Lecture Notes in Computer Science 13045

Founding Editors

Gerhard Goos
Karlsruhe Institute of Technology, Karlsruhe, Germany
Juris Hartmanis
Cornell University, Ithaca, NY, USA

Editorial Board Members

Elisa Bertino
Purdue University, West Lafayette, IN, USA
Wen Gao
Peking University, Beijing, China
Bernhard Steffen
TU Dortmund University, Dortmund, Germany
Gerhard Woeginger
RWTH Aachen, Aachen, Germany
Moti Yung
Columbia University, New York, NY, USA

More information about this series at https://link.springer.com/bookseries/558

David Clark · Hector Menendez ·
Ana Rosa Cavalli (Eds.)

Testing Software and Systems

33rd IFIP WG 6.1 International Conference, ICTSS 2021
London, UK, November 10–12, 2021
Proceedings

Springer

Editors
David Clark
University College London
London, UK

Hector Menendez
Middlesex University
London, UK

Ana Rosa Cavalli
Telecom SudParis
Evry Cedex, France

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-031-04672-8 ISBN 978-3-031-04673-5 (eBook)
https://doi.org/10.1007/978-3-031-04673-5

© IFIP International Federation for Information Processing 2022
This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This volume contains the proceedings of the 33rd IFIP International Conference on Testing Software Systems (ICTSS 2021). This event is a well-established conference of Working Group 6.1 of the International Federation for Information Processing (IFIP). The conference was organized at University College London in the UK but conducted online because of the prevalence of the Delta variant of the SARS-CoV-2 virus. The conference took place during November 10–11, 2021.

ICTSS addresses multiple topics related to software systems, ranging from theoretical concepts for testing to practical testing frameworks. These include communication protocols, services, distributed computing, embedded systems, cyber-physical systems, security, infrastructure evaluation, applications of artificial intelligence to testing, and more. The conference engages both academic researchers and industrial practitioners, providing a forum for reviews and discussions on new contributions to the testing field in the form of methodologies, theories, tools, and use cases.

This year, the conference received a total of 36 submissions consisting of regular papers, short papers, and project reports. From these submissions 10 were accepted as full papers, seven as short papers, and six as project reports. These papers cover multiple topics including artificial intelligence in testing, security of programs, monitoring and performance, and use cases. In this edition there is a strong emphasis on Finite State Machine (FSM)-based testing.

ICTSS 2021 created a forum to share experiences between existing research projects related to the conference topics. Projects from both academia and industry were represented and several European funded projects were brought to the discussion table, hopefully seeding future collaborations among the attendees. Reports from some of these are presented in the appendix.

We want to thank University College London for support in organizing the conference, the authors who submitted their insightful contributions, the reviewers who provided their time and expertise and helped to ensure the quality of the accepted papers, the session chairs who managed the sessions, the keynote speakers, Mohammad Reza Mousavi and Konstantin (Kostya) Serebryany, and, finally, the Program Committee for their participation and advice along with the local organization team for running the conference and handling every specific detail.

We would like to thank the ICTSS Steering Committee who gave support and advice when decisions were tricky. We especially thank Ilaria Pia de la Torre, Dan Blackwell, Dan Bruce, Afnan Alsubaihin, and Bill Langdon from the Organizing Committee who underpinned the conference organization and were always available to solve problems, whether of advertising, finance, the webpage, the online delivery platform, or technical support during the conference. In addition we would like to thank IFIP for their ongoing support for this and earlier conferences in the series, as well as our publishers, Springer.

On behalf of the ICTSS 2021 organizers, we hope that you find the conference proceedings useful, interesting, and challenging.

November 2021

David Clark
Héctor D. Menéndez
Ana Cavalli

Organization

General Chair

David Clark	University College London, UK

Program Committee Chairs

Héctor D. Menéndez	Middlesex University London, UK
Ana Cavalli	Telecom SudParis, France

Steering Committee

Rob Hierons	University of Sheffield, UK
Ana Cavalli	Telecom SudParis, France
Andreas Ulrich	Siemens AG, Germany
Nikolai Kosmatov	CEA List, France
Christophe Gaston	CEA List, France
Pascale Le Gall	CentraleSupelec, France
Inmaculada Medina-Bulo	University of Càdiz, Spain
Mercedes Merayo	Universidad Complutense de Madrid, Spain
Francisco Palomo-Lozano	University of Càdiz, Spain
Valentina Casola	University of Napoli Federico II, Italy
Massimiliano Rak	Università della Campania Luigi Vanvitelli, Italy
Alessandra De Benedictis	University of Napoli Federico II, Italy

Program Committee

Héctor D. Menéndez	Middlesex University London, UK
Antonio Pecchia	Università degli Studi del Sannio, Italy
Burkhart Wolff	Paris-Saclay University, France
Natalia Kushik	Telecom SudParis and Paris-Saclay University, France
Roland Groz	Grenoble INP - LIG, France
Jorge Lopez	Airbus Defence and Space, Spain
Antoine Rollet	University of Bordeaux, France
Ana Cavalli	Telecom SudParis, France
Porfirio Tramontana	University of Naples Federico II, Italy
David Clark	University College London, UK
Manuel Núñez	Universidad Complutense de Madrid, Spain
Nikolai Kosmatov	CEA List, France
Stephane Maag	Telecom SudParis, France
Christophe Gaston	CEA List, France
Alessandra De Benedictis	University of Naples Federico II, Italy

Radu Mateescu	Inria, France
Roberto Natella	University of Naples Federico II, Italy
Wissam Mallouli	Montimage, France
Justyna Petke	University College London, UK
Roberto Pietrantuono	University of Naples Federico II, Italy
Sergio Segura	University of Seville, Spain
Hüsnü Yenigün	Sabanci University, Turkey
Antonia Bertolino	ISTI-CNR, Italy
Inmaculada Medina-Bulo	Universidad de Càdiz, Spain
Mercedes Merayo	Universidad Complutense de Madrid, Spain
Gunel Jahangirova	Università della Svizzera Italiana, Switzerland
Rob Hierons	University of Sheffield, UK
Teruo Higashino	Osaka University, Japan
Ferhat Khendek	Concordia University, Canada
Robert Feldt	Blekinge Institute of Technology, Sweden
Jan Peleska	Universität Bremen, Germany
Umberto Villano	University of Sannio, Italy
Delphine Longuet	Paris-Saclay University, France
Franz Wotawa	Technische Universitaet Graz, Austria
Thierry Jéron	Inria, France
Pedro Delgado-Pérez	Universidad de Càdiz, Spain
Valentina Casola	University of Naples Federico II, Italy
Moez Krichen	University of Sfax, Tunisia
Angelo Gargantini	University of Bergamo, Italy
Khaled El-Fakih	American University of Sharjah, UAE
Shin Yoo	Korea Advanced Institute of Science and Technology, South Korea
Mike Papadakis	University of Luxembourg, Luxembourg
Luis Llana	Universidad Complutense de Madrid, Spain
Juergen Grossmann	Fraunhofer FOKUS, Germany
Bernhard K. Aichernig	TU Graz, Austria
Sébastien Salva	LIMOS, France
Andreas Ulrich	Siemens AG, Germany
Kelly Androutsopoulos	Middlesex University London, UK

Additional Reviewers

Huu Nghia Nguyen
Daniel Blackwell
Ilaria La Torre
Renzo Degiovanni
Guillaume Haben
Vinh Hoa La

Contents

Finite State Machine-based Testing

libfsmtest An Open Source Library for FSM-Based Testing 3
Moritz Bergenthal, Niklas Krafczyk, Jan Peleska, and Robert Sachtleben

Mining Precise Test Oracle Modelled by FSM 20
Omer Nguena Timo

Reverse-Engineering EFSMs with Data Dependencies 37
Michael Foster, John Derrick, and Neil Walkinshaw

Testing Against Non-deterministic FSMs: A Probabilistic Approach for Test Suite Minimization 55
Natalia Kushik, Nina Yevtushenko, and Jorge López

Test Generation and Selection

Automatic Test Generation with ASMETA for the Mechanical Ventilator Milano Controller 65
Andrea Bombarda, Silvia Bonfanti, and Angelo Gargantini

Locality-Based Test Selection for Autonomous Agents 73
Sina Entekhabi, Wojciech Mostowski, Mohammad Reza Mousavi, and Thomas Arts

Improving Model Inference via *W*-Set Reduction 90
Moritz Halm, Rafael S. Braz, Roland Groz, Catherine Oriat, and Adenilso Simao

Using Ant Colony Optimisation to Select Features Having Associated Costs . 106
Alfredo Ibias, Luis Llana, and Manuel Núñez

Initial Results on Counting Test Orders for Order-Dependent Flaky Tests Using Alloy 123
Wenxi Wang, Pu Yi, Sarfraz Khurshid, and Darko Marinov

Metamorphic Testing of Logic Theorem Prover 131
Oliver A. Tazl and Franz Wotawa

AI-based Techniques

Creation of Human-friendly Videos for Debugging Automated GUI-Tests . . . 141
Jianwei Shi and Kurt Schneider

Combining Holistic Source Code Representation with Siamese Neural Networks for Detecting Code Clones . . . 148
Smit Patel and Roopak Sinha

Robustness Analysis of Deep Learning Frameworks on Mobile Platforms . . . 160
Amin Eslami Abyane and Hadi Hemmati

Use Cases

Specification and Validation of Numerical Algorithms with the Gradual Contracts Pattern . . . 181
René Fritze and Stephan Rave

Solving the Instance Identification Problem in Micro-service Testing . . . 189
Theofanis Vassiliou-Gioles

On the Quality of Network Flow Records for IDS Evaluation: A Collaborative Filtering Approach . . . 196
Marta Catillo, Andrea Del Vecchio, Antonio Pecchia, and Umberto Villano

GROOT: A GDPR-Based Combinatorial Testing Approach . . . 210
Said Daoudagh and Eda Marchetti

Appendix – Project Reports

H2020 DIGITbrain – Advanced Digital Twins for Manufacturing . . . 221
Antonio M. Ortiz, Jeanett Bolther, Carolina Salas, Luong Nguyen, and Monika Rakoczy

Definition and Assessment of Security and Service Level Agreements (Project Report) . . . 224
Huu Nghia Nguyen and Edgardo Montes de Oca

Attack Configuration Engine for 5G Networks . . . 227
Zujany Salazar, Huu Nghia Nguyen, Wissam Mallouli, Ana R. Cavalli, and Edgardo Montes de Oca

The BIECO Conceptual Framework Towards Security and Trust in ICT Ecosystems 230
Ricardo Silva Peres, Lilian Adkinson, Emilia Cioroaica, Eda Marchetti, Enrico Schiavone, Sara Matheu, Ovidiu Cosma, Radosław Piliszek, and José Barata

Industrial Machine Learning for Enterprises (IML4E) 233
Jürgen Großmann and Jukka K. Nurminen

NLP-based Testing and Monitoring for Security Checking 235
Andrey Sadovykh, Zujany Salazar, Wissam Mallouli, Ana R. Cavalli, Dragos Truscan, Eduard Paul Enoiu, Rosa Iglesias, and Olga Hendel

Author Index 239