Linhai Song

Assistant Professor
College of Information Sciences and Technology
Pennsylvania State University

305H Steam Services Building
State College, PA 16802
songlh@ist.psu.edu
Tel: (814) 863-7566
https://songlh.github.io/

RESEARCH INTERESTS

Tool support for improving the reliability, security and efficiency of software systems

EDUCATION

University of Wisconsin–Madison, Madison, WI, USA — Nov. 2015
Ph.D., Computer Science (M.S. along the way)
Advisor: Shan Lu

Chinese Academy of Sciences, Beijing, China — Jun. 2010
M.S., Computer Science

Huazhong University of Science and Technology, Wuhan, Hubei, China — Jun. 2007
B.E., Software Engineering

EMPLOYMENT

Pennsylvania State University, State College, PA, USA — Aug. 2017 - Present
Assistant Professor at College of Information Sciences and Technology

ByteDance Ltd., Palo Alto, CA, USA — May 2019 - Aug. 2019
Consultant

FireEye, Inc., Milpitas, CA, USA — Nov. 2015 - Jul. 2017
Staff Research Scientist

NEC Laboratories America, Inc., Princeton, NJ, USA — May 2013 - Aug. 2013
Research Intern

Microsoft Research Asia, Beijing, China — May 2010 - Jul. 2010
Research Intern

HONORS AND AWARDS

Mozilla Research Award, 2019

MICRO'2014 Best Paper Runner Up for paper [C5], 2014

ACM SIGPLAN Research Highlights @ PLDI for paper [C1], 2011

PUBLICATIONS[1]

Refereed Journal Articles

[1]Students directly under my supervision are denoted by "S".

[J3] Boqin Qin^S, Yilun Chen, **Linhai Song**, and Yiying Zhang. "Understanding and Detecting Real-World Safety Issues in Rust." Under Preparation.

[J2] Boqin Qin^S, Tengfei Tu^S, Ziheng Liu^S, Tingting Yu, and **Linhai Song**. "Algorithmic Profiling for Real-World Complexity Problems." Submitted to *Transactions on Software Engineering (**TSE**)*.

[J1] Dongdong Deng, Guoliang Jin, Marc de Kruijf, Ang Li, Ben Liblit, Shan Lu, Shanxiang Qi, Jinglei Ren, Karthikeyan Sankaralingam, **Linhai Song**, Yongwei Wu, Mingxing Zhang, Wei Zhang, and Weimin Zheng. "Fixing, Preventing, and Recovering from Concurrency Bugs." In *Science China Information Sciences volume*, vol. 58, pp. 1–18, April 2014.

Refereed Conference Proceedings

[C13] Ziheng Liu^S, Shuofei Zhu^S, Boqin Qin^S, Hao Chen, and **Linhai Song**. "Automatically Detecting and Fixing Concurrency Bugs in Go Software Systems." In *Proceedings of the 26th International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS'2021**)*. (Acceptance Rate: 18.8%, 75 out of 398)

[C12] Boqin Qin^S*, Yilun Chen*, Zeming Yu^S, **Linhai Song**, and Yiying Zhang. "Understanding Memory and Thread Safety Practices and Issues in Real-World Rust Programs." In *Proceedings of the 41st ACM SIGPLAN Conference on Programming Language Design and Implementation (**PLDI'2020**)*, pp. 763–779, June 2020. (Acceptance Rate: 22.5%, 77 out of 341) (*: co-first authors)

[C11] Shuofei Zhu^S, Jianjun Shi^S, Limin Yang, Boqin Qin^S, Ziyi Zhang^S, **Linhai Song**, and Gang Wang. "Measuring and Modeling the Label Dynamics of Online Anti-Malware Engines." In *Proceedings of the 29th USENIX Security Symposium (**USENIX Security'2020**)*, August 2020. (Acceptance Rate: 17.1%, 44 out of 256)

[C10] Bangwen Deng, Wenfei Wu, and **Linhai Song**. "NFReducer: Redundant Logic Elimination in Network Functions." In *Proceedings of the 2020 ACM SIGCOMM Symposium on SDN Research (**SOSR'2020**)*, pp. 34–40, March 2020. (Acceptance Rate: 28.3%, 17 out of 60)

[C9] Peng Peng, Limin Yang, **Linhai Song**, and Gang Wang. "Opening the Blackbox of VirusTotal: Analyzing Online Phishing Scan Engines." In *Proceedings of the 2019 ACM Internet Measurement Conference (**IMC'2019**)*, pp. 478–485, October 2019. (Acceptance Rate: 19.7%, 39 out of 197)

[C8] Tengfei Tu^S, Xiaoyu Liu, **Linhai Song**, and Yiying Zhang. "Understanding Real-World Concurrency Bugs in Go." In *Proceedings of the 24th International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS'2019**)*, pp. 865-878, April 2019. (Acceptance Rate: 21.1%, 74 out of 350)

[C7] **Linhai Song** and Shan Lu. "Program Analysis for Inefficient Loops." In *Proceedings of the 39th International Conference on Software Engineering (**ICSE'2017**)*, pp. 370–380, May 2017. (Acceptance Rate: 16.4%, 68 out of 415)

[C6] Rui Gu, Guoliang Jin, **Linhai Song**, Linjie Zhu, and Shan Lu. "What Change History Tells Us About Thread Synchronization." In *Proceedings of the 2015 10th Joint Meeting on Foundations of Software Engineering (**FSE'2015**)*, pp. 426–438, August 2015. (Acceptance Rate: 25.4%, 74 out of 291)

[C5] **Linhai Song**, Min Feng, Nishkam Ravi, Yi Yang, and Srimat Chakradhar. "COMP: Compiler Optimizations for Manycore Processors." In *Proceedings of the 47th Annual IEEE/ACM International Symposium on Microarchitecture (**MICRO'2014**)*, pp. 659–671, December 2014. (Acceptance Rate: 19.4%, 53 out of 273) **MICRO'2014 Best Paper Runner Up**

[C4] **Linhai Song** and Shan Lu. "Statistical Debugging for Real-World Performance Problems." In *Proceedings of the 2014 ACM International Conference on Object Oriented Programming Systems Languages & Applications (**OOPSLA'2014**)*, pp. 561–578, October 2014. (Acceptance Rate: 28.4%, 53 out of 186)

[C3] Adrian Nistor, **Linhai Song**, Darko Marinov, and Shan Lu. "Toddler: Detecting Performance Problems via Similar Memory-Access Patterns." In *Proceedings of the 2013 International Conference on Software Engineering (**ICSE'2013**)*, pp. 562–571, May, 2013. (Acceptance Rate: 18.5%, 85 out of 461)

[C2] Guoliang Jin*, **Linhai Song***, Xiaoming Shi, Joel Scherpelz, and Shan Lu. "Understanding and Detecting Real-World Performance Bugs." In *Proceedings of the 33rd ACM SIGPLAN Conference on Programming Language Design and Implementation (**PLDI'2012**)*, pp. 77–88, June 2012. (Acceptance Rate: 18.8%, 48 out of 255) (*: co-first authors)

[C1] Guoliang Jin, **Linhai Song**, Wei Zhang, Shan Lu, and Ben Liblit. "Automated Atomicity-Violation Fixing." In *Proceedings of the 32nd ACM SIGPLAN Conference on Programming Language Design and Implementation (**PLDI'2011**)*, pp. 389–400, June 2011. (Acceptance Rate: 23.3%, 55 out of 236) **ACM SIGPLAN Research Highlights Award** (Top 8 papers selected from all papers in 13 SIGPLAN conferences in 2011 for "high quality and broad appeal")

Refereed Workshop Proceedings

[W3] Yongheng Chen^S, **Linhai Song**, Xinyu Xing, Fengyuan Xu, and Wenfei Wu. "Automated Finite State Machine Extraction." In *Proceedings of the 3rd ACM Workshop on Forming an Ecosystem Around Software Transformation (**FEAST'2019**)*, pp. 9–15, November 2019. (Acceptance Rate: 87.5%, 7 out of 8)

[W2] **Linhai Song** and Xinyu Xing. "Fine-Grained Library Customization." In *Proceedings of the First International Workshop on SoftwAre debLoating And Delayering (**SALAD'2018**)*, July 2018. (Acceptance Rate: 66.7%, 2 out of 3)

[W1] **Linhai Song**, Heqing Huang, Wu Zhou, Wenfei Wu, and Yiying Zhang. "Learning from Big Malware." In *Proceedings of the 7th ACM SIGOPS Asia-Pacific Workshop on Systems (**APSys'2016**)*, pp. 1–8, August 2016. (Acceptance Rate: 40.8%, 20 out of 49)

Technical Reports

[T4] Zeming Yu^S, **Linhai Song**, and Yiying Zhang. "Fearless Concurrency? Understanding Concurrent Programming Safety in Real-World Rust Software." arXiv:1902.01906.

[T3] **Linhai Song** and Xinyu Xing. "Fine-Grained Library Customization." arXiv:1810.11128.

[T2] **Linhai Song** and Shan Lu. "Program Analysis for Inefficient Loops." UChicago CS Technical Report TR-2016-06.

[T1] **Linhai Song** and Shan Lu. "Statistical Debugging for Real-World Performance Problems." UW-Madison CS Technical Report 1803.

Posters

[P3] Ziyi Zhang^S and **Linhai Song**. "Poster: Visualizing Critical Sections in Rust." In *Student Research Competition at the 27th ACM Symposium on Operating Systems Principles (**SOSP'2019**)*.

[P2] Tengfei Tu^S, Xiaoyu Liu, **Linhai Song** and Yiying Zhang. "Poster: Understanding Real-World Concurrency Bugs in Go." In *the 13rd USENIX Symposium on Operating Systems Design and Implementation (**OSDI'2018**)*.

[P1] **Linhai Song** and Shan Lu. "Poster: Statistical Debugging for Real-World Performance Problems." In *the 4th Greater Chicago Area Systems Research Workshop (**GCASR'2015**)*.

Demonstrations

[D2] Ziyi Zhang^S, Boqin Qin^S, and **Linhai Song**. "Demonstration: VRLifeTime: An IDE Tool to Avoid Concurrency and Memory Bugs in Rust." Under Preparation.

[D1] Shuofei Zhu[S], Ziyi Zhang[S], Limin Yang, **Linhai Song**, and Gang Wang. "Demonstration: Benchmarking Label Dynamics of VirusTotal Engines." Submitted to *the 28th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (FSE'2020)*.

Software and Data Release

[D3] Dataset of the daily snapshots of VirusTotal labels for 14,000 files over a year, 2020.
https://sfzhu93.github.io/projects/vt/index.html

[D2] Dataset of 170 real-world Rust safety issues, 2020.
https://github.com/system-pclub/rust-study

[D1] Dataset of 171 real-world Go concurrency bugs, 2019.
https://github.com/system-pclub/rust-study

Patents

[PA1] Min Feng, Srimat Chakradhar, and **Linhai Song**. "Compiler Optimization for Many Integrated Core Processors." U.S. Patent No. 20150277877, October 1st, 2015.

PROFESSIONAL ACTIVITIES

Conference Program Committee Service

- Poster and Demonstration Session at ACM Conference on Computer and Communications Security (**CCS**): 2020
- Poster Session at International Conference on Software Engineering (**ICSE**): 2020
- Software Engineering in Practice at International Conference on Software Engineering (**ICSE**): 2019
- ACM SIGOPS Asia-Pacific Workshop on Systems (**APSys**): 2018, 2019
- Student Research Competition (**SRC**) at ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (**FSE**): 2018
- Student Research Competition (**SRC**) at International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**): 2018
- Artifact Evaluation at ACM SIGPLAN Conference on Programming Language Design and Implementation (**PLDI**): 2015
- Artifact Evaluation at ACM SIGSOFT International Symposium on Software Testing and Analysis (**ISSTA**): 2014

Conference Reviewer

- ACM SIGSOFT International Symposium on Software Testing and Analysis (**ISSTA**): 2018
- International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**): 2019, 2020, 2021
- ACM Conference on Computer and Communications Security (**CCS**): 2017, 2018
- USENIX Annual Technical Conference (**USENIX ATC**): 2017

Journal Reviewer

- ACM Transactions on Computer Systems: 2020
- Empirical Software Engineering Journal: 2020
- IEEE Computer Architecture Letters: 2019

- Transactions on Software Engineering: 2017, 2020
- Journal of Computer Science and Technology: 2017

Journal Editor

- EAI Transactions on Security and Safety: 2019, 2020

Conference & Workshop Organization Service

- Chair for Student Research Competition (**SRC**) at International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**): 2019

Other Services

- National Science Foundation (NSF) Review Panel: 2018

TALKS

- Understanding Real-World Concurrency Bugs in Go
  - ASPLOS'2019, April 2018
- Understanding Real-World Concurrency Bugs in New Programming Languages
  - Carnegie Mellon University, October 2019
  - ByteDance, December 2018
  - Baidu X-lab, December 2018
- Protocol Subsetting and Dialect Generation
  - Salad'2018, July 2018
- Protocol Subsetting and Dialect Generation
  - Baidu X-lab, December 2017
- Performance Diagnosis for Inefficient Loops
  - ICSE'2017, May 2016
- Improve Software Security and Performance through Data Analytics
  - Pennsylvania State University, March 2016
- Learning from Big Malware
  - APSys'2016, August 2016
- Understanding, Detecting, and Diagnosing Real-World Performance Bugs
  - National University of Singapore, March 2016
  - Microsoft Research Asia, December 2015
  - Peking University, June 2015
  - Pivotal Labs, May 2015
- Statistical Debugging for Real-World Performance Problems
  - OOPSLA'2014, October 2014
  - WISDOM Workshop II, May 2014
- Optimizing Memory Performance on Many Integrated Core Coprocessors
  - NEC Labs America, August 2013
- Understanding and Detecting Real-World Performance Bugs
  - PLDI'2012, June 2012
  - Programming Languages Seminar, University of Wisconsin-Madison, May 2012

GRANTS

- SaTC: CORE: Small: Understanding and Detecting Memory Bugs in Rust.
  - Role: PI; with Hao Chen from UC Davis as Co-PI;
  - Total: $497,340; Personal Share: $298,404 (60%);
  - National Science Foundation (NSF);
  - 07/01/2020 to 06/30/2023.
- Measuring and Modeling the Label Dynamics of Online AntiMalware Engines
  - Role: Sole PI;
  - Total: $9,966; Personal Share: $9,966 (100%);
  - ICDS@PSU Seed Grant;
  - 05/01/2020 to 04/30/2021.
- Statically Detecting Memory Bugs in Rust Applications
  - Role: Sole PI;
  - Total: $80,100; Personal Share: $80,100 (100%);
  - Open Tech Fund;
  - 01/01/2020 to 06/30/2021.
- Benchmarking Generic Functions in Rust
  - Role: Sole PI;
  - Total: $25,000; Personal Share: $25,000 (100%);
  - Mozilla Research Award;
  - 09/01/2019 to 09/01/2020.
- Benchmarking, Detecting, and Diagnosing Real-World Performance Problems
  - Role: Sole PI;
  - Total: $85,500; Personal Share: $85,500 (100%);
  - IST@PSU Seed Grants;
  - 09/01/2018 to 09/01/2019.

TEACHING

Term	Course	Enrollment	Course Quality	Instructor Quality
Fall 2020	SRA 221 Overview of Information Security	68	6/7	6/7
Fall 2019	IST 451 Network Security (1)	72	4.78/7	5.03/7
Fall 2019	IST 451 Network Security (2)	66	5.23/7	5.57/7
Fall 2018	IST 451 Network Security (1)	71	5.69/7	5.66/7
Fall 2018	IST 451 Network Security (2)	45	5.59/7	5.59/7
Spring 2018	IST 451 Network Security (1)	48	5.68/7	5.8/7
Fall 2017	IST 451 Network Security (1)	71	5.16/7	5.19/7

ADVISING

Ph.D. Students

- Shuofei Zhu (2018 – Present): [C11] [C13] [D1]
- Ziheng Liu (2019 – Present): [C13] [J2]
- Shihao Xia (co-advised with Hong Hu) (2020 – Present)

Visiting Students

- Boqin Qin (Ph.D. student from BUPT) (2018 – 2020): [C11] [C12] [C13] [J2] [J3] [D2]

- Ziyi Zhang (Undergraduate from USTC) (2019): [C11] [P3] [D1] [D2] → Ph.D. at Wisconsin-Madison
- Jianjun Shi (Ph.D. student from BIT) (2018 – 2019): [C11]
- Zeming Yu (2018 – 2019): [C12] [T4]
- Yongheng Chen (Undergraduate from NJU) (2019): [W3] → Ph.D. at Gatech
- Tengfei Tu (Ph.D. student from BUPT) (2017 – 2018): [C8] [J2] [P2] → faculty at BUPT