Linhai Song

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FireEye Research Labs
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Interests

- Performance Optimization & Tuning for Large Software
- Program Analysis and Software Testing

Employment

FireEye Research Labs, FireEye, Inc. — California, USA
Staff Research Scientist — *2015.11 – Present*

Education

University of Wisconsin-Madison — Wisconsin, USA
Ph.D. in Computer Science (M.S. along the way) — *2010.08 – 2015.10*
Advisor: Shan Lu
Thesis: Understanding, Detecting, and Diagnosing Real-World Performance Bugs

Institute of Computing Technology, Chinese Academy of Sciences — Beijing, China
M.S. in Computer Science — *2007.08 – 2010.06*
Advisor: Xueqi Cheng

Huazhong University of Science and Technology — Hubei, China
B.E. in Software Engineering — *2003.08 – 2007.06*

Academic Award

MICRO Best Paper Runner Up, 2014

- "COMP: Compiler Optimizations for Manycore Processors" published in MICRO'2014
- One of five papers selected from 273 MICRO'2014 submissions

ACM SIGPLAN Research Highlights Award, 2011

- "Automated Atomicity-Violation Fixing" published in PLDI'2011
- One of eight papers selected from all papers published in 13 ACM SIGPLAN conferences in 2011

Research Experience

Staff Research Scientist, FireEye Research Labs — 2015.11 – Present

- Conduct data mining for the security repository on VirusTotal;
- Design and implement an end-point anti-virus system;
- Design and implement algorithms to calculate similarity between JavaScript programs.

Research Assistant, University of Wisconsin-Madison — 2011.01 – 2015.10

- Design and implement a series of static-dynamic hybrid analysis for inefficient loops;
- Study the correlation between features of critical sections and their change histories;
- Explore the design space of applying statistical debugging to performance failure diagnosis;
- Implement a dynamic technique to detect inefficient nested loops for C/C++ programs;
- Design and implement a series of static rule-based detectors for performance bugs;
- Conduct a comprehensive study on 110 real-world performance bugs;

- Implement the deadlock detection module in an atomicity violation concurrent bug fixing project.

Research Intern, FutureWei Technologies Inc. 2014.05 – 2014.09

- Demonstrate a static bug detection technique for inefficient loops with Cond-Break fixes;
- Demonstrate a failure diagnosis technique built on hardware performance counters.

Research Intern, NEC Labs America 2013.05 – 2013.08

- Explore performance bottlenecks for Intel Xeon Phi manycore coprocessors (MIC);
- Design and implement three source-to-source compiler optimizations for parallel loops which offload computation to MIC.

Research Intern, Microsoft Research Asia 2010.05 – 2010.07

- Design and implement a toolkit for graphical model inference based on secondary development on Visio;
- Get **excellent** assessment for this project.

Research Assistant, Institute of Computing Technology, Chinese Academy of Sciences 2007.09 – 2010.05

- Design two separate algorithms to extract news articles and blog posts respectively;
- Implement the web content extraction module for a web retrieve system.

Publications

Refereed Conference Publications

1. **Linhai Song**, Shan Lu
   Program Analysis for Inefficient Loops, **Under Submission**.
2. Rui Gu, Guoliang Jin, **Linhai Song**, Linjie Zhu, Shan Lu
   What Change History Tells Us About Thread Synchronization, **FSE'2015**.
3. **Linhai Song**, Min Feng, Nishkam Ravi, Yi Yang, Srimat Chakradhar
   COMP: Compiler Optimizations for Manycore Processors, **MICRO'2014**.
   Won MICRO'2014 Best Paper Runner Up
4. **Linhai Song**, Shan Lu
   Statistical Debugging for Real-World Performance Problems, **OOPSLA'2014**.
   (A followup work is under submission.)
5. Adrian Nistor, **Linhai Song**, Darko Marinov, Shan Lu
   Toddler: Detecting Performance Problems via Similar Memory-Access Patterns, **ICSE'2013**.
6. Guoliang Jin*, **Linhai Song***, Xiaoming Shi, Joel Scherpelz, Shan Lu
   Understanding and Detecting Real-World Performance Bugs, **PLDI'2012**.
   (*: alphabetical order of surnames)
   Most cited paper from PLDI'2012
7. Guoliang Jin, **Linhai Song**, Wei Zhang, Shan Lu, Ben Liblit
   Automated Atomicity-Violation Fixing, **PLDI'2011**.
   Won ACM SIGPLAN Research Highlights Award

Other Publications

1. **Linhai Song**, Heqing Huang, Wu Zhou, Wenfei Wu, Yiying Zhang
   Learning from Big Malwares, **APSys'2016**.
2. **Linhai Song**, Shan Lu
   Program Analysis for Inefficient Loops, UChicago CS **Technical Report TR-2016-06**.
3. 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, Weimin Zheng
   Fixing, Preventing, and Recovering from Concurrency Bugs, **Science China Information Sciences, April 2015**.
4. **Linhai Song**, Shan Lu
   Statistical Debugging for Real-World Performance Problems, **GCASR'2015 Poster**.
5. **Linhai Song**, Shan Lu

Statistical Debugging for Real-World Performance Problems, UW-Madison CS **Technical Report 1803**.

Publications before Ph.D

1. Yan Guo, Huifeng Tang, **Linhai Song**, Yu Wang, Guodong Ding
   ECON: An Approach to Extract Content from Web News Page, **APWeb'2010** (CCF Class C).
2. **Linhai Song**, Xueqi Cheng, Yan Guo, Bo Wu, Yu Wang
   Blog Post Extraction Using Title Finding, **CCIR'2009**.
3. Yu Wang, Bingxing Fang, Bo Wu, **Linhai Song**, Yan Guo
   Schema Matching Incorporating with Attribute Distribution Features, **CCIR'2009**.
4. Feng Guan, Xiaoming Yu, Zeying Peng, Hongbo Xu, Yue Liu, **Linhai Song**, Xueqi Cheng
   ICTNET at Web Track 2009 Ad-hoc Task, **TREC'2009**.
5. Xueke Xu, Yue Liu, Hongbo Xu, Xiaoming Yu, **Linhai Song**, Feng Guan, Zeying Peng, Xueqi Cheng
   ICTNET at Blog Track TREC 2009, **TREC'2009**.
6. Bo Wu, Xueqi Cheng, Yu Wang, Yan Guo, **Linhai Song**
   Simultaneous Product Attribute Name and Value Extraction from Web Pages, **WI'2009 workshop**.
7. **Linhai Song**, Xueqi Cheng, Yan Guo, Yue Liu, Guodong Ding
   ContentEx: A framework for automatic content extraction programs, **ISI'2009 short**.

Patents

1. Min Feng, Srimat Chakradhar, **Linhai Song**
   Compiler Optimization for Many Integrated Core Processors, U.S. Patent No. 20150277877, Oct 1st, 2015.

Professional Services

- Reviewer for the Journal of Computer Science and Technology
- PC member of Artifact Evaluation session in PLDI'2015
- PC member of Artifact Evaluation session in ISSTA'2014

Talks

1. Learning from Big Malwares
   Conference Presentation in APSys'2014, August 2016
2. Understanding, Detecting, and Diagnosing Real-World Performance Bugs
   National University of Singapore, March 2016
3. Understanding, Detecting, and Diagnosing Real-World Performance Bugs
   Microsoft Research Asia, December 2015
4. Understanding, Detecting, and Diagnosing Real-World Performance Bugs
   Peking University, June 2015
5. Understanding, Detecting, and Diagnosing Real-World Performance Bugs
   Pivotal Labs, May 2015
6. Statistical Debugging for Real-World Performance Problems
   Conference Presentation in OOPSLA'2014, October 2014
7. Statistical Debugging for Real-World Performance Problems
   WISDOM Workshop II, May 2014
8. Optimizing Memory Performance on Many Integrated Core Coprocessors
   NEC Labs America, August 2013
9. Understanding and Detecting Real-World Performance Bugs
   Conference Presentation in PLDI'2012, June 2012
10. Understanding and Detecting Real-World Performance Bugs
    Programming Languages Seminar, University of Wisconsin-Madison, May 2012

Skills

- **Languages:** C/C++, C#, Java, Python, PHP, SQL, HTML, JavaScript, Bash
- **Instrumentation & Analysis:** LLVM, PIN, GCC, GDB
- **Tools & Libraries:** Pthread, OMP, STL, SVN, GIT, MySQL, SQLite
- **Platforms:** Linux, Windows, Intel MIC