[10] Ying Tian, Zhiliang Wang*, Xia Yin, Xingang Shi, Jiahai Yang, **Han Zhang***. "Centralized Network Utility Maximization with Accelerated Gradient Method." *IEEE Transactions on Networking*, 2025.

[11] Xingang Shi, Zitong Jin*, Bin Xiong, Xinyao Huang, Xiaotian Xi, Dan Li, **Han Zhang**, Zhiliang Wang, Xia Yin. "HELA: Inferring AS Relationships with a Hybrid of Empirical and Learning Algorithms." *IEEE Transactions on Networking*, 2025.

[12] Weiting Zhang, Jiadong Ren, Tao Zheng, Ruibin Guo, **Han Zhang**, Shiwen Mao, Hongke Zhang*. "GenNet: Computing-Efficient Generative AI for Deterministic Transmission Scheduling in 6G Networks." *IEEE Communications Magazine*, vol. 63, no. 8, pp. 48–55, 2025.

[13] Yanxu Fu, Pei Zhang*, **Han Zhang**, Xiaohong Huang, Kun Xie, Dandan Li. "BGPFlow: Flow-Based Feature Extraction for BGP Anomaly Detection." *ACM SIGCOMM NGNO Workshop 2025*, pp. 13–20.

2024

[1] Yi Qiao, **Han Zhang***, Jilong Wang. "NetFEC: In-Network FEC Encoding Acceleration for Latency-Sensitive Multimedia Applications." *IEEE INFOCOM 2024*, pp. 2348–2357.

[2] Yahui Li, **Han Zhang***, Jilong Wang, Xingang Shi, Xia Yin, Zhiliang Wang, Jiankun Hu, Congcong Miao, Jianping Wu. "Proactively Verifying Quantitative Network Policy across Unsafe and Unreliable Environments." *IEEE Transactions on Information Forensics and Security*, vol. 19, pp. 10099–10113, 2024.

[3] XinZhe Liu, Yahui Li*, **Han Zhang**, Xia Yin, Xingang Shi, Zhiliang Wang, Gang Ren, Jiangyuan Yao. "Poster: Scalable and Interpretable Multilayer Overlay Network Checking via Ensemble Verification." *ACM SIGCOMM 2024 Posters & Demos*.

[4] Weihan Chen, Zhiliang Wang*, **Han Zhang**, Xia Yin, Xingang Shi. "Cost-Efficient Flow Migration for SFC Dynamical Scheduling in Geo-Distributed Clouds." *Computer Networks*, vol. 249, 2024.

[5] Jun He, Yahui Li*, **Han Zhang***, Changqing An, Jilong Wang. "ROV-GD: Improving the Measurement of ROV Deployment Using Graph Difference." *IEEE ISCC 2024*, pp. 1–7.

[6] Kunling He, Fenghua Li, Jessie Hui Wang, **Han Zhang**, Yiren Zhao. "AB-TCAD: An Access Behavior-Based Two-Stage Compromised Account Detection Framework." *IFIP Networking 2024*, pp. 104–112.

2023

[1] Junxian Shen, **Han Zhang***, Yang Xiang, Xingang Shi, Xinrui Li, Yunxi Shen, Zijian Zhang, et al. "Network-Centric Distributed Tracing with DeepFlow: Troubleshooting Your Microservices in Zero Code." *ACM SIGCOMM 2023*, pp. 420–437.

[2] Dongqi Han, Zhiliang Wang*, Wenqi Chen, Kai Wang, Rui Yu, Su Wang, **Han Zhang**, et al. "Anomaly Detection in the Open World: Normality Shift Detection, Explanation, and Adaptation." *NDSS 2023*.

[3] Heng Yu, **Han Zhang***, Junxian Shen, Yantao Geng, et al. "Serpens: A High-Performance FaaS Platform for Network Functions." *IEEE Transactions on Parallel and Distributed Systems*, vol. 34, no. 8, pp. 2448–2463, 2023.

[4] Yahui Li, **Han Zhang***, Jilong Wang, Xia Yin, Xingang Shi, Jianping Wu. "A General Approach to Generate Test Packets with Network Configurations." *IEEE Transactions on Parallel and Distributed Systems*, vol. 34, no. 4, pp. 1362–1375, 2023.

[5] Pei Zhang, Fangzhou He, **Han Zhang***, Jiankun Hu, et al. "Real-Time Malicious Traffic Detection with Online Isolation Forest over SD-WAN." *IEEE Transactions on Information Forensics and Security*, vol. 18, pp. 2076–2090, 2023.

[6] Tianbo Wang, Huacheng Li, Chunhe Xia*, **Han Zhang**, Pei Zhang. "From the Dialectical Perspective: Modeling and Exploiting of Hybrid Worm Propagation." *IEEE Transactions on Information Forensics and Security*, vol. 18, pp. 1610–1624, 2023.

[7] Yantao Geng, **Han Zhang***, Jilong Wang. "Delay-Based Congestion Control for Cross-Datacenter Networks." *IEEE/ACM IWQoS 2023*.

[8] Jiawei Li, **Han Zhang***, Jilong Wang. "PUVAR: Minimize Idle Resource SLO Violations by Uncertainty-Aware Scheduling in Cloud Platforms." *IEEE ICWS 2023*.

[9] Ming Wang, Yahui Li, **Han Zhang**, Anlun Hong, Jun He, Jilong Wang. "Knocking Cells: Latency-Based Identification of IPv6 Cellular Addresses on the Internet." *IEEE ISCC 2023*.

[10] Allen Hong, Yahui Li*, **Han Zhang***, Ming Wang, Changqing An, Jilong Wang. "A Cheap and Accurate Delay-Based IP Geolocation Method Using Machine Learning and Looking Glass." *IFIP Networking 2023*.

[11] Jun He, Yahui Li*, **Han Zhang***, Ming Wang, Changqing An, Jilong Wang. "Be Careful of Your Neighbors: Injected Sub-Prefix Hijacking Invisible to Public Monitors." *IEEE ICC 2023*.

[12] Shuanghong Yu, Fenghua Li*, **Han Zhang**, Kunling He, Xingkun Yao. "GapReplay: A High-Accuracy Packet Replayer." *IEEE ICC 2023*.

2022

[1] Junxian Shen, **Han Zhang***, Yantao Geng, Jiawei Li, Jilong Wang, Mingwei Xu. "Gringotts: Fast and Accurate Internal Denial-of-Wallet Detection for Serverless Computing." *ACM CCS 2022*, pp. 2627–2641.

[2] **Han Zhang**, Xia Yin, Xingang Shi*, Jilong Wang, Zhiliang Wang, Yingya Guo, Tian Lan, Yahui Li, Yongqing Zhu, Ke Ruan, Haijun Geng. "Achieving High Availability in Inter-DC WAN Traffic Engineering." *IEEE/ACM Transactions on Networking*, 2022.

[3] Su Wang, Zhiliang Wang*, Tao Zhou, Hongbin Sun, Xia Yin, Dongqi Han, **Han Zhang**, et al. "THREATRACE: Detecting and Tracing Host-Based Threats in Node Level through Provenance Graph Learning." *IEEE Transactions on Information Forensics and Security*, vol. 17, pp. 3972–3987, 2022.

[4] Yi Qiao, Menghao Zhang, Yu Zhou, Xiao Kong, **Han Zhang***, et al. "NetEC: Accelerating Erasure Coding Reconstruction with In-Network Aggregation." *IEEE Transactions on Parallel and Distributed Systems*, vol. 33, no. 10, pp. 2571–2583, 2022.

[5] Zongyi Zhao, Xingang Shi*, Zhiliang Wang, Qi Li, **Han Zhang**, Xia Yin. "Efficient and Accurate Flow Record Collection with HashFlow." *IEEE Transactions on Parallel and Distributed Systems*, vol. 33, no. 5, pp. 1069–1083, 2022.

[6] Ying Tian, Zhiliang Wang*, Xia Yin, Xingang Shi, Jiahai Yang, **Han Zhang**. "Centralized Network Utility Maximization with Accelerated Gradient Method." *IEEE ICNP 2022*.

[7] Heng Yu, Junxian Shen, **Han Zhang***, Jilong Wang, Congcong Miao, Mingwei Xu. "Scorpius: Proactive Code Preparation to Accelerate Function Startup." *IEEE/ACM IWQoS 2022*.

[8] Shangbin Han, Qianhong Wu, **Han Zhang***, Bo Qin. "Light-Weight Unsupervised Anomaly Detection for Encrypted Malware Traffic." *IEEE DSC 2022*.

[9] Shangbin Han, Qianhong Wu, **Han Zhang**, Bo Qin, Jiangyuan Yao, Willy Susilo. "Autoperman: Automatic Network Traffic Anomaly Detection with Ensemble Learning." *ICAIS 2022*.

[10] Yongkang Chen, Ming Zhang*, Jin Li, Xiaohui Kuang, Xurong Zhang, **Han Zhang**. "Dynamic and Diverse Transformations for Defending against Adversarial Examples." *IEEE TrustCom 2022*.

2021

[1] **Han Zhang**, Xingang Shi*, Xia Yin, Jilong Wang, Zhiliang Wang, Yingya Guo, Tian Lan. "Boosting Bandwidth Availability over Inter-DC WAN." *ACM CoNEXT 2021*, pp. 297–312.

[2] Dongqi Han, Zhiliang Wang*, Wenqi Chen, Ying Zhong, Su Wang, **Han Zhang**, Jiahai Yang, Xingang Shi, Xia Yin. "DeepAID: Interpreting and Improving Deep Learning-Based Anomaly Detection in Security Applications." *ACM CCS 2021*, pp. 3197–3217.

[3] Shangbin Han, Qianhong Wu, **Han Zhang***, Bo Qin, Jiankun Hu, et al. "Log-Based Anomaly Detection with Robust Feature Extraction and Online Learning." *IEEE Transactions on Information Forensics and Security*, vol. 16, pp. 2300–2311, 2021.

[4] Yingya Guo, Weipeng Wang, **Han Zhang**, Wenzhong Guo, Zhiliang Wang, Ying Tian, et al. "Traffic Engineering in Hybrid Software-Defined Network via Reinforcement Learning." *Journal of Network and Computer Applications*, vol. 189, 2021.

[5] Weihan Chen, Zhiliang Wang*, **Han Zhang**, Xia Yin, Xingang Shi. "Cost-Efficient Dynamic Service Function Chain Embedding in Edge Clouds." *IEEE CNSM 2021*.

[6] Ying Tian, Zhiliang Wang*, Xia Yin, Xingang Shi, Jiahai Yang, **Han Zhang**, Yingya Guo, et al. "Traffic Engineering with Segment Routing Considering Probabilistic Failures." *IEEE CNSM 2021*.

[7] Haijun Geng, **Han Zhang***, Yangyang Zhang. "Efficient Routing Protection Algorithm in Large-Scale Networks." *Computers, Materials & Continua*, vol. 66, no. 2, pp. 1733–1744, 2021.

2020

[1] Yahui Li, Zhiliang Wang*, Xia Yin, Xingang Shi, Jianping Wu, Fangdan Ye, Jiangyuan Yao, **Han Zhang**. "Assisting Reachability Verification of Network Configurations Updates with NUV."

Computer Networks, vol. 177, 2020.

[2] Haijun Geng, **Han Zhang**, Xingang Shi*, Zhiliang Wang, Xia Yin. "Efficient Computation of Loop-Free Alternates." *Journal of Network and Computer Applications*, vol. 151, 2020.

[3] Haijun Geng, **Han Zhang**, Xingang Shi*, et al. "A Hybrid Link Protection Scheme for Ensuring Network Service Availability in Link-State Routing Networks." *Journal of Communications and Networks*, vol. 22, no. 1, pp. 46–60, 2020.

[4] Weihan Chen, Zhiliang Wang, **Han Zhang**, Xia Yin, Xingang Shi, Lei Sun. "Joint Optimization of Service Function Chain Elastic Scaling and Routing." *IEEE INFOCOM Workshops 2020*.

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2018 and Earlier

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Scheme for Link-State Routing Networks." *IEEE ICC 2015*.

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[15] Haijun Geng, Xingang Shi, Xia Yin, Zhiliang Wang, **Han Zhang**, Jiangyuan Yao. "Let More Nodes Have a Second Choice." *IEEE IPCCC 2014*.

Research Funding

- **NSFC General Program** (国家自然科学基金面上项目), No. 62572269 — *Network-Behaviour-Based Anomaly Detection for Distributed Microservice Applications*. **PI**.
- **NSFC Youth Program** (国家自然科学基金青年项目), No. 62002009 — *Resource Allocation for Bulk Transfer in Inter-Datacenter WANs*. **PI**.
- **NSFC Major Program** (国家自然科学基金重大项目), No. 62394322 — *Key Technologies for Intelligent-Computing Convergence Network Construction and Routing*. **Sub-project PI**.
- **NSFC Key Program** (国家自然科学基金重点项目), No. 61932011 — *Blockchain-Based IoT Security*. **Sub-project PI**.
- **MIIT Key R&D Program**, No. TC220A04A-78 — *High-Precision BeiDou Automotive-Grade Positioning Chip and Terminal Positioning System*. **PI**.
- **MOST National Key R&D Program** (国家重点研发计划), No. 2018YFB1800400 — *Key Technologies for Large-Scale Secure and Trustworthy Addressing and Routing*. Participant.
- **Industry-funded projects** (all as **PI**): China Telecom — large-scale WAN sensing and optimisation; Tencent — observability for large-scale microservice systems; Sangfor — application-aware WAN transmission optimisation; NSFOCUS — key technologies for security-testing facilities.

Production Systems & Open-Source Artifacts

- **DeepFlow** — zero-code eBPF observability for cloud-native and AI infrastructure (Kubernetes, service meshes, serverless platforms, LLM / AI-agent pipelines). **CNCF Sandbox project**; 4,000+ GitHub stars, 450+ forks; deployed on tens of thousands of hosts. SIGCOMM'23
- **DeepTrace** — non-intrusive distributed application tracing and fault monitoring for AI data centers and large microservice deployments; >95% accuracy under high concurrency, used in production by dozens of companies. 170+ stars. SIGCOMM'25, ICSE'26
- **SRmesh Probing Toolkit** — slice-parallel SRv6 probing achieving $O(1)$-round full-mesh latency maps; validated on the national FITI testbed. ICNP'25, ToN'26
- **IScan** — continuous Internet-wide active and passive probing (IP space, BGP/RPKI routing, CT logs/Web-PKI) assembled into a queryable Internet knowledge base. WWW'25, WWW'26
- **Kuiper / AIDC Manager** — full-stack AIOps platform unifying fault management, security-event response, configuration management and network verification; 5× MTTR reduction in production GPU clusters. NSDI'27, ICNP'25, ToN'26
- **SiteGuard / AIDC Protector** — ingress/egress traffic monitoring and ML-based threat detection for AI data-center perimeters, running on programmable switches (P4/Tofino), DPUs, SmartNICs and eBPF at Tbps-class line rate. SIGCOMM'25, SIGCOMM'26
- **NetVerify Suite** — static verification and simulation for configurations, overlay networks and quantitative policies; applied to FITI and CERNET. TIFS'24, CoNEXT'25, INFOCOM'26
- **Public datasets** — GlassMiner Looking-Glass corpus (WWW'26); labelled encrypted-flow IDS benchmark (SIGCOMM'25/'26, CCS'21, NDSS'23).

Technology Transfer & National Impact

- **China Telecom metropolitan and backbone networks** — hybrid link protection in the metropolitan networks: construction cost cut by more than 40% over five years for 120 million

users (2025 China Institute of Communications S&T Award, First Prize; 2026 World Internet Conference Leading Technology Award); line-rate encrypted-traffic anomaly detection; WAN sensing and optimisation.

- **FITI (Future Internet Technology Infrastructure)** — resource scheduling and experiment services that have kept the national testbed running for three years (40 sites, more than 100 large experiments); configuration and overlay verification; programmable-switch IDS and SRv6 diagnosis. The technology is also used by 32 companies including Huawei, and by Tencent.
- **Certificate situational-awareness platform** — the first in China; serves the telecom and banking sectors and monitors all central state-owned enterprises and more than 2,000 government and critical public institutions, uncovering over a hundred certificate-deployment threats.
- **CERNET / CERNET2** — DeepFlow-based observability and routing-anomaly analysis across the China Education and Research Network.
- **Tencent Cloud** — observability for large-scale microservice systems; co-designed inter-DC WAN traffic engineering.
- **Sangfor** (深信服) — application-aware WAN transmission optimisation for enterprise SD-WAN products.
- **NSFOCUS** (绿盟科技) — key technologies for security-testing facilities and large-scale traffic analysis.
- Cumulatively, the resulting technologies serve telecom operators, national defence, the education network and public clouds, reaching **hundreds of millions of end users**.

Patents

Two portfolios of Chinese invention patents — **Network Measurement & Security** (27 entries) and **AI for Networking** (19 entries) — first inventor on the large majority. Selected entries:

- Dual-plane feature extraction for high-speed encrypted traffic on programmable switches. (基于可编程交换机的高速加密流量双平面特征提取技术)
- Encrypted-traffic anomaly detection via frequency-domain enhancement and one-class adaptive learning. (基于频域增强与单类自适应学习的加密流量异常检测技术)
- Distributed request tracing based on dual-path kernel/user-space protocol feature parsing. (基于内核态与用户态双路径协议特征解析的分布式请求追踪方法)
- Metadata-driven distributed request tracing with local anomaly awareness. (基于本地异常感知的元数据驱动型分布式请求追踪方法)
- Two-stage adaptive anomalous-traffic detection for SD-WAN based on AE-DQN. (面向 SD-WAN 的基于 AE-DQN 的双阶段自适应异常流量检测系统)
- Pre-training data-source auditing for deep-learning malicious-traffic detection. (深度学习恶意流量检测的预训练数据源审计方法)
- Secure verification method and system based on the ACME protocol. (基于 ACME 协议的安全验证方法、系统及相关装置)
- Trusted verification for cross-domain segment routing. (面向跨域分段路由的可信验证方法技术)
- OSPF routing-anomaly detection based on in-band network telemetry. (基于带内网络遥测的 OSPF 路由异常检测方法技术)
- Perfect routing-tree construction for fast network re-routing. (一种面向网络快速重路由的完美路由树构建方法)
- Internet measurement-service mining; Internet router geolocation. (互联网测量服务挖掘方法；互联网路由器地理定位方法)
- SLO-violation diagnosis for cloud platforms. (服务等级目标违规诊断方法、装置、设备及介质)

Academic Service

- **TPC Co-Chair** — ACM SIGCOMM NGNO Workshop 2025.
- **Travel Grant Co-Chair** — ACM APNet 2025.
- **TPC Member** — USENIX NSDI 2027 (Spring); USENIX Security 2027; IEEE INFOCOM 2023, 2024, 2025, 2027; ACM CoNEXT 2025, 2026; IEEE ICNP 2024, 2025.

- **Editorial Board** — *Communication Technology*《通信技术》. **Guest Editor** — MDPI *Electronics*; *IEEE Journal on Selected Areas in Communications* (JSAC).
- **Reviewer** — IEEE/ACM Transactions on Networking; IEEE Transactions on Parallel and Distributed Systems; IEEE Transactions on Information Forensics and Security.

Teaching

Autumn 2023, 2024	**Internet Engineering** — undergraduate, 32 hours. Routing, traffic engineering, observability, Internet measurement; with labs.
Autumn 2022–2024	**Network Optimization Theory and Methods** — graduate, 32 hours.
Spring 2022–2025	**Network Anomaly Detection** — graduate, 32 hours.

Students Advised

Current (13)

Kaiyang Zhao	Ph.D., Y5	SRv6 probing (ICNP'25, ToN'26); co-advised with Prof. Xia Yin & Prof. Jianping Wu
Yantao Geng	Ph.D., Y4	DeepTrace lead (SIGCOMM'25, ICSE'26)
Chenyan Gaoyang	Ph.D., Y4	co-advised with Prof. Youjian Zhao
Xuefeng Liu	Ph.D., Y3	network verification
Zeji Xiao	Ph.D., Y3	co-advised with Prof. Jilong Wang
Boyang Wang	Ph.D., Y2	co-advised with Prof. Xia Yin
Yantu Tong	Ph.D., Y1	SRv6 / measurement
Zhuo Li	Master, Y3	encrypted-traffic IDS
Hanyang Lin	Master, Y2	eBPF observability
Zhiheng Wu	Master, Y2	distributed tracing
Linqiang Qian	Master, Y1	programmable data plane
Yao Tong	Master, Y1	co-advised with Prof. Xia Yin
Kexin Peng	Master, Y1	co-advised with Prof. Youjian Zhao

Alumni (6)

Junxian Shen	Ph.D.	Assistant Professor, South China University of Technology (SIGCOMM'23, '25; ToN'26)
Heng Yu	Ph.D.	Zhongguancun Laboratory (TPDS'23)
Yi Qiao	Ph.D.	China Academy of Space Technology (INFOCOM'24; TPDS'22)
Shangbin Han	Ph.D.	Quan Cheng Laboratory (TIFS'21)
Zhiyun Tang	Master	Huawei Technologies
Jiarui Li	Master	Alibaba Cloud

Recruiting Ph.D. and Master's students for Fall 2027 enrolment; systems-programming experience is a strong plus.