

2019 IEEE 19th International Conference on Software Quality, Reliability and Security (QRS 2019)

**Sofia, Bulgaria
22 – 26 July 2019**



**IEEE Catalog Number: CFP19C33-POD
ISBN: 978-1-7281-3928-9**

**Copyright © 2019 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

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

IEEE Catalog Number:	CFP19C33-POD
ISBN (Print-On-Demand):	978-1-7281-3928-9
ISBN (Online):	978-1-7281-3927-2

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
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

2019 IEEE 19th International Conference on Software Quality, Reliability and Security (QRS) **QRS 2019**

Table of Contents

Message from General Chairs	xi
Message from Program Chairs	xii
Message from Steering Committee Chairs	xiii
Organizing Committee	xiv
Program Committee	xvi
Steering Committee	xviii
Chairs of Workshops Co-Located with QRS 2019	xix
Keynotes	xxi
First International Workshop on Data-driven System Quality Assurance Workshop Summary	xxiv

Session I-A: Fault Localization and Prediction

A Cluster-Based Hybrid Feature Selection Method for Defect Prediction	1
<i>Fei Wang (Beihang University), Jun Ai (Beihang University), and Zhuoliang Zou (Beihang University)</i>	
MVSE: Effort-Aware Heterogeneous Defect Prediction via Multiple-View Spectral Embedding	10
<i>Zhou Xu (Harbin Engineering University), Sizhe Ye (Wuhan University), Tao Zhang (Harbin Engineering University), Zhen Xia (Wuhan University), Shuai Pang (Wuhan University), Yong Wang (Harbin Engineering University), and Yutian Tang (Hong Kong Polytechnic University)</i>	
An Empirical Study of Bug Isolation on the Effectiveness of Multiple Fault Localization	18
<i>Zheng Li (Beijing University of Chemical Technology), Yonghao Wu (Beijing University of Chemical Technology), and Yong Liu (Beijing University of Chemical Technology)</i>	
Evaluating Fault Localization for Resource Adaptation via Test-Based Software Modification	26
<i>Arpit Christi (Oregon State University), Alex Groce (Northern Arizona University), and Rahul Gopinath (CISPA Helmholtz Center for Information Security)</i>	

Session I-B: Random and Combinatorial Testing

Combinatorial Robustness Testing with Negative Test Cases	34
<i>Konrad Fögen (RWTH Aachen University) and Horst Lichter (RWTH Aachen University)</i>	

A Distance-Based Dynamic Random Testing with Test Case Clustering	46
<i>Hanyu Pei (Beihang University, City University of Hong Kong), Beibei Yin (Beihang University), Kai-Yuan Cai (Beihang University), and Min Xie (City University of Hong Kong)</i>	
Random Border Mirror Transform: A Diversity Based Approach to an Effective and Efficient Mirror Adaptive Random Testing	54
<i>Michael Omari (Jiangsu University), Jinfu Chen (Jiangsu University), Patrick Kwaku Kudjo (Jiangsu University), Hilary Ackah-Arthur (Jiangsu University), and Rubing Huang (Jiangsu University)</i>	
Efficient Evolutionary Fuzzing for Android Application Installation Process	62
<i>Veysel Hatas (Hacettepe Universitesi), Sevil Sen (Hacettepe University), and John A. Clark (University of Sheffield)</i>	

Session I-C: Reliability Analysis

A Novel Reliability Assessment Method Based on the Effects of Components	69
<i>Yue Chen (Nanjing University of Aeronautics and Astronautics), Xuefeng Yan (Nanjing University of Aeronautics and Astronautics), and Arif Ali Khan (Nanjing University of Aeronautics and Astronautics)</i>	
On Kolmogorov-Smirnov Test for Software Reliability Models with Grouped Data	77
<i>Hiroyuki Okamura (Hiroshima University) and Tadashi Dohi (Hiroshima University)</i>	
A Point Process Approach of Bug Fixing Analysis in Open Source Software Projects	83
<i>Takahiro Ushiroda (Hiroshima University), Tadashi Dohi (Hiroshima University), Yasuhiro Saito (Japan Coast Guard Academy), and Hiroyuki Okamura (Hiroshima University)</i>	
Reliability Analysis of Phased-Mission System in Irrelevancy Coverage Model	89
<i>Ming Yang (Wuhan University of Technology), Dongdong Zhao (Wuhan University of Technology), Luyao Ye (Wuhan University of Technology), Siwei Zhou (Wuhan University of Technology), and Jianwen Xiang (Wuhan University of Technology)</i>	

Session I-D: Software Maintenance

SMARTKT: A Search Framework to Assist Program Comprehension using Smart Knowledge Transfer	97
<i>Srijoni Majumdar (Indian Institute of Technology, Kharagpur, India), Shakti Papdeja (Indian Institute of Technology, Kharagpur, India), Partha Pratim Das (Indian Institute of Technology, Kharagpur, India), and Soumya Kanti Ghosh (Indian Institute of Technology, Kharagpur, India)</i>	
Importance and Aptitude of Source Code Density for Commit Classification into Maintenance Activities.....	109
<i>Sebastian Hönel (Linnaeus University), Morgan Ericsson (Linnaeus University), Welf Löwe (Linnaeus University), and Anna Wingkvist (Linnaeus University)</i>	
A Mechanism for Automatically Summarizing Software Functionality from Source Code	121
<i>Christos Psarras (Aristotle University of Thessaloniki), Themistoklis Diamantopoulos (Aristotle University of Thessaloniki), and Andreas Symeonidis (Aristotle University of Thessaloniki)</i>	

Characterizing Software Maintainability in Issue Summaries using a Fuzzy Classifier	131
<i>Celia Chen (Occidental College), Michael Shoga (University of Southern California), and Barry Boehm (University of Southern California)</i>	

Session II-A: Bug Finding

WARDER: Refining Cell Clustering for Effective Spreadsheet Defect Detection via Validity Properties	139
<i>Da Li (Nanjing University, Nanjing, China), Huiyan Wang (Nanjing University, Nanjing, China), Chang Xu (Nanjing University, Nanjing, China), Fengmin Shi (Nanjing University, Nanjing, China), Xiaoxing Ma (Nanjing University, Nanjing, China), and Jian Lu (Nanjing University, Nanjing, China)</i>	
A Control Flow Error Detection Method Without Code Modification for Space Application	N/A
<i>Xiangeng Liang (China Academy of Space Technology), Yingke Gao (China Academy of Space Technology), Gengxin Hua (China Academy of Space Technology), Xiang He (University of Utah), Shenglong Li (China Academy of Space Technology), and Yunfu Zhao (China Academy of Space Technology)</i>	
Detecting Vulnerabilities in Android Applications using Event Sequences	159
<i>Zachary B. Ratliff (Raytheon BBN Technologies), D. Richard Kuhn (National Institute of Standards and Technology), and Daniel J. Ragsdale (Texas A&M University)</i>	
BugIdentifier: An Approach to Identifying Bugs via Log Mining for Accelerating Bug Reporting Stage	167
<i>Wensheng Xia (Peking University), Ying Li (Peking University), Tong Jia (Peking University), and Zhonghai Wu (Peking University)</i>	

Session II-B: Non-Functional Properties

Microservice Based Architecture: Towards High-Availability for Stateful Applications with Kubernetes.....	176
<i>Leila Abdollahi Vayghan (Concordia University Montreal, Canada), Mohamed Aymen Saied (University of Quebec Rimouski Quebec, Canada), Maria Toeroe (Ericsson Inc Montreal, Canada), and Ferhat Khendek (Concordia University Montreal, Canada)</i>	
A Transfer Learning Based Interpretable User Experience Model on Small Samples	186
<i>Qi Yu (Beijing Jiaotong University), Xiaoping Che (Beijing Jiaotong University), Yuxiang Yang (Beijing Jiaotong University), and Liqiang Wang (University of Central Florida)</i>	
Experimental Analysis and Comparison of Load Prediction Algorithms in Cloud Data Center	197
<i>Yanxin Liu (Harbin Institute of Technology), Jian Dong (Harbin Institute of Technology), Decheng Zuo (Harbin Institute of Technology), and Hongwei Liu (Harbin Institute of Technology)</i>	
Analyzing Software Architecture Evolvability Based on Multiple Architectural Attributes Measurements.....	204
<i>Tong Wang (Southeast University) and Bixin Li (Southeast University)</i>	

Session II-C: Formal Method I

Hybrid Predicate Transition Nets - A Formal Method for Modeling and Analyzing Cyber-Physical Systems.....	216
<i>Xudong He (Florida International University) and Dewan Mohammad Moksedul Alam (Florida International University)</i>	
Tool-Supported Analysis of Dynamic and Stochastic Behaviors in Cyber-Physical Systems	228
<i>Li Huang (Sun Yat-Sen University), Tian Liang (Sun Yat-Sen University), and Eun-Young Kang (University of Southern Denmark)</i>	
Repeatable Decentralized Simulations for Cyber-Physical Systems	240
<i>Christophe Reymann (LAAS-CNRS), Mohammed Foughali (LAAS-CNRS), and Simon Lacroix (LAAS-CNRS)</i>	

Session III-A: Bug Reporting

Improving the Accuracy of Vulnerability Report Classification Using Term Frequency-Inverse Gravity Moment	248
<i>Patrick Kwaku Kudjo (Jiangsu University, Zhenjiang, China), Jinfu Chen (Jiangsu University, Zhenjiang, China), Minmin Zhou (Jiangsu University, Zhenjiang, China), Solomon Mensah (University of Ghana, Legon), and Rubing Huang (Jiangsu University, Zhenjiang, China)</i>	
Reorganizing and Optimizing Post-Inspection on Suspicious Bug Reports in Path-Sensitive Analysis	260
<i>Xutong Ma (University of Chinese Academy of Sciences), Jiwei Yan (Chinese Academy of Sciences), Jun Yan (University of Chinese Academy of Sciences), and Jian Zhang (University of Chinese Academy of Sciences)</i>	
Are All Duplicates Value-Neutral? An Empirical Analysis of Duplicate Issue Reports	272
<i>Mingyang Li (ISCAS), Lin Shi (ISCAS), and Qing Wang (ISCAS)</i>	
What are Good Discussions Within Bug Report Comments for Shortening Bug Fixing Time?	280
<i>Yuki Noyori (Waseda University), Hironori Washizaki (Waseda University), Yoshiaki Fukazawa (Waseda University), Keishi Ooshima (Hitachi,Ltd. Research & Development Group), Hideyuki Kanuka (Hitachi,Ltd. Research & Development Group), Shuhei Nojiri (Hitachi,Ltd. Research & Development Group), and Ryosuke Tsuchiya (Hitachi,Ltd. Research & Development Group)</i>	

Session III-B: Empirical Studies & Security

When and Why Do Software Developers Face Uncertainty?	288
<i>Naoyasu Ubayashi (Kyushu University), Yasutaka Kamei (Kyushu University), and Ryosuke Sato (Kyushu University)</i>	
An Exploratory Study on Judicial Image Quality Assessment Based on Deep Learning	300
<i>Qiqi Gu (Nanjing University), Weilin Cai (Nanjing University), Shengcheng Yu (Nanjing University), and Zhenyu Chen (Nanjing University)</i>	
Branch Use in Practice: A Large-Scale Empirical Study of 2,923 Projects on GitHub	306
<i>Weiqin Zou (Nanjing University), Weiqiang Zhang (Nanjing University), Xin Xia (Monash University), Reid Holmes (University of British Columbia), and Zhenyu Chen (Nanjing University)</i>	

Automatic Analysis of Critical Sections for Efficient Secure Multi-Execution	318
<i>Tobias Pfeffer (Technische Universität Berlin), Thomas Göthel (Technische Universität Berlin), and Sabine Glesner (Technische Universität Berlin)</i>	

Session III-C: Formal Method II

Fault Detection in Timed FSM with Timeouts by SAT-Solving	326
<i>Omer Nguena Timo (Computer Research Institute of Montréal), Dimitri Prestat (University of Québec in Montréal), and Florent Avellaneda (Computer Research Institute of Montréal)</i>	
Improved Invariant Generation for Industrial Software Model Checking of Time Properties	334
<i>Vassil Todorov (LRI, Groupe PSA), Safouan Taha (LRI, CentraleSupélec), Frédéric Boulanger (LRI, CentraleSupélec), and Armando Hernandez (Groupe PSA)</i>	
UML-SR: A Novel Security Requirements Specification Language	342
<i>Muhammad Mohsin (Riphah International University, Pakistan) and Muhammad Umair Khan (Riphah International University, Pakistan)</i>	

Session IV-A: Test Selection, Prioritization, and Generation

Method-Level Test Selection for Continuous Integration with Static Dependencies and Dynamic Execution Rules	350
<i>Yingling Li (Chinese Academy of Sciences), Junjie Wang (Chinese Academy of Sciences), Yun Yang (Anhui University), and Qing Wang (Chinese Academy of Sciences)</i>	
Learning and Adaptive Testing of Nondeterministic State Machines	362
<i>Alexandre Petrenko (Computer Research Institute of Montréal) and Florent Avellaneda (Computer Research Institute of Montréal)</i>	
A Systematic Requirements and Risks-Based Test Case Prioritization Using a Fuzzy Expert System	374
<i>Charitha Hettiarachchi (Northwest Missouri State University) and Hyunsook Do (University of North Texas)</i>	
Efficient Generation of Test Data with Extended Cardinality Constraints	386
<i>Michaël Larouche (Université du Québec à Chicoutimi) and Sylvain Hallé (Université du Québec à Chicoutimi)</i>	

Sessions V-A: Testing Specialized Software

On the Investigation of Essential Diversities for Deep Learning Testing Criteria	394
<i>Zhiyi Zhang (Wuhan University, Wuhan, China) and Xiaoyuan Xie (Wuhan University, Wuhan, China)</i>	
Testing Scientific Software with Invariant Relations: A Case Study	406
<i>Junhua Ding (University of North Texas), XinChuan Li (China University of Geosciences), and Xin-Hua Hu (East Carolina University)</i>	

Genetic Algorithm-Based Test Parameter Optimization for ADAS System Testing	418
<i>Florian Klück (Graz University of Technology), Martin Zimmermann (Graz University of Technology), Franz Wotawa (Graz University of Technology), and Mihai Nica (AVL List GmbH)</i>	

TFCheck : A TensorFlow Library for Detecting Training Issues in Neural Network Programs	426
<i>Houssem Ben Braiek (Polytechnique Montreal) and Foutse Khomh (Polytechnique Montreal)</i>	

Session V-B: Quality and Cost

Technical Debt Prioritization: A Search-Based Approach	434
<i>Reem Alfayez (University of Southern California) and Barry Boehm (University of Southern California)</i>	

Quality of Reusable Game Software: Empowering Developers with Automated Quality Checks	446
<i>Wim van der Vegt (Open University of the Netherlands) and Wim Westera (Open University of the Netherlands)</i>	

Author Index	453
---------------------------	-----