

# **2016 31st IEEE/ACM International Conference on Automated Software Engineering (ASE 2016)**

**Singapore  
3 – 7 September 2016**



**IEEE Catalog Number: CFP16075-POD**  
**ISBN: 978-1-5090-5571-5**

**Copyright © 2016, Association for Computing Machinery (ACM)  
All Rights Reserved**

***\*\*\*This publication is a representation of what appears in the IEEE Digital Libraries. Some format issues inherent in the e-media version may also appear in this print version.***

|                         |                   |
|-------------------------|-------------------|
| IEEE Catalog Number:    | CFP16075-POD      |
| ISBN (Print-On-Demand): | 978-1-5090-5571-5 |
| ISBN (Online):          | 978-1-4503-3845-5 |
| ISSN:                   | 1938-4300         |

**Additional Copies of This Publication Are Available From:**

Curran Associates, Inc  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: (845) 758-0400  
Fax: (845) 758-2633  
E-mail: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

# Contents

## Frontmatter

---

|                                          |     |
|------------------------------------------|-----|
| <b>Message from the Chairs</b> . . . . . | iii |
| <b>ASE 2016 Organization</b> . . . . .   | v   |
| <b>Sponsors</b> . . . . .                | xi  |

## Keynotes

---

|                                                                                                                                 |   |
|---------------------------------------------------------------------------------------------------------------------------------|---|
| <b>Program Generation for Performance</b><br>Markus Püschel — <i>ETH Zurich, Switzerland</i> . . . . .                          | 1 |
| <b>Changing Microsoft's Build: Revolution or Evolution</b><br>Wolfram Schulte — <i>Microsoft, USA</i> . . . . .                 | 2 |
| <b>The Power of Probabilistic Thinking</b><br>David S. Rosenblum — <i>National University of Singapore, Singapore</i> . . . . . | 3 |

## Main Research Papers

---

### Test Evaluation

|                                                                                                                                                                                                                                                                                                                                                                                |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>An Empirical Investigation into the Nature of Test Smells</b><br>Michele Tufano, Fabio Palomba, Gabriele Bavota, Massimiliano Di Penta, Rocco Oliveto, Andrea De Lucia, and Denys Poshyvanyk — <i>College of William and Mary, USA; University of Salerno, Italy; University of Lugano, Switzerland; University of Sannio, Italy; University of Molise, Italy</i> . . . . . | 4  |
| <b>Evaluating Non-adequate Test-Case Reduction</b><br>Mohammad Amin Alipour, August Shi, Rahul Gopinath, Darko Marinov, and Alex Groce — <i>Oregon State University, USA; University of Illinois at Urbana-Champaign, USA</i> . . . . .                                                                                                                                        | 16 |
| <b>Optimizing Customized Program Coverage</b><br>Peter Ohmann, David Bingham Brown, Naveen Neelakandan, Jeff Linderorth, and Ben Liblit — <i>University of Wisconsin-Madison, USA</i> . . . . .                                                                                                                                                                                | 27 |
| <b>What Makes Killing a Mutant Hard</b><br>Willem Visser — <i>Stellenbosch University, South Africa</i> . . . . .                                                                                                                                                                                                                                                              | 39 |
| <b>Test Case Permutation to Improve Execution Time</b><br>Panagiotis Stratis and Ajitha Rajan — <i>University of Edinburgh, UK</i> . . . . .                                                                                                                                                                                                                                   | 45 |

### Learning

|                                                                                                                                                                                                                                                                                        |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Predicting Semantically Linkable Knowledge in Developer Online Forums via Convolutional Neural Network</b><br>Bowen Xu, Deheng Ye, Zhenchang Xing, Xin Xia, Guibin Chen, and Shanping Li — <i>Zhejiang University, China; Nanyang Technological University, Singapore</i> . . . . . | 51 |
| <b>Testing Advanced Driver Assistance Systems using Multi-objective Search and Neural Networks</b><br>Raja Ben Abdesslem, Shiva Nejati, Lionel C. Briand, and Thomas Stifter — <i>University of Luxembourg, Luxembourg; IEE, Luxembourg</i> . . . . .                                  | 63 |
| <b>Privacy Preserving via Interval Covering Based Subclass Division and Manifold Learning Based Bi-directional Obfuscation for Effort Estimation</b><br>Fumin Qi, Xiao-Yuan Jing, Xiaoke Zhu, Fei Wu, and Li Cheng — <i>Wuhan University, China</i> . . . . .                          | 75 |
| <b>Deep Learning Code Fragments for Code Clone Detection</b><br>Martin White, Michele Tufano, Christopher Vendome, and Denys Poshyvanyk — <i>College of William and Mary, USA</i> . . . . .                                                                                            | 87 |

## Recommendation and Automation

|                                                                                                                           |     |
|---------------------------------------------------------------------------------------------------------------------------|-----|
| <b>Automatically Recommending Code Reviewers Based on Their Expertise: An Empirical Comparison</b>                        |     |
| Christoph Hannebauer, Michael Patalas, Sebastian Stünkel, and Volker Gruhn — <i>University of Duisburg-Essen, Germany</i> | 99  |
| <b>Evaluating the Evaluations of Code Recommender Systems: A Reality Check</b>                                            |     |
| Sebastian Proksch, Sven Amann, Sarah Nadi, and Mira Mezini — <i>TU Darmstadt, Germany</i>                                 | 111 |
| <b>Too Much Automation? The Bellwether Effect and Its Implications for Transfer Learning</b>                              |     |
| Rahul Krishna, Tim Menzies, and Wei Fu — <i>North Carolina State University, USA</i>                                      | 122 |
| <b>Automatic Microbenchmark Generation to Prevent Dead Code Elimination and Constant Folding</b>                          |     |
| Marcelino Rodriguez-Cancio, Benoit Combemale, and Benoit Baudry — <i>University of Rennes 1, France; INRIA, France</i>    | 132 |

## Model-Based Testing and Oracles

|                                                                                                                                                          |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>Visualization of Combinatorial Models and Test Plans</b>                                                                                              |     |
| Rachel Tzoref-Brill, Paul Wojciak, and Shahar Maoz — <i>Tel Aviv University, Israel; IBM, USA</i>                                                        | 144 |
| <b>Finding Access Control Bugs in Web Applications with CanCheck</b>                                                                                     |     |
| Ivan Bocić and Tefvik Bultan — <i>University of California at Santa Barbara, USA</i>                                                                     | 155 |
| <b>SOFIA: An Automated Security Oracle for Black-Box Testing of SQL-Injection Vulnerabilities</b>                                                        |     |
| Mariano Ceccato, Cu D. Nguyen, Dennis Appelt, and Lionel C. Briand — <i>Fondazione Bruno Kessler, Italy; University of Luxembourg, Luxembourg</i>        | 167 |
| <b>Supporting Oracle Construction via Static Analysis</b>                                                                                                |     |
| Junjie Chen, Yanwei Bai, Dan Hao, Lingming Zhang, Lu Zhang, Bing Xie, and Hong Mei — <i>Peking University, China; University of Texas at Dallas, USA</i> | 178 |

## Crowdsourcing

|                                                                                                                                                                                                                                     |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>Local-Based Active Classification of Test Report to Assist Crowdsourced Testing</b>                                                                                                                                              |     |
| Junjie Wang, Song Wang, Qiang Cui, and Qing Wang — <i>Institute of Software at Chinese Academy of Sciences, China; University of Waterloo, Canada</i>                                                                               | 190 |
| <b>Multi-objective Test Report Prioritization using Image Understanding</b>                                                                                                                                                         |     |
| Yang Feng, James A. Jones, Zhenyu Chen, and Chunrong Fang — <i>University of California at Irvine, USA; Nanjing University, China</i>                                                                                               | 202 |
| <b>CrowdService: Serving the Individuals through Mobile Crowdsourcing and Service Composition</b>                                                                                                                                   |     |
| Xin Peng, Jingxiao Gu, Tian Huat Tan, Jun Sun, Yijun Yu, Bashar Nuseibeh, and Wenyun Zhao — <i>Fudan University, China; Singapore University of Technology and Design, Singapore; Open University, UK; Open University, Ireland</i> | 214 |
| <b>QUICKAR: Automatic Query Reformulation for Concept Location using Crowdsourced Knowledge</b>                                                                                                                                     |     |
| Mohammad Masudur Rahman and Chanchal K. Roy — <i>University of Saskatchewan, Canada</i>                                                                                                                                             | 220 |

## Android

|                                                                                                           |     |
|-----------------------------------------------------------------------------------------------------------|-----|
| <b>Taming Android Fragmentation: Characterizing and Detecting Compatibility Issues for Android Apps</b>   |     |
| Lili Wei, Yepang Liu, and Shing-Chi Cheung — <i>Hong Kong University of Science and Technology, China</i> | 226 |
| <b>Automated Model-Based Android GUI Testing using Multi-level GUI Comparison Criteria</b>                |     |
| Young-Min Baek and Doo-Hwan Bae — <i>KAIST, South Korea</i>                                               | 238 |
| <b>HybriDroid: Static Analysis Framework for Android Hybrid Applications</b>                              |     |
| Sungho Lee, Julian Dolby, and Sukyoung Ryu — <i>KAIST, South Korea; IBM Research, USA</i>                 | 250 |

## Faults

|                                                                                                           |     |
|-----------------------------------------------------------------------------------------------------------|-----|
| <b>Locus: Locating Bugs from Software Changes</b>                                                         |     |
| Ming Wen, Rongxin Wu, and Shing-Chi Cheung — <i>Hong Kong University of Science and Technology, China</i> | 262 |
| <b>Fine-Tuning Spectrum Based Fault Localisation with Frequent Method Item Sets</b>                       |     |
| Gulsher Laghari, Alessandro Murgia, and Serge Demeyer — <i>University of Antwerp, Belgium</i>             | 274 |

|                                                                                                                                                                                                                                          |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>Recommending Relevant Classes for Bug Reports using Multi-objective Search</b>                                                                                                                                                        |     |
| Rafi Almhana, Wiem Mkaouer, Marouane Kessentini, and Ali Ouni — <i>University of Michigan, USA; Osaka University, Japan</i> . . . . .                                                                                                    | 286 |
| <b>An Empirical Study on Dependence Clusters for Effort-Aware Fault-Proneness Prediction</b>                                                                                                                                             |     |
| Yibiao Yang, Mark Harman, Jens Krinke, Syed Islam, David Binkley, Yuming Zhou, and Baowen Xu — <i>Nanjing University, China; University College London, UK; University of East London, UK; Loyola University Maryland, USA</i> . . . . . | 296 |
| <b>Program Analysis</b>                                                                                                                                                                                                                  |     |
| <b>StraightTaint: Decoupled Offline Symbolic Taint Analysis</b>                                                                                                                                                                          |     |
| Jiang Ming, Dinghao Wu, Jun Wang, Gaoyao Xiao, and Peng Liu — <i>Pennsylvania State University, USA</i> . . . . .                                                                                                                        | 308 |
| <b>IncA: A DSL for the Definition of Incremental Program Analyses</b>                                                                                                                                                                    |     |
| Tamás Szabó, Sebastian Erdweg, and Markus Voelter — <i>itemis, Netherlands; Delft University of Technology, Netherlands; itemis, Germany</i> . . . . .                                                                                   | 320 |
| <b>What Developers Want and Need from Program Analysis: An Empirical Study</b>                                                                                                                                                           |     |
| Maria Christakis and Christian Bird — <i>Microsoft Research, USA</i> . . . . .                                                                                                                                                           | 332 |
| <b>DistIA: A Cost-Effective Dynamic Impact Analysis for Distributed Programs</b>                                                                                                                                                         |     |
| Haipeng Cai and Douglas Thain — <i>Washington State University, USA; University of Notre Dame, USA</i> . . . . .                                                                                                                         | 344 |
| <b>Locks and Races</b>                                                                                                                                                                                                                   |     |
| <b>Radius Aware Probabilistic Testing of Deadlocks with Guarantees</b>                                                                                                                                                                   |     |
| Yan Cai and Zijiang Yang — <i>Institute of Software at Chinese Academy of Sciences, China; Western Michigan University, USA</i> . . . . .                                                                                                | 356 |
| <b>LockPeeker: Detecting Latent Locks in Java APIs</b>                                                                                                                                                                                   |     |
| Ziyi Lin, Hao Zhong, Yuting Chen, and Jianjun Zhao — <i>Shanghai Jiao Tong University, China; Kyushu University, Japan</i> . . . . .                                                                                                     | 368 |
| <b>Sound Static Deadlock Analysis for C/Pthreads</b>                                                                                                                                                                                     |     |
| Daniel Kroening, Daniel Poetzl, Peter Schrammel, and Björn Wachter — <i>University of Oxford, UK; University of Sussex, UK; SSW-Trading, Germany</i> . . . . .                                                                           | 379 |
| <b>Static Race Detection for Device Drivers: The Goblint Approach</b>                                                                                                                                                                    |     |
| Vesal Vojdani, Kalmer Apinis, Vootele Rõtov, Helmut Seidl, Varmo Vene, and Ralf Vogler — <i>University of Tartu, Estonia; TU Munich, Germany</i> . . . . .                                                                               | 391 |
| <b>Empirical Studies and New Ideas</b>                                                                                                                                                                                                   |     |
| <b>An Empirical Evaluation of Two User Interfaces of an Interactive Program Verifier</b>                                                                                                                                                 |     |
| Martin Hentschel, Reiner Hähnle, and Richard Bubel — <i>TU Darmstadt, Germany</i> . . . . .                                                                                                                                              | 403 |
| <b>Traceability Maintenance: Factors and Guidelines</b>                                                                                                                                                                                  |     |
| Salome Maro, Anthony Anjorin, Rebekka Wohlrab, and Jan-Philipp Steghöfer — <i>Chalmers University of Technology, Sweden; University of Paderborn, Germany</i> . . . . .                                                                  | 414 |
| <b>Usage, Costs, and Benefits of Continuous Integration in Open-Source Projects</b>                                                                                                                                                      |     |
| Michael Hilton, Timothy Tunnell, Kai Huang, Darko Marinov, and Danny Dig — <i>Oregon State University, USA; University of Illinois, USA</i> . . . . .                                                                                    | 426 |
| <b>DSL-Maps: From Requirements to Design of Domain-Specific Languages</b>                                                                                                                                                                |     |
| Ana Pescador and Juan de Lara — <i>Autonomous University of Madrid, Spain</i> . . . . .                                                                                                                                                  | 438 |
| <b>The IDE as a Scriptable Information System</b>                                                                                                                                                                                        |     |
| Dimitar Asenov, Peter Müller, and Lukas Vogel — <i>ETH Zurich, Switzerland; Ergon Informatik, Switzerland</i> . . . . .                                                                                                                  | 444 |
| <b>Inference</b>                                                                                                                                                                                                                         |     |
| <b>Inferring Annotations for Device Drivers from Verification Histories</b>                                                                                                                                                              |     |
| Zvonimir Pavlinovic, Akash Lal, and Rahul Sharma — <i>New York University, USA; Microsoft Research, India; Stanford University, USA</i> . . . . .                                                                                        | 450 |

## Array Length Inference for C Library Bindings

Alisa J. Maas, Henrique Nazaré, and Ben Liblit — *University of Wisconsin-Madison, USA; Federal University of Minas Gerais, Brazil* . . . . . 461

## APEx: Automated Inference of Error Specifications for C APIs

Yuan Kang, Baishakhi Ray, and Suman Jana — *Columbia University, USA; University of Virginia, USA* . . . . . 472

## Interactions, Deltas, Goals

### On Essential Configuration Complexity: Measuring Interactions in Highly-Configurable Systems

Jens Meinicke, Chu-Pan Wong, Christian Kästner, Thomas Thüm, and Gunter Saake — *University of Magdeburg, Germany; Carnegie Mellon University, USA; TU Braunschweig, Germany* . . . . . 483

### Precise Semantic History Slicing through Dynamic Delta Refinement

Yi Li, Chenguang Zhu, Julia Rubin, and Marsha Chechik — *University of Toronto, Canada; Massachusetts Institute of Technology, USA* . . . . . 495

### Goal-Conflict Detection Based on Temporal Satisfiability Checking

Renzo Degiovanni, Nicolas Ricci, Dalal Alrajeh, Pablo Castro, and Nazareno Aguirre — *Universidad Nacional de Río Cuarto, Argentina; Imperial College London, UK* . . . . . 507

## Symbolic Execution

### Symbolic Execution of Stored Procedures in Database Management Systems

Muhammad Suleman Mahmood, Maryam Abdul Ghafoor, and Junaid Haroon Siddiqui — *Lahore University of Management Sciences, Pakistan* . . . . . 519

### Conc-iSE: Incremental Symbolic Execution of Concurrent Software

Shengjian Guo, Markus Kusano, and Chao Wang — *Virginia Tech, USA; University of Southern California, USA* . . . . . 531

### Model-Based Whitebox Fuzzing for Program Binaries

Van-Thuan Pham, Marcel Böhme, and Abhik Roychoudhury — *National University of Singapore, Singapore* . . . . . 543

### Symbolic Execution of Complex Program Driven by Machine Learning Based Constraint Solving

Xin Li, Yongjuan Liang, Hong Qian, Yi-Qi Hu, Lei Bu, Yang Yu, Xin Chen, and Xuandong Li — *Nanjing University, China* . . . . . 554

### Towards Bounded Model Checking using Nonlinear Programming Solver

Masataka Nishi — *Hitachi, Japan* . . . . . 560

## Design and Specs

### Identifying Domain Elements from Textual Specifications

Jitendra Singh Thakur and Atul Gupta — *IIITDM Jabalpur, India* . . . . . 566

### Continuous Detection of Design Flaws in Evolving Object-Oriented Programs using Incremental Multi-pattern Matching

Sven Peldszus, Géza Kulcsár, Malte Lochau, and Sandro Schulze — *University of Koblenz-Landau, Germany; TU Darmstadt, Germany; TU Hamburg, Germany* . . . . . 578

### Efficient Detection of Inconsistencies in a Multi-developer Engineering Environment

Andreas Demuth, Markus Riedl-Ehrenleitner, and Alexander Egyed — *JKU Linz, Austria* . . . . . 590

### How Good Are the Specs? A Study of the Bug-Finding Effectiveness of Existing Java API Specifications

Owolabi Legunsen, Wajih Ul Hassan, Xinyue Xu, Grigore Roşu, and Darko Marinov — *University of Illinois at Urbana-Champaign, USA* . . . . . 602

## Test Generation

### Greedy Combinatorial Test Case Generation using Unsatisfiable Cores

Akihisa Yamada, Armin Biere, Cyrille Artho, Takashi Kitamura, and Eun-Hye Choi — *University of Innsbruck, Austria; JKU Linz, Austria; AIST, Japan* . . . . . 614

### Towards Automatically Generating Descriptive Names for Unit Tests

Benwen Zhang, Emily Hill, and James Clause — *University of Delaware, USA; Drew University, USA* . . . . . 625

|                                                                                                                                                                                                               |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>Applying Combinatorial Test Data Generation to Big Data Applications</b>                                                                                                                                   |     |
| Nan Li, Yu Lei, Haider Riaz Khan, Jingshu Liu, and Yun Guo — <i>Medidata Solutions, USA; University of Texas at Arlington, USA; George Mason University, USA</i> . . . . .                                    | 637 |
| <b>Generating Test Cases to Expose Concurrency Bugs in Android Applications</b>                                                                                                                               |     |
| Hongyin Tang, Guoquan Wu, Jun Wei, and Hua Zhong — <i>Institute of Software at Chinese Academy of Sciences, China</i>                                                                                         | 648 |
| <b>Automatic Test Image Generation using Procedural Noise</b>                                                                                                                                                 |     |
| Matthew Patrick, Matthew D. Castle, Richard O. J. H. Stutt, and Christopher A. Gilligan — <i>University of Cambridge, UK</i>                                                                                  | 654 |
| <b>Code Comparison and Transformation</b>                                                                                                                                                                     |     |
| <b>Move-Optimized Source Code Tree Differencing</b>                                                                                                                                                           |     |
| Georg Dotzler and Michael Philippsen — <i>University of Erlangen-Nuremberg, Germany</i> . . . . .                                                                                                             | 660 |
| <b>Migrating Cascading Style Sheets to Preprocessors by Introducing Mixins</b>                                                                                                                                |     |
| Davood Mazinanian and Nikolaos Tsantalis — <i>Concordia University, Canada</i> . . . . .                                                                                                                      | 672 |
| <b>Automatic Runtime Recovery via Error Handler Synthesis</b>                                                                                                                                                 |     |
| Tianxiao Gu, Chengnian Sun, Xiaoxing Ma, Jian Lü, and Zhendong Su — <i>Nanjing University, China; University of California at Davis, USA</i> . . . . .                                                        | 684 |
| <b>Mining Revision Histories to Detect Cross-Language Clones without Intermediates</b>                                                                                                                        |     |
| Xiao Cheng, Zhiming Peng, Lingxiao Jiang, Hao Zhong, Haibo Yu, and Jianjun Zhao — <i>Shanghai Jiao Tong University, China; Singapore Management University, Singapore; Kyushu University, Japan</i> . . . . . | 696 |
| <b>Battery-Aware Transformations in Mobile Applications</b>                                                                                                                                                   |     |
| Jürgen Cito, Julia Rubin, Phillip Stanley-Marbell, and Martin Rinard — <i>University of Zurich, Switzerland; Massachusetts Institute of Technology, USA</i> . . . . .                                         | 702 |
| <b>Language</b>                                                                                                                                                                                               |     |
| <b>Bugram: Bug Detection with N-gram Language Models</b>                                                                                                                                                      |     |
| Song Wang, Devin Chollak, Dana Movshovitz-Attias, and Lin Tan — <i>University of Waterloo, Canada; Carnegie Mellon University, USA</i> . . . . .                                                              | 708 |
| <b>Mining Input Grammars from Dynamic Taints</b>                                                                                                                                                              |     |
| Matthias Höschle and Andreas Zeller — <i>Saarland University, Germany</i> . . . . .                                                                                                                           | 720 |
| <b>Phrase-Based Extraction of User Opinions in Mobile App Reviews</b>                                                                                                                                         |     |
| Phong Minh Vu, Hung Viet Pham, Tam The Nguyen, and Tung Thanh Nguyen — <i>Utah State University, USA</i> . . . . .                                                                                            | 726 |
| <b>Mining and Retrieval</b>                                                                                                                                                                                   |     |
| <b>Practical Guidelines for Change Recommendation using Association Rule Mining</b>                                                                                                                           |     |
| Leon Moonen, Stefano Di Alesio, David Binkley, and Thomas Rølsnes — <i>Simula Research Laboratory, Norway; Loyola University Maryland, USA</i> . . . . .                                                      | 732 |
| <b>Learning a Dual-Language Vector Space for Domain-Specific Cross-Lingual Question Retrieval</b>                                                                                                             |     |
| Guibin Chen, Chunyang Chen, Zhenchang Xing, and Bowen Xu — <i>Nanyang Technological University, Singapore; Zhejiang University, China</i> . . . . .                                                           | 744 |
| <b>Demonstrations</b>                                                                                                                                                                                         |     |
| <b>Mobile and Security</b>                                                                                                                                                                                    |     |
| <b>Reflection-Aware Static Analysis of Android Apps</b>                                                                                                                                                       |     |
| Li Li, Tegawendé F. Bissyandé, Damien Outeau, and Jacques Klein — <i>University of Luxembourg, Luxembourg; Pennsylvania State University, USA</i> . . . . .                                                   | 756 |
| <b>Relda2: An Effective Static Analysis Tool for Resource Leak Detection in Android Apps</b>                                                                                                                  |     |
| Tianyong Wu, Jierui Liu, Xi Deng, Jun Yan, and Jian Zhang — <i>Institute of Software at Chinese Academy of Sciences, China</i> . . . . .                                                                      | 762 |

|                                                                                                                                                                                                                                                                                                               |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>An End-User Oriented Tool Suite for Development of Mobile Applications</b><br>Zhongyi Zhai, Bo Cheng, Meng Niu, Zhaoning Wang, Yimeng Feng, and Junliang Chen — <i>Beijing University of Posts and Telecommunications, China</i> . . . . .                                                                 | 768 |
| <b>Model Driven Design of Heterogeneous Synchronous Embedded Systems</b><br>Huafeng Zhang, Yu Jiang, Han Liu, Hehua Zhang, Ming Gu, and Jiaguang Sun — <i>Tsinghua University, China; University of Illinois at Urbana-Champaign, USA</i> . . . . .                                                           | 774 |
| <b>MACKE: Compositional Analysis of Low-Level Vulnerabilities with Symbolic Execution</b><br>Saahil Ognawala, Martín Ochoa, Alexander Pretschner, and Tobias Limmer — <i>TU Munich, Germany; Singapore University of Technology and Design, Singapore; Siemens, Germany</i> . . . . .                         | 780 |
| <b>BovInspector: Automatic Inspection and Repair of Buffer Overflow Vulnerabilities</b><br>Fengjuan Gao, Linzhang Wang, and Xuandong Li — <i>Nanjing University, China</i> . . . . .                                                                                                                          | 786 |
| <b>Performance, Recommendation, and Analysis</b>                                                                                                                                                                                                                                                              |     |
| <b>CORRECT: Code Reviewer Recommendation at GitHub for Vendasta Technologies</b><br>Mohammad Masudur Rahman, Chanchal K. Roy, Jesse Redl, and Jason A. Collins — <i>University of Saskatchewan, Canada; Vendasta Technologies, Canada; Google, USA</i> . . . . .                                              | 792 |
| <b>ProcessPAIR: A Tool for Automated Performance Analysis and Improvement Recommendation in Software Development</b><br>Mushtaq Raza and João Pascoal Faria — <i>University of Porto, Portugal</i> . . . . .                                                                                                  | 798 |
| <b>CVExplorer: Identifying Candidate Developers by Mining and Exploring Their Open Source Contributions</b><br>Gillian J. Greene and Bernd Fischer — <i>Stellenbosch University, South Africa</i> . . . . .                                                                                                   | 804 |
| <b>Lightweight Collection and Storage of Software Repository Data with DataRover</b><br>Thomas Kowark, Christoph Matthies, Matthias Uflacker, and Hasso Plattner — <i>HPI, Germany</i> . . . . .                                                                                                              | 810 |
| <b>Visual Contract Extractor: A Tool for Reverse Engineering Visual Contracts using Dynamic Analysis</b><br>Abdullah Alshanqiti, Reiko Heckel, and Timo Kehrer — <i>University of Leicester, UK; Politecnico di Milano, Italy</i> . . . . .                                                                   | 816 |
| <b>SuperMod: Tool Support for Collaborative Filtered Model-Driven Software Product Line Engineering</b><br>Felix Schwägerl and Bernhard Westfechtel — <i>University of Bayreuth, Germany</i> . . . . .                                                                                                        | 822 |
| <b>AnModeler: A Tool for Generating Domain Models from Textual Specifications</b><br>Jitendra Singh Thakur and Atul Gupta — <i>IIITDM Jabalpur, India</i> . . . . .                                                                                                                                           | 828 |
| <b>SimilarTech: Automatically Recommend Analogical Libraries across Different Programming Languages</b><br>Chunyang Chen and Zhenchang Xing — <i>Nanyang Technological University, Singapore</i> . . . . .                                                                                                    | 834 |
| <b>Testing, Validation, and Verification</b>                                                                                                                                                                                                                                                                  |     |
| <b>TeeVML: Tool Support for Semi-automatic Integration Testing Environment Emulation</b><br>Jian Liu, John Grundy, Iman Avazpour, and Mohamed Abdelrazek — <i>Swinburne University of Technology, Australia; Deakin University, Australia</i> . . . . .                                                       | 840 |
| <b>The Interactive Verification Debugger: Effective Understanding of Interactive Proof Attempts</b><br>Martin Hentschel, Reiner Hähnle, and Richard Bubel — <i>TU Darmstadt, Germany</i> . . . . .                                                                                                            | 846 |
| <b>Verifying Simulink Stateflow Model: Timed Automata Approach</b><br>Yixiao Yang, Yu Jiang, Ming Gu, and Jiaguang Sun — <i>Tsinghua University, China; University of Illinois at Urbana-Champaign, China</i> . . . . .                                                                                       | 852 |
| <b>GUICat: GUI Testing as a Service</b><br>Lin Cheng, Jialiang Chang, Zijiang Yang, and Chao Wang — <i>Western Michigan University, USA; University of Southern California, USA</i> . . . . .                                                                                                                 | 858 |
| <b>An Automated Collaborative Requirements Engineering Tool for Better Validation of Requirements</b><br>Nor Aiza Moketar, Massila Kamalrudin, Safiah Sidek, Mark Robinson, and John Grundy — <i>Technical University of Malaysia Malacca, Malaysia; Fulgent, USA; Deakin University, Australia</i> . . . . . | 864 |
| <b>An Extensible Framework for Variable-Precision Data-Flow Analyses in MPS</b><br>Tamás Szabó, Simon Alperovich, Markus Voelter, and Sebastian Erdweg — <i>itemis, Netherlands; JetBrains, Czechia; itemis, Germany; Delft University of Technology, Netherlands</i> . . . . .                               | 870 |



# Doctoral Symposium

---

|                                                                                                                  |         |
|------------------------------------------------------------------------------------------------------------------|---------|
| <b>Towards Efficient and Effective Automatic Program Repair</b>                                                  |         |
| Xuan-Bach D. Le — <i>Singapore Management University, Singapore</i> . . . . .                                    | 876     |
| <b>Automated Testing and Notification of Mobile App Privacy Leak-Cause Behaviours</b>                            |         |
| Joseph Chan Joo Keng — <i>Singapore Management University, Singapore</i> . . . . .                               | 880     |
| <b>Factoring Requirement Dependencies in Software Requirement Selection using Graphs and Integer Programming</b> |         |
| Davoud Mougouei — <i>Flinders University, Australia</i> . . . . .                                                | 884     |
| <b>Statistical Analysis of Large Sets of Models</b>                                                              |         |
| Önder Babur — <i>Eindhoven University of Technology, Netherlands</i> . . . . .                                   | 888     |
| <b>Developer Targeted Analytics: Supporting Software Development Decisions with Runtime Information</b>          |         |
| Jürgen Cito — <i>University of Zurich, Switzerland</i> . . . . .                                                 | 892     |
| <b>API Recommendation System for Software Development</b>                                                        |         |
| Ferdian Thung — <i>Singapore Management University, Singapore</i> . . . . .                                      | 896     |
| <br><b>Author Index</b> . . . . .                                                                                | <br>900 |