GUEST EDITORIAL

Guest editorial to the special section on SEFM'22

Bernd-Holger Schlingloff[1,2] · Ming Chai[3]

© The Author(s) 2024

This special section contains revised and extended versions of selected papers from SEFM'22, the 20th International Conference on Software Engineering and Formal Methods, held in Berlin, Germany, on September 28–30, 2022.

The SEFM conference series aims to bring together researchers and practitioners from academia, industry and government, to advance the state of the art in formal methods, to facilitate their uptake in the software industry, and to encourage their integration within practical software engineering methods and tools. The year 2022 marked the 20th anniversary of the series. Within these 20 years, the field has matured and extended focus: Whereas already in the 1st edition, which was held 2003 in Brisbane, topics like verification, testing, object-oriented modelling and integration of formal and informal methods prevailed, today additional topics like verification of machine learning, program synthesis from formal specifications, and correctness of cyber-physical and multi-agent systems have been added to the range. To reflect this extension, "Software Engineering and Formal Methods for Intelligent and Learning Systems" had been declared to be a topic with special emphasis at SEFM'22.

Besides five attached workshops, SEFM'22 featured a summer school with lectures on software verification, reliable autonomous systems, design of self-adaptive systems, and algebraic specification. The event was jointly organised by the Institute of Computer Science of Humboldt University Berlin (DE) and the School of Electronic and Information Engineering of Beijing Jiaotong University (CN). We also kindly acknowledge the support of Fraunhofer FOKUS, the Fraunhofer Institute for Open Communication Systems, Berlin.

Following the call for papers, there were 68 announced submissions to SEFM'22, of which six were retracted or not submitted in time. The remaining 62 submissions were each reviewed by three reviewers; the program committee selected 22 for presentation at the conference. From these, seven papers were invited to submit revised and extended versions of their contribution to this special section. The revisions should reflect the discussions after the presentation, and include full expositions of ideas and proofs which had been cut short in the conference version. The respective submissions underwent a second round of reviewing, where each paper was thoroughly reviewed by three new reviewers. Finally, after additional modifications and improvements, the five papers which you can find subsequently were accepted to this special section.

The resulting selection presents a good cross section of cutting-edge research in formal methods for software engineering and systems modelling:

In the paper "User journey games: automating user-centric analysis", whose predecessor won the SEFM'22 best paper award, Paul Kobianka, Silvia Lizeth Tapia Tarifa, Gunnar Rye Bergersen and Einar Broch Johnsen formalise how users manoeuver through a service, in order to provide support for companies in analysing and guiding the user interaction and improving customer experience.

The paper "Learning minimal automata with recurrent neural networks" by Andrea Pferscher, Bernhard Aichernig, Sandra König, Cristinel Mateis, and Martin Tappler sheds a new light on the automated generation of finite automata from input–output traces via artificial intelligence: They show that a constrained training approach can significantly improve the effectiveness towards minimization of the generated Mealy machines.

Pedro Antonino, Juliandson Ferreira, Augusto Sampaio, Bill Roscoe, and Filipe Arruda study formal specifications of smart contracts in their paper "A refinement-based approach to safe smart contract deployment and evolution". They propose a specification formalism and a notion of specification refinement for smart contracts in a blockchain, and a methodology for checking it.

Jan Haltermann and Heike Wehrheim deal with the problem of distributed verification of programs. In their paper

✉ Bernd-Holger Schlingloff
hs@informatik.hu-berlin.de

[1] Humboldt University, Berlin, Germany

[2] Fraunhofer FOKUS, Berlin, Germany

[3] Beijing Jiaotong University, Berlin, Germany

"Exchanging information in cooperative software validation" they show how to coordinate several over- and underapproximative analyses via so-called general information exchange automata, which can yield a significant speedup in verification and test generation processes.

The fifth contribution of this special section, "On applying residual reasoning within neural network verification" by Yizhak Elboher, Elazar Cohen, and Guy Katz, elaborates on the special emphasis topic of SEFM'22. The authors improve abstraction-based verification of neural networks by reusing information acquired when verifying an abstract network in order to facilitate the verification of refined networks. In benchmarks, they were able to achieve a significant performance increase in the verification of adversarial robustness and other safety properties.

We thank all authors and reviewers for their contributions, and their patience with the reviewing process. Moreover, we thank the editorial team of Springer, in particular, Martin Schindler, for the continuous support in the collection of this special section.

Berlin and Beijing, March 2024 Holger Schlingloff and Ming Chai.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Bernd-Holger Schlingloff is chief scientist of Quality Engineering at the Fraunhofer Institute for Open Communication Systems FOKUS, and professor for software engineering at Humboldt University, Berlin. Furthermore, he is chairman of the boards of the applied research associations GFaI e.V. and ZeSys e.V. His main interests are specification, verification and testing of embedded safety-critical software. He obtained his PhD from the Technical University of Munich in 1990 with a thesis on temporal logic of trees; after that, he visited Carnegie-Mellon-University, Pittsburgh, where he worked on model checking of real-time systems. After his return, he was associate professor at the TU Munich and, from 1997 to 2001, managing director of the Bremen Institute for Safe Systems within the Center for Computing Technologies, Bremen. His habilitation treatise in 2001 was on partial state space of safety-critical systems. Since 2002, when he joined Fraunhofer, he is managing industrial and European projects in the automotive, railway, and medical technology domain. His areas of expertise include quality assurance of embedded control software, model-based development and model checking, logical verification of requirements, static analysis, and automated software testing.

Ming Chai is the deputy director and an associate professor of Train Intelligent Control Technology Research Institute at the School of Automation and Intelligence, Beijing Jiaotong University. His main interests include intelligent train control and optimization, formal verification and testing for train control systems. He obtained his PhD from Humboldt University of Berlin with a thesis on runtime verification of train control systems in 2016. After that, he participated in developing a V2V communication-based train control system and an automatic train controller for virtually coupled trains. His areas of expertise include designing, verifying, and testing of railway train control systems, and methods of train control and operation optimization.