

Ting Dai

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I am a Staff Research Scientist at IBM Research. My interests are in the areas of system reliability and security, with the current focus on Edge security.

Education

- 2014–2019 **Ph.D. in Computer Science**,
North Carolina State University, USA.
GPA: 4/4
thesis advisor A Hybrid Approach to Cloud System Performance Bug Detection, Diagnosis and Fix
Professor Xiaohui (Helen) Gu
- 2011–2014 **Master in Computer Software and Theory**,
Nanjing University of Posts and Telecommunications, China.
GPA: 3.78/4
- 2007–2011 **Bachelor in Information Security**,
Nanjing University of Posts and Telecommunications, China.
GPA: 3.85/4

Work Experience

- Jul 8, 2022 – now **Staff Research Scientist**, IBM Research,
📍 1101 Kitchawan Rd, Yorktown Heights, NY 10598.
 - I integrated Keylime with IBM Cloud Satellite and Redhat CoreOS, delivering automated remote attestation service on Satellite locations.
 - I delivered an automated analytic framework with Openshift Container Platform to manage Jupyter Notebooks and conduct AI algorithms in user DataLakes.
- Sep 16, 2019 – Jul 7, 2022 **Research Staff Member**, IBM Research,
📍 1101 Kitchawan Rd, Yorktown Heights, NY 10598.
 - I co-developed GreenABR [MMSys'22], a deep reinforcement learning-based ABR system that optimizes the energy consumption during video streaming without sacrificing the user quality of experience.
 - I developed SecureCode [SoCC'20], an analysis framework which is integrated into the DevOps pipeline deployed in IBM cloud to automatically detect risky Shell and PowerShell scripts in infrastructure code.
 - I co-developed a policy-based governance, risk, and compliance system to manage VM configurations in multi-cloud environments, which is integrated with IBM AIOps.
 - I co-developed an environment-aware ranking system to quantify threats, including risky configurations and security vulnerabilities.
 - I designed and co-developed a risk enhancement service which periodically populates the latest weaponization metrics of the vulnerabilities to clients' data service.

- May 16, 2015 – Jul 31, 2019 **Research Assistant**, North Carolina State University,
 890 Oval Dr, Raleigh, NC 27606.
- I developed a performance bug detection and fixing system including Hytrace [SoCC'17, TPDS'19], DScope [SoCC'18], and HangFix [SoCC'20] by leveraging rule-based static code analysis and ML-based anomaly detection on kernel-level syscall traces.
 - I co-developed a timeout bug detection and fixing system including TScope [ICAC'18], TFix [ICDCS'19] and TFix+ [arXiv'21] by leveraging static taint analysis and adaptive self-configuration considering application workloads and runtime environment.
 - I also worked on understanding real-world timeout problems [IC2E'18] and evaluating existing detection schemes on container vulnerability attacks [IC2E'19].
 - Moreover, I developed CCM, a cloud configuration management system for elastic application deployment in private clouds. CCM supports automatic component composition and instantiation, and elastic auto-scaling to handle overload conditions and resource contentions.
- Jan 1, 2019 – May 15, 2019 **Teaching Assistant**, North Carolina State University,
 890 Oval Dr, Raleigh, NC 27606.
- I worked as a TA of Advanced Distributed Systems for Prof. Xiaohui Gu. I helped reconstruct the class syllabus with an updated list of classic and state-of-the-art papers, connecting the canonical distributed concepts with cutting-edge cloud computing technologies. I read students' paper review assignments and give concrete feedback, help them set up evaluation environments, and suggest proper workload benchmarks for their implemented systems.
- May 21, 2018 – Aug 10, 2018 **Graduate Intern**, IBM Research,
 1101 Kitchawan Rd, Yorktown Heights, NY 10598.
- I developed FabZK [DSN'19], a privacy-preserving and auditable blockchain system which conceals transaction amounts and participants on a shared ledger and conducts on-demand, automated auditing based only on the encrypted data.
- Jun 1, 2016 – Aug 12, 2016 **Software Engineer Intern**, InsightFinder Inc,
 310 S Harrington St, Raleigh, NC 27603.
- I implemented a cloud application performance analysis system, including a trace-based intelligence engine to identify performance problems using ML algorithms and a tracing agent [InsightAgent] to collect system calls from the VMs which host the cloud applications to the intelligence engine.
- Aug 16, 2014 – May 15, 2015 **Teaching Assistant**, North Carolina State University,
 890 Oval Dr, Raleigh, NC 27606.
- I worked as a TA of Discrete Math for Computer Scientists for two semesters with Prof. Tiffany Barnes and Prof. Dennis Bahler, respectively. I was responsible for developing exam questions, moderating discussions on Piazza, and hosting review sessions.

Publications

Refereed Journal Articles (9 total)

- SNC'20 Haiping Huang, Qinglong Huang, Fu Xiao, Wenming Wang, Qi Li, and **Ting Dai**. An Improved Broadcast Authentication Protocol for Wireless Sensor Networks Based on the Self-Reinitializable Hash Chains. in *Security and Communication Networks*, vol. 2020, Article ID 8897282, 2020. *Impact Factor: 1.968*.
- TPDS'19 **Ting Dai**, Daniel Dean, Peipei Wang, Xiaohui Gu, and Shan Lu. Hytrace: A Hybrid Approach to Performance Bug Diagnosis in Production Cloud Infrastructures. in *IEEE Transactions on Parallel and Distributed Systems*, vol. 30, no. 1, 2019. *Impact Factor: 4.181*.

- JS'16 Haiping Huang, Tianhe Gong, Tao Chen, Mingliang Xiong, Xinxing Pan, and **Ting Dai**. An Improved μ TESLA Protocol Based on Queuing Theory and Benaloh-Leichter SSS in WSNs. in *Journal of Sensors*, vol. 2016, Article ID 9021650, 2016. *Impact Factor: 2.336*.
- IJDSN'13 **Ting Dai**, Haiping Huang, Yang Lu, Ruchuan Wang, Xingxing Pan. Research on Migration Strategy of Mobile Agent in Wireless Sensor Networks. in *International Journal of Distributed Sensor Networks*, vol. 9, no. 11, 2013. *Impact Factor: 1.938*.
- JoC'13 Haiping Huang, **Ting Dai**, Ruchuan Wang, Xiaolin Qin, and Jiutian Chen. Novel Self-Renewal Hash Chain Scheme based on (t, n)-Threshold and Division Tree. in *Journal of Communications*, vol. 34, no. 4, pp. 70-81, Apr. 2013. *Impact Factor: 1.734*.
- JCUPT'12 **Ting Dai**, Haiping Huang, Ruchuan Wang, and Xinxing Pan. Novel Self-Renewal Hash chain based on Ito-Saito-Nishizeki Secret Sharing Scheme. in *The Journal of China Universities of Posts and Telecommunications*, vol. 19(Suppl. 2), pp. 122-127, Oct. 2012.
- IR'11 Hao Chen, Ruchuan Wang, Haiping Huang, Lijuan Sun, and **Ting Dai**. Semi-dependent Base Station Key Management Scheme for Wireless Multimedia Sensor Networks. in *Informatization Research*, vol. 37, no. 5, pp. 1-5, 2011.
- I&C'11 Li Liu, Yi Dou, **Ting Dai**, Haiping Huang, and Shengwei Zhao. Jini-based IoT Service Framework. in *Information & Communications*, vol. 5, pp. 26-28, 2011.
- AMR'11 Li Liu, **Ting Dai**, Yi Dou, Haiping Huang, Junjie Huang, and Ning Ye. Simulation of the Park Behaviors in a Shopping Mall of Dalian. in *Advanced Material Research*, vol. 317-319, pp. 2133-2137, Aug. 2011.

Refereed Conference Publications (9 total, 1 award, 1 nominee)

- MMSys'22 Bekir Turkkan, **Ting Dai**, Adithya Raman, Tefvik Kosar, Changyou Chen, Fatih Bulut, Jaroslaw Zola, and Daby Sow. GreenABR: Energy-Aware Adaptive Bitrate Streaming with Deep Reinforcement Learning. in *Proceedings of the 13th ACM Multimedia Systems Conference*. Athlone, Ireland, 2022. *Acceptance Rate: 34.9%*.  **DASH Award in 3rd place**.
- SoCC'20 **Ting Dai**, Alexei Karve, Grzegorz Koper, and Sai Zeng. Automatically Detecting Risky Scripts in Infrastructure Code. in *Proceedings of the 11th ACM Symposium on Cloud Computing*. Virtual Event, USA, 2020. *Acceptance Rate: 24.5%*.
- SoCC'20 Jingzhu He, **Ting Dai**, Xiaohui Gu, and Guoliang Jin. HangFix: Automatically Fixing Software Hang Bugs for Production Cloud Systems. in *Proceedings of the 11th ACM Symposium on Cloud Computing*. Virtual Event, USA, 2020. *Acceptance Rate: 24.5%*.
- DSN'19 Hui Kang*, **Ting Dai***, Nerla Jean-Louis, Shu Tao, and Xiaohui Gu. FabZK: Supporting Privacy-Preserving, Auditable Smart Contracts in Hyperledger Fabric. in *Proceedings of the 49th IEEE/IFIP International Conference on Dependable Systems and Networks*. Portland, OR, USA, 2019. *Acceptance Rate: 21.4%* (*Co-primary authors).
- ICDCS'19 Jingzhu He, **Ting Dai**, and Xiaohui Gu. TFix: Automatic Timeout Bug Fixing in Production Server Systems. in *Proceedings of the 39th IEEE International Conference on Distributed Computing Systems*. Dallas, TX, USA, 2019. *Acceptance Rate: 19.6%*.

- IC2E'19 Olufogorehan Tunde-Onadele, Jingzhu He, **Ting Dai**, and Xiaohui Gu. A Study on Container Vulnerability Exploit Detection. in *Proceedings of the 7th IEEE International Conference on Cloud Engineering*. Prague, Czech Republic, 2019. *Acceptance Rate: 26%*.
- IC2E'18 **Ting Dai**, Jingzhu He, Xiaohui Gu, and Shan Lu. Understanding Real-World Timeout Problems in Cloud Server Systems. in *Proceedings of the 6th IEEE International Conference on Cloud Engineering*. Orlando, FL, USA, 2018. *Acceptance Rate: 19%*. [★ best paper nominee](#).
- SoCC'18 **Ting Dai**, Jingzhu He, Xiaohui Gu, Shan Lu, and Peipei Wang. DScope: Detecting Real-World Data Corruption Hang Bugs in Cloud Server Systems. in *Proceedings of the 9th ACM Symposium on Cloud Computing*. Carlsbad, CA, USA, 2018. *Acceptance Rate: 24.4%*
- ICAC'18 Jingzhu He, **Ting Dai**, and Xiaohui Gu. TScope: Automatic Timeout Bug Identification for Server Systems. in *Proceedings of the 15th IEEE International Conference on Autonomic Computing*. Trento, Italy, 2018.

[ePrint Archive \(1 total\)](#)

- arXiv'21 Jingzhu He, **Ting Dai**, and Xiaohui Gu. TFix+: Self-configuring Hybrid Timeout Bug Fixing for Cloud Systems. 2021.

[Refereed Poster Publications \(1 total\)](#)

- SoCC'17 **Ting Dai**, Daniel Dean, Peipei Wang, Xiaohui Gu, and Shan Lu. Hytrace: a hybrid approach to performance bug diagnosis in production cloud infrastructures. in *Proceedings of the 8th ACM Symposium on Cloud Computing*. Santa Clara, CA, USA, 2017.

Patents

[Filed \(2 total\)](#)

- US17656245 **Ting Dai**, Muhammed Fatih Bulut, Shripad Nadgowda, and Daby Mousse Sow. A system and method for propagating vulnerability remediations. Filed on Mar 24, 2022.
- US17643205 Muhammed Fatih Bulut, Abdulhamid Adebawale Adebayo, Lilian Mathias Ngweta, **Ting Dai**, Constantin Mircea Adam, Daby Mousse Sow, and Steven Oceppek. A system and method for mapping compliance security checks into mitigation techniques and to vulnerabilities for risk assessment. Filed on Dec 08, 2021.

[Granted \(8 total\)](#)

- US11200048 Alexei Karve, Sai Zeng, and **Ting Dai**. Modification of Codified Infrastructure for Orchestration in a Multi-Cloud Environment. Filed on May 14, 2020. Granted on Dec 14, 2021.
- CN103124421 Ruchuan Wang, Xinxing Pan, Haiping Huang, Dan Sha, **Ting Dai**, Linyun Jiang, Chao Sha, Jia Xu, and Fu Xiao. The cluster-dividing method of mobile node in a kind of wireless sensor network. Filed on Dec 12, 2012. Granted on Jun 8, 2016.

- CN102196431 Haiping Huang, Yi Dou, Ruchuan Wang, Haitao Zhang, Liang Xu, Lijuan Sun, **Ting Dai**, Haiyan Wang, Linyun Jiang, Chao Sha, Fu Xiao, Lin Zhang, Jian Guo, Zhigang Tan, Li Liu, and Xiang Gu. Internet of things application scene-based protection method of privacy query and private identity verification. Filed on May 13, 2011. Granted on Oct 22, 2014.
- CN102325344 Haiping Huang, **Ting Dai**, Ruchuan Wang, Biao Liang, Lijuan Sun, Chao Sha, Qiang Zhao, Fu Xiao, Yi Dou, Jia Xu, Linyun Jiang, Zhigang Tan, and Jian Guo. Method for tracking and locating container by adopting label sensor network. Filed on Jun 13, 2011. Granted on Sep 10, 2014.
- CN102594820 Lijuan Sun, Xuan Zhou, Haiping Huang, Ruchuan Wang, Jia Xu, Yachao Lv, Qi Yan, Shang Shang, **Ting Dai**, Yi Dou, Chao Sha, and Fu Xiao. Secure multi-party computation privacy-protecting evaluation method based on scenes of internet of things. Filed on Feb 17, 2012. Granted on Sep 10, 2014.
- CN102325345 Haiping Huang, **Ting Dai**, Ruchuan Wang, Biao Liang, Lijuan Sun, Chao Sha, Qiang Zhao, Fu Xiao, Yi Dou, Jia Xu, Linyun Jiang, Zhigang Tan, and Jian Guo. Container logistic tracking and positioning method based on tag sensor network. Filed on Jun 13, 2011. Granted on Nov 27, 2013.
- CN102164369 Haiping Huang, **Ting Dai**, Ruchuan Wang, Lijuan Sun, Yi Dou, Zhigang Tan, Li Liu, Wei Zhang, Xuan Zhou, Wencong Huang, Hao Chen, and Chao Sha. Method for broadcast authentication of wireless sensor network based on automaton and game of life. Filed on May 13, 2011. Granted on Sep 25, 2013.
- CN102193498 Haiping Huang, Baoyang She, Ruchuan Wang, Yun Zhang, Qiwang Cai, Lijuan Sun, Xiao Cao, Di Gao, Junjie Huang, Pingfan Ji, Zhigang Tan, and **Ting Dai**. Method for setting intelligent electronic alarm clock based on applied statistical method and embedded computing. Filed on Mar 18, 2011. Granted on Apr 10, 2013.

Mentoring Experience

Over the years I had the fantastic opportunity to work with talented students on some of the research projects that I envisioned at the time.

- 2nd half 2021 Bekir Turkkan (SUNY Buffalo) - Energy-efficient video streaming [[MMSys'22](#)]
- Summer 2020 Sam Cheng (UIUC) - Risky script pattern discovery from open source communities
- Fall 2017 Pavithra Iyer (NC State) - Software testing on data corruption hang bug detector [[SoCC'18](#)]

Honors & Awards

- 2022 DASH-IF Excellence in DASH Award (3rd place)
- 2021 IBM Research Accomplishments (three A-level Awards)
- 2020 IBM First Patent Application Invention Achievement Award
- 2020 IBM Research Accomplishment Nomination
- 2018 IC2E Best Paper Nomination
- 2018 OSDI Travel Grant
- 2017, 2018 SoCC Travel Grants
- 2014 Outstanding Master Award

- 2014 Outstanding Postgraduate Dissertation Award
- 2013 The Winning Prize in 'Graduate Science Star' Contest in Yangtze-River-Delta Region
- 2012, 2013 National Scholarships for Postgraduate Students
- 2012, 2013 The NJUPT 'Star of the Academy' Awards
- 2012, 2013 Outstanding Postgraduate Student Scholarships
- 2012 The 2nd Prize in National Postgraduate Mathematical Contest in Modeling
- 2012 The 2nd Prize in National College and University Contest of Computer Coursewares
- 2012 The 'Hengtong Optic-electric' Scholarship
- 2011 The 3rd Prize in 'Challenge Cup' Science and Technology Contest in Jiangsu Province
- 2011 Outstanding Bachelor Award
- 2011 Outstanding Undergraduate Dissertation Award
- 2009 The Winning Prize in 'Zhongfu-Nanyou Cup' Information Security Contest
- 2009 The NJUPT Second-class Scholarship
- 2008, 2010 The NJUPT First-class Scholarships
- 2008–2010 Best Undergraduate Student Awards

Service

- TPC Member IEEE International Conference on Distributed Computing Systems, 2023
IEEE International Conference on Cloud Computing, 2021-2022
- co-Editor Journal of Systems Research, 2021
- Panelist Workshop on Hot Topics in Operating Systems, 2021
- External IEEE International Conference on Automation and Computing, 2019
- Reviewer ACM Asia-Pacific Workshop on Systems, 2018
IEEE Transactions on Parallel and Distributed Systems, 2017
IEEE International Conference on Cloud Engineering, 2017

Press

- 2021 New service from IBM Research and X-Force Red makes vulnerability management more efficient
◦ [\[IBM Research\]](#) ◦ [\[IBM MediaCenter\]](#)
- 2020 Kubernetes-based Control Plane to Manage Risk and Compliance for Hybrid Cloud
◦ [\[\[IBM Research\]](#)
- 2020 Software Spots and Fixes Hang Bugs in Seconds, Rather Than Weeks
◦ [\[NC State News\]](#) ◦ [\[EurekaAlert!\]](#) ◦ [\[Tech Xplore\]](#) ◦ [\[Mirage News\]](#) ◦ [\[ScienceDaily\]](#)
- 2020 We won't leave you hanging any longer: Tool strips freeze-inducing bugs from Java bytecode while in production
◦ [\[The Register\]](#)
- 2020 Software program spots and fixes grasp bugs in seconds, fairly than weeks
◦ [\[News8Plus\]](#)
- 2020 NC State researchers develop software that fixes 'hang bugs' in seconds, rather than weeks
◦ [\[WRAL TechWire\]](#)

- 2020 The tool removes the bug that causes freezes from Java bytecode in production
 - [\[Eminetra Today\]](#)
- 2020 Researchers develop HangFix to quickly resolve hang bugs
 - [\[News Break\]](#) ◦ [\[SD Times\]](#)