# **2024 IEEE Conference on** Software Testing, Verification and Validation (ICST 2024)

**Toronto, Ontario, Canada** 27-31 May 2024



IEEE Catalog Number: CFP24TVV-POD **ISBN:** 

979-8-3503-0819-8

# Copyright © 2024 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.

9-8
8-1

#### 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



# 2024 IEEE Conference on Software Testing, Verification and Validation (ICST) ICST 2024

### **Table of Contents**

Message from the General Chair	xiii
Message from the Program Co-Chairs	xv
Organizing Committee	xvi
Journal First Papers	xix
Sponsors and Supporters	xxiv

#### **Research Track**

MACS: Multi-Agent Adversarial Reinforcement Learning for Finding Diverse Critical Driving

EmoSTL: Formal Spatial-Temporal Verification of Emotion Specifications in Computer Games ...... 13 Saba Gholizadeh Ansari (Utrecht University, The Netherlands), I. S. W.
B. Prasetya (Utrecht University, The Netherlands), Mehdi Dastani (Utrecht University, The Netherlands), Frank Dignum (Umeå University, Sweden), and Gabriele Keller (Utrecht University, The Netherlands)

<ul> <li>Differential Optimization Testing of Gremlin-Based Graph Database Systems</li></ul>
<ul> <li>Sciences, University of Chinese Academy of Sciences, Beijing, China)</li> <li>FusionFL: A Statement-Level Feature Fusion Based Fault Localization Approach</li></ul>
<ul> <li>Enhanced Fast and Reliable Statistical Vulnerability Root Cause Analysis with Sanitizer</li></ul>
<ul> <li>State of the Practice in Software Testing Teaching in Four European Countries</li></ul>

<ul> <li>Predicting Safety Misbehaviours in Autonomous Driving Systems Using Uncertainty</li> <li>Quantification</li></ul>
<ul> <li>KAT: Dependency-Aware Automated API Testing with Large Language Models</li></ul>
Quantizing Large-Language Models for Predicting Flaky Tests
<ul> <li>Evolutionary Testing for Program Repair</li></ul>
METAL: Metamorphic Testing Framework for Analyzing Large-Language Model Qualities
Intent-Driven Mobile GUI Testing with Autonomous Large Language Model Agents

<ul> <li>Yang Zhang (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Dongliang Fang (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China, University of Chinese Academy of Sciences, China), Puzhuo Liu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Laile Xi (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China, University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li> <li>Tan Hu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Hui Shu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Hui Shu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Zheming Li (Tsinghua University, China)</li> </ul>
<ul> <li>Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Dongliang Fang (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Puzhuo Liu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Laile Xi (Beijing Key Laboratory of Chinese Academy of Sciences, China), Laile Xi (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>University of Chinese Academy of Sciences, China), Dongliang Fang</li> <li>(Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Puzhuo Liu (Beijing Key</li> <li>Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Laile Xi (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Sluaizong Si</li> <li>(Beijing Key Laboratory of IOT Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Sluaizong Si</li> <li>(Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key</li> <li>Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key</li> <li>Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Education, China), Jiangan Ji (Key Laboratory of Cyberspace Security, Ministry of Education, China), Hui Shu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Aud Laboratory of Cyberspace Security, Ministry of Education, China), Aud Chao Zhang (Tsinghua University, China)</li> </ul>
<ul> <li>(Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Puzhuo Liu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Laile Xi (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li> <li>151 Fan Hu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Hui Shu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Hui Shu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Zheming Li (Tsinghua University, China), Tieming Liu (Key Laboratory of Cyberspace Security, Ministry of Education, China), and Chao Zhang (Tsinghua Unive</li></ul>
Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Puzhuo Liu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Laile Xi (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China) Formatted Stateful Greybox Fuzzing of TLS Server
<ul> <li>Chinese Academy of Sciences, China), Puzhuo Liu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Laile Xi (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Laile Xi (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Laile Xi (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Sciences, China), Laile Xi (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>University of Chinese Academy of Sciences, China), Xiao Lu (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Sciences, China), Xin Chen (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), Shuaizong Si (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>University of Chinese Academy of Sciences, China), Shuaizong Si</li> <li>(Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>(Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Chinese Academy of Sciences, China), and Limin Sun (Beijing Key Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Laboratory of IOT Information Security Technology, Institute of Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Information Engineering, CAS, China; University of Chinese Academy of Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
<ul> <li>Sciences, China)</li> <li>Formatted Stateful Greybox Fuzzing of TLS Server</li></ul>
Formatted Stateful Greybox Fuzzing of TLS Server
Formatted Statetul Greybox Fuzzing of TLS Server
Fan Hu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Jiangan Ji (Key Laboratory of Cyberspace Security, Ministry of Education, China), Hui Shu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Zheming Li (Tsinghua University, China), Tieming Liu (Key Laboratory of Cyberspace Security, Ministry of Education, China), and Chao Zhang (Tsinghua University, China)
China), Jiangan Ji (Key Laboratory of Cyberspace Security, Ministry of Education, China), Hui Shu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Zheming Li (Tsinghua University, China), Tieming Liu (Key Laboratory of Cyberspace Security, Ministry of Education, China), and Chao Zhang (Tsinghua University, China)
of Education, China), Hui Shu (Key Laboratory of Cyberspace Security, Ministry of Education, China), Zheming Li (Tsinghua University, China), Tieming Liu (Key Laboratory of Cyberspace Security, Ministry of Education, China), and Chao Zhang (Tsinghua University, China)
Ministry of Education, China), Zheming Li (Tsinghua University, China), Tieming Liu (Key Laboratory of Cyberspace Security, Ministry of Education, China), and Chao Zhang (Tsinghua University, China)
China), Tieming Liu (Key Laboratory of Cyberspace Security, Ministry of Education, China), and Chao Zhang (Tsinghua University, China)
of Education, China), and Chao Zhang (Tsinghua University, China)
Causal Test Adequacy 161
Michael Foster (The University of Sheffield, UK) Christonher Wild
(The University of Sheffield, UK), Robert M. Hierons (The University
of Sheffield 11K) and Neil Walkinshazu (The University of Sheffield
11K)
Assessing Quality Metrics for Neural Reality Gap Input Mitigation in Autonomous Driving
Testing
Stefano Carlo Lambertenghi (Technical University of Munich, Germany)
and Andrea Stocco (Technical University of Munich, Munich, Germany)
Brewing Up Reliability: Espresso Test Generation for Android Apps
Iván Arcuschin (University of Buenos Aires, Argentina; Institute of
Computer Science UBA-CONICET, Argentina), Lisandro Di Meo (University
of Buenos Aires, Argentina), Michael Auer (University of Passau,
Germany), Juan P. Galeotti (University of Buenos Aires, Argentina;
Institute of Computer Science UBA-CONICET, Argentina), and Gordon
Fraser (University of Passau, Germany)

Learning Environment Models with Continuous Stochastic Dynamics - with an Application to Deep RL Testing
U-Fuzz: Stateful Fuzzing of IoT Protocols on COTS Devices
<ul> <li>AURORA: Navigating UI Tarpits via Automated Neural Screen Understanding</li></ul>
Automatically Removing Unnecessary Stubbings from Test Suites
Spectral Analysis of the Relation Between Deep Learning Faults and Neural Activation       245         Nargiz Humbatova (Università della Svizzera italiana (USI)), Gunel       Jahangirova (King's College London), and Paolo Tonella (Università         della Svizzera italiana (USI))       Suizera italiana (USI)
230,439 Test Failures Later: An Empirical Evaluation of Flaky Failure Classifiers
Automatically Reproducing Timing-Dependent Flaky-Test Failures
Does Going Beyond Branch Coverage Make Program Repair Tools More Reliable?
Adversarial Testing with Reinforcement Learning: A Case Study on Autonomous Driving

On the Coupling Between Vulnerabilities and LLM-Generated Mutants: A Study on Vul4J Dataset
<ul> <li>Improving Patch Correctness Analysis via Random Testing and Large Language Models</li></ul>
Industry Track
Cost of Flaky Tests in Continuous Integration: An Industrial Case Study
Using Mutation Testing To Improve and Minimize Test Suites for Smart Contracts
<ul> <li>Are We Testing or Being Tested? Exploring the Practical Applications of Large Language</li> <li>Models in Software Testing</li></ul>
<ul> <li>Metamorphic Testing of an Autonomous Delivery Robots Scheduler</li></ul>
<ul> <li>BugOut: Automated Test Generation and Bug Detection for Low-Code</li></ul>
In Industrial Embedded Software, are Some Compilation Errors Easier to Localize and fix than Others?

SafeRevert: When Can Breaking Changes be Automatically Reverted? Tim A. D. Henderson (Google LLC), Avi Kondareddy (Google LLC), Sushmita Azad (Google LLC), and Eric Nickell (Google LLC)	395
Randomised Testing of the Compiler for a Verification-Aware Programming Language Alastair Donaldson (Imperial College London, UK), Dilan Sheth (Imperial College London, UK), Jean-Baptiste Tristan (AWS, USA), and Alex Usher (Imperial College London, UK)	407
End-to-end RPA-Like Testing Using Reinforcement Learning <i>Ciprian Paduraru (University of Bucharest and Institute for Logic and Data Science, Romania), Rares Cristea (University of Bucharest and Institute for Logic and Data Science, Romania), and Alin Stefanescu (University of Bucharest and Institute for Logic and Institute for Logic and Institute for Logic and Institute for Logic and Data Science, Romania), and Alin Stefanescu (University of Bucharest and Institute for Logic and Data Science, Romania)</i>	419

#### **Poster Abstracts**

Poster: Towards Understanding Root Causes of Real Failures in Healthcare Machine Learning Applications <i>Guna Sekaran Jaganathan (University of North Florida, USA), Nazmul</i> <i>Kazi (University of North Florida, USA), Indika Kahanda (University of</i> <i>North Florida, USA), and Upulee Kanewala (University of North Florida, USA)</i>	430
Poster: VeriSol-MCE: Verification-Based Condition Coverage Analysis of Smart Contracts	
Using Model Checker Engines	434
Sangharatna Godboley (NITMiner Technologies, Department of Computer	
Science and Engineering, National Institute of Technology Warangal,	
India) and P. Radha Krishna (NITMiner Technologies, Department of	
Computer Science and Engineering, National Institute of Technology	
Warangal, India)	
Poster: gptCombFuzz: Combinatorial Oriented LLM Seed Generation for Effective Fuzzing Darshan Lohiya (NITMiner Technologies, Department of Computer Science	438
and Engineering, National Institute of Technology, India), Monika Rani	
Golla (NITMiner Technologies, Department of Computer Science and	
Engineering National Institute of Technology, India), Sangharatna	
Godboley (NITMiner Technologies, Department of Computer Science and	
Engineering National Institute of Technology, India), and P. Radha	
Krishna (NITMiner Technologies, Department of Computer Science and	
Engineering, National Institute of Technology, India)	

### **Tools and Demo**

MLHCBugs: A Framework to Reproduce Real Faults in Healthcare Machine Learning Applications..... 445

Guna Sekaran Jaganathan (University of North Florida, USA), Nazmul Kazi (University of North Florida, USA), Indika Kahanda (University of North Florida, USA), and Upulee Kanewala (University of North Florida, USA)

U-Fuzz: A Tool Prototype for Stateful Fuzzing of IoT Protocols on COTS Devices	448
Zewen Shang (Singapore University of Technology and Design), Matheus	
E. Garbelini (Singapore University of Technology and Design), and	
Sudipta Chattopadhyay (Singapore University of Technology and Design)	
MOTIF: A Tool for Mutation Testing with Fuzzing 4	451

Jaekwon Lee (University of Ottawa), Enrico Viganò (University of Luxembourg), Fabrizio Pastore (University of Luxembourg), and Lionel Briand (University of Ottawa; University of Limerick, Ireland)

## **Doctoral Symposium**

Teaching Model-Driven Engineering from a Model-testing Perspective Felix Cammaerts (KU Leuven)	454
Agile Regression Testing Suddhasvatta Das (Arizona State University, USA)	457
Insights into System Failures: ML-Assisted Testing and Failure Models for Cyber-Physical Systems	460
Baharin A. Jodat (University of Ottawa, Canada)       Search-based Security Testing of Enterprise Microservices         Susruthan Seran (Kristiania University College, Norway)	463
Susrainan Seran (Ichshania antoersity Concee, Ivorway)	

Author Index
--------------