Yunho Kim

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Education

Feb 2009-Feb 2017 **Ph. D in Computer Science, KAIST** (advisor: Prof. Moonzoo Kim)
Thesis: Automated Unit Test Generation with Realistic Unit Context Synthesis for Low False Alarms

Mar 2007-Feb 2009 **M. S. in Computer Science, KAIST** (advisor: Prof. Moonzoo Kim)

- Integrated Master and Ph. D program in computer science

Mar 2003-Feb 2007 **B. S. in Computer Science, KAIST**

Experience

Mar 2018-Present **Research Assistant Professor, Software Testing and Verification(SWTV) group, KAIST**
Feb 2017-Feb 2018 **Postdoctoral Researcher, Software Testing and Verification(SWTV) group, KAIST** (advisor: Prof. Moonzoo Kim)

Research Interests

My research interests span software testing and debugging especially for embedded software.

- **Automated Software Unit Test Generation**

  To improve the reliability of embedded software in a low cost, I am working on improving the accuracy and practicality of automated unit testing through concolic testing. I have developed CONBRIO which is an automated unit test generation framework using concolic testing to automatically generate effective and precise unit test drivers/stubs and unit test cases which (try to) cover all possible execution paths of the target unit function. Through industrial collaboration research with Samsung Electronics, LG electronics, Hyundai Motor Company, and Hyundai Mobis, I have shown that our approach could detect bugs in smartphone firmware, automotive control software, and Android kernel's device drivers.

- **Effective Fault Localization using Mutation Analysis and Machine Learning**

  To identify buggy statements precisely, I have worked on a fault localization technique MUSE (Mutation-baSEd fault localization technique) based on mutation analysis. MUSE can localize a buggy statement after reviewing less than 10 statements for 6500 ~ 12600 LOC C programs. In addition, I am working on improving MUSE to identify buggy statements more accurately by applying machine learning techniques on various dynamic and static code features.

- **Behavioral Coverage for Effective and Quantifiable Software Testing**

  To improve the reliability of embedded software effectively, I am working on developing behavioral coverage with Prof. Willem Visser at Stellenbosch University. The behavioral coverage quantifies how much of the input space is covered using a combination of symbolic execution and model counting. In addition, we are working on symbolic execution techniques to increase the behavioral coverage efficiently during testing.

- **Hybrid Directed Test Suite Augmentation**

  To effectively augment regression test suites for evolving software, I have developed a hybrid directed test suite augmentation technique with Prof. Gregg Rothermel at University of Nebraska-Lincoln. The approach combines concolic testing and genetic algorithm which have different strengths and weaknesses to augment existing test suites more cost-effectively than each algorithm used singly.

Awards and Scholarships

1. IEEE Conference on Software Testing, Validation and Verification(ICST), **Distinguished paper award**, 2018
    - **Y. Kim**, S. Hong, B. Ko, L. Phan and M. Kim, Invasive Software Testing: Mutating Target Programs to Diversify Test Exploration for High Test Coverage
2. Korea Software Congress (KSC), **Best paper award(1st place)**, 2017
    - H. Lim, **Y. Kim**, and M. Kim, Automated Capturing & Replaying Dynamic Unit Inputs of C Programs from System Executions
3. Korea Software Congress (KSC), **Best paper award**, 2017
    - D. Phan, B. Ko, **Y. Kim**, and M. Kim, COMUT: A Configurable Mutant Generation Tool for C programs for effective and efficient mutation analysis
4. KAIST School of Computing, **Best Ph.D's dissertation award**, 2017
    - **Y. Kim**, Automated Unit Test Generation with Realistic Unit Context Synthesis for Low False Alarms
5. Samsung HumanTech Paper Competition, **Bronze award**, 2017
    - **Y. Kim**, Effective Concolic Unit Testing based on Realistic Unit Context Synthesis
6. Winter Korea Computer Congress (KCC), **Best paper award**, 2016
    - **Y. Kim,** H. Kim, W. Yang, and M. Kim, A Comparative Study of C Program Mutation Tools for Effective Mutation Analysis: A Case Study of Proteum and Milu
7. Korea Computer Congress (KCC), **Best paper award**, 2016
    - **Y. Kim** and M. Kim, Automated Unit-test Generation for Detecting Vulnerabilities of Android Kernel Modules
8. Korean Institute of Information Scientists and Engineers, 35th Student Research Paper Competition (graduate student track), **Second prize**, Apr 2016
    - **Y. Kim**, Effective Automated Concolic Unit Testing based on Realistic Unit Context Synthesis
9. Korea Conference on Software Engineering (KCSE), **Best paper award (short paper)**, 2016
    - **Y. Kim**, and M. Kim, Efficient Dynamic Symbolic Execution Search Strategy using Input Coverage
10. Samsung HumanTech Paper Competition, **Bronze award**, 2014
    - S. Moon and **Y. Kim**, MUSE: Precise Fault Localization based on Program Mutants
11. Korea Conference on Software Engineering (KCSE), **Best paper award (short paper)**, 2014
    - Y. Park, **Y. Kim**, J. Cho, and M. Kim, Effective Concolic Testing using a Symbolic Library
12. Korean Institute of Information Scientists and Engineers, 32nd Student Research Paper Competition (graduate student track), **Grand prize**, Apr 2013
    - S. Moon and **Y. Kim**, FEAST: Coverage-based Fault Localization with Fault Weights on Test Cases
13. Korea Computer Congress (KCC), **Best presentation award**, 2012
    - Y. Park, **Y. Kim**, and M. Kim, A Comparative Study of Static Analysis Tools: A Case Study on libexif by Using Coverity and Sparrow
14. Korea Computer Congress (KCC), **Best paper award**, 2012
    - Y. Kim, M. Kim, and Y. Jang, CREST-BV: An Improved Concolic Testing Technique with Bitwise Operations Support for Embedded Software
15. Korea Computer Congress (KCC), **Best presentation award**, 2011
    - Y. Kim, **Y. Kim**, M. Kim, Comparison of Search Strategies of KLEE Concolic Testing Tool
16. Korea Presidential Science Scholarship, Mar 2003 to Feb 2007

Publications

- **Refereed international journal articles**

[1] S. Hong, T. Kwak, B. Lee, Y. Jeon, B. Ko, **Y. Kim**, M. Kim, MUSEUM: Debugging Real-World Multilingual Programs Using Mutation Analysis, Information and Software Technology (IST), vol 82, pages 80-95, Feb 2017

[2] Z. Xu, **Y. Kim**, M. Kim, M. Cohen, and G. Rothermel, Directed Test Suite Augmentation: An Empirical Investigation, Journal of Software Testing, Verification and Reliability (STVR), volume 25, issue 2, pages 77-114, March 2015

[3] M. Kim, **Y. Kim**, and Y. Choi, Concolic Testing of the Multi-sector Read Operation for Flash Storage Platform Software, Formal Aspects of Computing (FACJ), vol 24, no 2, 2012

[4] M. Kim, **Y. Kim**, and H. Kim, A Comparative Study of Software Model Checkers as Unit Testing Tools: An Industrial Case Study, IEEE Transactions on Software Engineering (TSE), vol 37, no 2, March 2011

- **Refereed international conference papers**

[1] **Y. Kim**, Y. Choi, and M. Kim, Precise Concolic Unit Testing of C Programs with Alarm Filtering Using Symbolic Calling Contexts, Intl. Conf. on Software Engineering (ICSE), 2018 **(acceptance rate:21%)**

[2] **Y. Kim**, S. Hong, B. Ko, D. Phan, and M. Kim, Destructive Software Testing: Mutating a Target Program to Diversify Test Exploration for High Test Coverage, IEEE International Conference on Software Testing, Verification and Validation (ICST), 2018 **(Distinguished paper award)** (acceptance rate: 25.2%)

[3] L. Phan, **Y. Kim**, M. Kim, MUSIC: Mutation Analysis Tool with High Configurability and Extensibility, Mutation Workshop, 2018

[4] S. Hong, B. Lee, T. Kwak, Y. Jeon, B. Ko, **Y. Kim**, M. Kim, Mutation Based Fault Localization for Real-World Multilingual Programs, 30th IEEE/ACM International Conference on Automated Software Engineering (ASE), Nov 9-13, 2015 **(acceptance rate: 19%)**

[5] **Y. Kim** and M. Kim, SAT-based Bounded Software Model Checking for Embedded Software: A Case Study, Asia-Pacific Software Engineering Conference (APSEC), Dec 1-4 2014 (acceptance rate: 30%)

[6] **Y. Kim**, Z. Xu, M. Kim, M. Cohen, and G. Rothermel, Hybrid Directed Test Suite Augmentation: An Interleaving Framework, IEEE International Conference on Software Testing, Verification and Validation (ICST), March 31-April 4, 2014 (acceptance rate: 28%)

[7] S. Moon, **Y. Kim**, M. Kim, S. Yoo, Ask the Mutants: Mutating Faulty Programs for Fault Localization, IEEE International Conference on Software Testing, Verification and Validation (ICST), March 31-April 4, 2014 (acceptance rate: 28%)

[8] **Y. Kim**, Y. Kim, T. Kim, G. Lee, Y. Jang, and M. Kim, Automated Unit Testing of Large Industrial Embedded Software using Concolic Testing, IEEE/ACM Automated Software Engineering (ASE) Experience track, Nov 11-15, 2013 **(acceptance rate:23%)**

[9] **Y. Kim**, M. Kim, Y. Kim, and Y. Jang, Industrial Application of Concolic Testing Approach: A Case Study on libexif by Using CREST-BV and KLEE, Intl. Conf. on Software Engineering (ICSE), Software Engineering in Practice (SEIP) track, June 2-9, 2012 **(acceptance ratio:19%)**

[10] M. Kim, Y. Kim, and G. Rothermel, A Scalable Distributed Concolic Testing Approach: An Empirical Evaluation, IEEE International Conference on Software Testing, Verification, and Validation (ICST), April 17-21, 2012 (acceptance ratio: 27%)

[11] M. Kim, **Y. Kim** and Y. Jang, Industrial Application of Concolic Testing on Embedded Software: Case Studies, IEEE International Conference on Software Testing, Verification and Validation (ICST) Industrial track, April 17-21, 2012, **nominated as a best paper (acceptance ratio: 23%)**

[12] M. Kim, **Y. Kim** and Y. Jang, Industrial Application of Concolic Testing on Embedded Software: Case Studies, IEEE International Conference on Software Testing, Verification and Validation (ICST) Industrial track, April 17-21, 2012, **nominated as a best paper (acceptance ratio: 23%)**

[13] Z. Xu, **Y. Kim**, M. Kim and G. Rothermel, A Hybrid Directed Test Suite Augmentation Technique, IEEE Intl. Symp. on Software Reliability Engineering (ISSRE), Hiroshima, Japan, Nov 29-Dec 2 2011 **(acceptance ratio: 25%)**

[14] M. Kim and **Y. Kim**, Automated Analysis of Industrial Embedded Software, Automated Technology for Verification and Analysis (ATVA), Taipei, Taiwan, Oct 11-14 2011 (invited paper)

[15] **Y. Kim** and M. Kim, SCORE: a Scalable Concolic Testing Tool for Reliable Embedded Software, ACM SIGSOFT Foundation of Software Engineering (FSE) Tool demonstration track, pages 420-423, Szeged, Hungary, Sep 5-9 2011 (acceptance ratio: 47%)

[16] **Y. Kim**, M. Kim and Y. Jang, Concolic Testing on Embedded Software - Case Studies on Mobile Platform Programs, ACM SIGSOFT Foundation of Software Engineering (FSE) Industrial track, Szeged, Hungary, Sep 5-9 2011

[17] Z. Xu, **Y. Kim**, M. Kim, G. Rothermel, and M. Cohen, Directed Test Suite Augmentation: Techniques and Tradeoffs, ACM SIGSOFT Foundation of Software Engineering (FSE), pages 257-266, Santa Fe, New Mexico, USA, Nov 7-11 2010 **(acceptance ratio: 20%)**

[18] **Y. Kim**, M. Kim, N. Dang, Scalable Distributed Concolic Testing: a Case Study on a Flash Storage Platform, Grand Challenge in Verified Software Track @ Intl. Conf. on Theoretical Aspects of Computing (ICTAC) (LNCS 6255), pages 199-213, Natal, Brazil, Sep 1-3 2010

[19] M. Kim and **Y. Kim**, Concolic Testing of the Multi-sector Read Operation for Flash Memory File System, Grand Challenge in Verified Software Track @ Brazilian Symposium on Formal Methods (SBMF), pages 251-265, Gramado, Brazil, Aug 19-21 2009 (LNCS 5902)

[20] M. Kim, **Y. Kim** and H. Kim, Unit Testing of Flash Memory Device Driver through a SAT-based Model Checker, IEEE/ACM Automated Software Engineering (ASE), pages 198-207, L'Aquila, Italy, Sep 15-19 2008 **(acceptance ratio: 12%)**

[21] M. Kim, Y. Choi, **Y. Kim** and H. Kim, Formal Verification of a Flash Memory Device Driver - an Experience Report, Spin Workshop (LNCS 5156), pages 144-159, LA, USA, August 10-12 2008

[22] M. Kim, **Y. Kim**, Y. Choi, and H. Kim, Pre-testing Flash Device Driver through Model Checking Techniques, IEEE Intl. Conf. on Software Testing, Verification and Validation (ICST), pages 475-484, Lillehammer, Norway, April 9-11 2008 **(acceptance ratio: 20%)**

- **Refereed domestic journal articles**

[1] **Y. Kim**, H. Kim, W. Yang, and M. Kim, A Comparative Study of C Program Mutation Tools for Effective Mutation Analysis: A Case Study of Proteum and Milu, Journal of KIISE: Software and Applications, Vol. 45, No. 4, Apr 2018 (written in Korean)

[2] **Y. Kim** and M. Kim, Automated Unit-test Generation for Detecting Vulnerabilities of Android Kernel Modules, Journal of KIISE: Software and Applications, Vol. 44, No. 2, Feb 2017 (written in Korean)

[3] Y. Jeon, **Y. Kim**, S. Hong, and M. Kim, Mutagen4J: Effective Mutant Generation Framework for Java Programs, Journal of KIISE: Software and Applications, Vol. 43, No. 9, Sep 2016 (written in Korean)

[4] **Y. Kim**, T. Kim, M, Kim, H. Lee, H. Jang, and M. Park, Effective Integer Promotion Bug Detection Technique for Embedded Software, Journal of KIISE: Software and Applications, Journal of KIISE: Software and Applications, Vol. 43, No. 6, Jun 2016 (written in Korean)

[5] S. Moon, **Y. Kim**, M. Kim, FEAST: An Enhanced Fault Localization Technique using Probability of Test Cases Executing Faults, Journal of KIISE: Software and Applications, Vol 40, No. 10, Oct 2013 (written in Korean)

[6] **Y. Kim**, Y. Park, M. Kim, A Comparative Case Study on Static Program Analysis Tools, Journal of KIISE: Computing Practices and Letters, Vol. 19, No. 8, Aug 2013 (written in Korean)

[7] **Y. Kim**, M. Kim, Y. Jang, CREST-BV: An Improved Concolic Testing Technique Supporting Bitwise Operations for Embedded Software, Journal of KIISE: Software and Applications, Vol. 40, No. 2, Feb 2013 (written in Korean)

[8] Y. Kim, M. Kim, **Y. Kim**, E. Jung, Comparison of Search Strategies of KLEE Concolic Testing Tool, Vol. 18, No. 4, Apr 2012 (written in Korean)

- **Refereed domestic conference papers**

[1] H. Lim, **Y. Kim**, and M. Kim, Automated Capturing & Replaying Dynamic Unit Inputs of C Programs from System Executions, Korea Software Congress (KSC), Dec 20-22, 2017 (written in Korean)

[2] P. Loc, B. Ko, **Y. Kim**, and M.Kim, COMUT: A Configurable Mutant Generation Tool for C programs for effective and efficient mutation analysis, Korea Software Congress (KSC), Dec 20-22, 2017 (written in Korean)

[3] **Y. Kim**, H. Kim, W. Yang, and M. Kim, A Comparative Study of C Program Mutation Tools for Effective Mutation Analysis: A Case Study of Proteum and Milu, Winter Korea Computer Congress (KCC), Dec 21-23, 2016 (written in Korean)

[4] **Y. Kim** and M. Kim, Automated Unit-test Generation for Detecting Vulnerabilities of Android Kernel Modules, Korea Computer Congress (KCC), Jun 29-Jul 1, 2016 (written in Korean)

[5] **Y. Kim** and M. Kim, Efficient Dynamic Symbolic Execution Search Strategy using Input Coverage, Korea Conference on Software Engineering (KCSE), Jan 27-29, 2016 (written in Korean)

[6] Y. Park, **Y. Kim**, J. Cho, and M. Kim, Effective Concolic Testing using a Symbolic Library, Korea Conference on Software Engineering (KCSE), Feb 12-14, 2014 (written in Korean)

[7] S. Mun, **Y. Kim**, M. Kim, Improved Fault Localization Technique using Weighted Test Cases, Korea Conference on Software Engineering (KCSE), Jan 30 - Feb 1, 2013 (written in Korean)

[8] Y. Park, **Y. Kim**, and M. Kim, A Comparative Study of Static Analysis Tools: A Case Study on libexif by Using Coverity and Sparrow, Korea Computer Congress (KCC), Nov 23-24, 2012 (Best presentation award) (written in Korean

[9] **Y. Kim**, M. Kim, and Y. Jang, CREST-BV: An Improved Concolic Testing Technique with Bitwise Operations Support for Embedded Software, Korea Computer Congress(KCC), June 27-19, 2012 (Best paper award) (written in Korean)

[10] Duc Bui Hoang, **Y. Kim**, and M. Kim, A Case Study of the Application of Dynamic Symbolic Execution to Real-World Binary Programs, Korea Conference on Software Engineering (KCSE), Feb 8-10, 2012

[11] Y. Kim, **Y. Kim**, and M. Kim, Case Study on Testing with KLEE Concolic Testing Tool, Korea Computer Congress (KCC), Nov 25-26, 2011 (Best presentation award) (written in Korean)

[12] **Y. Kim** and M. Kim, Comparison of Test-case Generation Techniques based on Dynamic Symbolic Execution and Genetic Algorithm, Korea Conference on Software Engineering (KCSE), Feb 9-11, 2011 (written in Korean)

[13] **Y. Kim** and M. Kim, Comparison of Test-case Generation Tools based on Dynamic Symbolic Execution, Koea Conference on Software Engineering (KCSE), Feb 8-10, 2010 (written in Korean)

[14] M. Kim, **Y. Kim**, and H. Kim, Formal Verification of a Flash Memory Device Driver through Model Checking, Korea Conference on Software Engineering (KCSE), Feb 20-22, 2008 (written in Korean)

Patents

1. Co-inventor, Application No. 10-2018-0052680 in Korea, Testing Method and Apparatus of Target Function Included in Target Program, May 2018
2. Co-inventor, Application No. 10-2018-0053140 in Korea, Testing Method and Apparatus of Target Program using Mutated Program, May 2018
3. Co-inventor, Application No. 10-2018-0053145 in Korea, Generating Method and Apparatus of Mutant Programs, Which is Flexible and Highly Scalable, May 2018
4. Co-inventor, Patent No. 10-1227024-0000 in Korea, Method of distributed scalable concolic testing for software reliability, Jan 2010

Research Funding

- **Funding from Korean Government Agencies**

1. Automated SW Unit Testing based on Unit Correlation Metrics for Accurate Bug Detection**, Individual Basic Science & Engineering Research Program supported by national Research Foundation of Korea (NRF),** 2017-2019 (KRW 150,000,000)

Research Experiences

- **Industry funded project**

1. Co-investigator, Automated Dynamic Test Case Generation using Path Search Algorithms, 2017-Present, Hyundai Mobis
2. Research assistant, Effective Fault Localization using Mutation Analysis, 2015-Present, Samsung Electronics
3. Research assistant, Applying Concolic Testing for Improving Reliability of Automotive Software, Hyundai Motor Company, 2015-2017
4. Research assistant, Applying Concolic Testing for Embedded Software Testing Automation, LG Electronics, 2013-2015
5. Research assistant, Automated Unit Test Generation Framework by using Concolic Testing, Samsung Electronics, 2010-2014
6. Research assistant, Formal Verification of Flash Memory Device Driver, Samsung Electronics, 2007-2008

- **Government funded projects** (selected)

1. Principal investigator, Automated SW Unit Testing based on Unit Correlation Metrics for Accurate Bug Detection, National Research Foundation of Korea (NRF), 2017-Present
2. Research assistant, Intelligent Automation Techniques for Verification and Debugging of Fullstack Multilingual Software, National Research Foundation of Korea (NRF), 2017-Present
3. Research assistant, Automated SW Testing and Debugging Techniques for Improving SW Quality, National Research Foundation of Korea (NRF), 2016-Present
4. Research assistant, Behavioural Coverage for Effective Software Testing, National Research Foundation of Korea (NRF), 2014-2016
5. Research assistant, Development of Mobile S/W Security Testing Tools for Detecting New Vulnerabilities of Android, Institute for Information and communications Technology Promotion (IITP), 2013-2016
6. Research assistant, Research and Development of Dual Operating System Architecture with High-Reliable RTOS and High-Performance OS, Institute for Information and communications Technology Promotion (IITP), 2012-Present

7. Research assistant, Practical Dynamic Symbolic Execution for Binary Programs, National Security Research Institute (NSRI), 2011
8. Research assistant, Improved Automated Test Case Generation through Parallelized Concolic Testing Technique, National Research Foundation of Korea (NRF), 2010-2011
9. Research assistant, Improving Embedded Software Reliability using SAT Solver, National Research Foundation of Korea (NRF), 2008-2009

Professional Activities

- **International Conference Program Committees**

1. International Conference on Software Testing, Verification and Validation (ICST), 2018
   - ICST is enrolled in the best CS conference list made by KIISE(Korean Institute of Information Scientists and Engineers)
2. International Conference on Formal Aspects of Component Software (FACS), 2018