CHUNGHA SUNG

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EDUCATION

- **University of Southern California (USC) @ Los Angeles, CA, USA** *Aug.2017 - May.2021*
  - *Doctor of Philosophy (Ph.D.)*, Computer Science
  - Reliable & Secure Software (RSS) group with Prof. Chao Wang
- **Virginia Tech @ Blacksburg, VA, USA** *Aug.2014 - Dec.2016*
  - *Master of Science (M.S.)*, Electrical and Computer Engineering
- **Sung Kyun Kwan University (SKKU) @ Suwon, Korea** *Mar.2007 - June.2013*
  - *Bachelor of Science in Engineering (B.S.E.)*, Semiconductor Systems Engineering
  - Parallel Architecture and Programming Language Lab (PAPL) with Prof.Jae W. Lee

RESEARCH INTERESTS

Static/Dynamic Program Analysis, Program Languages, Software Testing & Verification, Formal Methods, Program Synthesis, Model Checking, Abstract Interpretation, SMT solver, Datalog, Compiler (e.g., LLVM, Clang), Side Channel, Automatic Repair, AI Safety.

EXPERIENCE

- **RSS group @ USC & Virginia Tech** *Aug.2014 - Dec.2020*
  - Dissertation: Constraint-based program analysis for efficient automated reasoning techniques for concurrent programs.
  - **Fast and approximate semantic diffing of concurrent programs [5]**
    - Proposed an interference analysis based on declarative analysis framework to compute synchronization differences in multi-threaded programs.
    - Implemented the analysis with Datalog in an LLVM compiler front-end pass, and achieved a high accuracy as well as up to 1000x faster analysis than a model checking based approach.
  - **A unified cache analysis framework [6]**
    - Proposed a unified code transformation framework for analyzing cache behavior by various verification methods (e.g., model checkering, abstract interpretation and symbolic execution).
    - Implemented a C/C++ code transformation in an LLVM compiler front-end pass and showed the cache behavior of transformed code can be analyzed by KLEE, SMACK and Crab-llvm.
  - **Accurate modular abstract interpretation for interrupt-driven software [7]**
    - Designed an interference analysis between interrupts by constraint-based program analysis.
    - Applied the analysis to prune infeasible data flows in thread modular abstract interpretation, and achieved 18x more proofs by reducing false positives.
  - **Optimizing web application testing by DOM-event dependency analysis [8]**
    - Designed a constraint-based dependency analysis on DOM objects in web applications.
    - Integrated the analysis into a systematic testing tool to prune redundant tests by partial order reduction, and achieved 20% higher code coverage with the analysis-based reduction.
  - **Power channel analysis and mitigation [4]**
    - Proposed a constraint-based analysis framework to detect power side channel leaks due to register reuse in compiler.
    - Designed a mitigation of power side channel leaks by register reallocation in LLVM which offers an efficient power side channel mitigation in terms of runtime and transformed code size.
  - **Compression side channel analysis and mitigation in web apps [3]**

- Proposed an automated approach to detect and mitigate compression side channels in web server applications.
- Implemented a taint analysis to collect sensitive data sinks and an enhanced compressor to mitigate the side channel leaks for the sensitive data sinks.

· **Research Intern @ Microsoft Research, Redmond, WA, USA** *May.2019 - Aug.2019*
  – Mentors: Dr.Shuvendu Lahiri and Dr.Mark Marron
  – Designed an automatic merge-conflict resolution framework for divergent forks [2, 9]
    - Built a prototype tool based on AST-based diffing and patching for merge-conflicts in the Microsoft Edge development.
    - Achieved 40% of automatic resolution for target conflicts in the framework.

· **Research Intern @ MediaTek Inc., Woburn, MA, USA** *May.2018 - Aug.2018*
  – Mentor: Dr.Henry Cox
  – Designed an SMT-based verifier for inconsistent constraints of instruction sets in mobile chips.

· **Research Intern @ Microsoft Research, India** *May.2017 - Aug.2017*
  – Mentors: Dr.Akash Lal and Dr.Kaushik Rajan
  – Extended a Scope query optimization tool by static analysis on queries to support various types of queries such as a query with uninterpreted functions.

· **Participant @ Google Summer of Code 2013** *May.2013 - Sep.2013*
  – Mentors: Prof.Jae W. Lee and Dr.Junghoon Lee
  – Published an interactive graphical open-source package named “RIGHT” in R project.

· **Software Development Intern @ Ahn Lab Inc., Korea** *Jul.2012 - Aug.2012*
  – Advanced server maintenance by modifying a boot loader sequence to support multiple layers of firmware.

TEACHING

· **Teaching Assistant**
  – Software Engineering (CSCI 310, USC) *Fall.2019, Spring.2021*
  – Data Structures and Object Oriented Design (CSCI 104, USC) *Spring.2019*
  – Microcontroller Programming and Interfacing (ECE 2534, Virginia Tech) *Fall.2014*
  – Digital Systems (SKKU) *Spring.2013*
  – Digital Logic Design Laboratory (SKKU) *Spring.2011, Spring.2012*

SERVICES

· **Student volunteer**: CAV 2020, ATVA 2018
· **(External) Reviewer**: FMCAD 2020, ASE 2020, IET Software 2020, ICSE 2020, FSE 2019, ICSE 2019, SAS 2018, TSE 2018, ICSE 2017, FORM 2017, FMCAD 2017, RV 2017, ISSTA 2017, ICSE 2016, SETTA 2016, TurstSoft 2016, FMCAD 2016, ATVA 2016, ICECCS 2016, TASE 2016

AWARDS

· LG Electronics industrial scholarship recipient *May.2017*
· ACM SIGSOFT travel grant for FSE *Nov.2016*
· Travel award for CAV *July.2016*
· First prize for graduation thesis and project award in SKKU *June.2013*
· Full Merit-based Awards from SKKU for Full Academic Years *Mar.2007 - Aug.2013*
· Dean’s List award in SKKU *Apr.2012*
· Scholarship from Samsung Electronics *Mar.2007 - Feb.2009*

PUBLICATIONS

[1] **[ICSE 2021] Data-Driven Synthesis of Provably Sound Side Channel Analyses**
Jingbo Wang, **Chungha Sung**, Mukund Raghothaman and Chao Wang
Proc. of the ACM/IEEE 43rd International Conference on Software Engineering (To appear).

[2] **[ICSE-SEIP 2020] Towards Understanding and Fixing Upstream Merge Induced Conflicts in Divergent Forks: An Industrial Case Study**
[Nominated as a best paper candidate]
Chungha Sung, Shuvendu Lahiri, Mike Kaufman, Pallavi Choudhury and Chao Wang
Proc. of the IEEE/ACM 42nd International Conference on Software Engineering: Software Engineering in Practice, pages 172-181.

[3] **[ASE 2019] Debreach: Mitigating Compression Side Channels via Static Analysis and Transformation**
Brandon Paulsen, **Chungha Sung**, Peter A.H. Peterson and Chao Wang
Proc. of the 34th IEEE/ACM International Conference on Automated Software Engineering, pages 899-911.

[4] **[FSE 2019] Mitigating Power Side Channels during Compilation**
Jingbo Wang, **Chungha Sung** and Chao Wang
Proc. of the 27th ACM Joint Meeting on European Software Engineering Conference and Symposium on the Foundations of Software Engineering, pages 590-601.

[5] **[ASE 2018] Datalog-based Scalable Semantic Diffing of Concurrent Programs**
Chungha Sung, Shuvendu Lahiri, Constantin Enea and Chao Wang
Proceedings of the 33rd ACM/IEEE International Conference on Automated Software Engineering, pages 656-666.

[6] **[ASE 2018] CANAL: A Cache Timing Analysis Framework via LLVM Transformation**
Chungha Sung, Brandon Paulsen and Chao Wang
Proceedings of the 33rd ACM/IEEE International Conference on Automated Software Engineering, pages 904-907.

[7] **[ASE 2017] Modular Verification of Interrupt-driven Software**
Chungha Sung, Markus Kusano, and Chao Wang
Proceedings of the 32nd IEEE/ACM International Conference on Automated Software Engineering, pages 206-216.

[8] **[FSE 2016] Static DOM Event Dependency Analysis for Testing Web Applications**
Chungha Sung, Markus Kusano, Nishant Sinha and Chao Wang
Proceedings of the 2016 24th ACM SIGSOFT International Symposium on Foundations of Software Engineering, pages 447-459.

[9] **[ICSE 2020, poster] Towards Understanding and Fixing Upstream Merge Induced Conflicts in Divergent Forks: An Industrial Case Study**
Chungha Sung, Shuvendu Lahiri, Mike Kaufman, Pallavi Choudhury, Jessica Wolk and Chao Wang
IEEE/ACM 42nd International Conference on Software Engineering, Seoul, Korea, July 2020.

[10] **[UseR 2014, poster] RIGHT: an HTML canvas and JavaScript-based interactive data visualization package for linked graphics**
ChungHa Sung, TaeJoon Song, Jae W. Lee and Junghoon Lee
The R User Conference, UCLA, Los Angeles, California, July 2014.