



Preface for the formal methods in system design special issue on ‘Formal Methods 2021’

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This special issue includes articles based on selected case study and tool presentations from the 24th International Symposium on Formal Methods, FM 2021, a Virtual Event organized by Institute of Software, Chinese Academy of Sciences and Formal Methods Europe (FME), that was held on November 20–26, 2021. Formal Methods 2021 received a total of 161 abstract submissions, which resulted in 131 full paper submissions from authors in 28 different countries, and from which 33 full papers and two short tool papers were accepted. The topics covered include the development and application of formal methods in a wide range of domains including software, cyber-physical systems and integrated computer-based systems.

The special issue contains the following five contributions:

- *Runtime Verification of Real-Time Streams Using HStriver* by Felipe Gorostiaga and Cesar Sanchez. HStriver is a tool that can perform stream runtime verification on event streams by relying on an extensible DSL embedded in the Haskell programming language. The article describes the architecture and usage of the tool and its DSL, provides an overview of the underlying algorithm for computing output streams, and illustrates example specifications.
- *Fingerprinting and Analysis of Bluetooth Devices with Automata Learning* by Andrea Pferscher and Bernhard K. Aichernig. The article presents an application of active automata learning to analyze Bluetooth Low Energy (BLE) implementations incorporated in peripherals, with the goal of obtaining output queries for fingerprinting the implementations. These can be used by an attacker to exploit implementation-specific vulnerabilities.

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- *Integrating ADTs in KeY and their Application to History-based Reasoning* by Jinting Bian, Hans-Dieter Hiep, Frank De Boer and Stijn De Gouw. This article describes an integration of KeY with Isabelle/HOL, allowing data types defined in HOL, together with lemmas proved in Isabelle/HOL, to be imported into KeY for use in specs and proofs.
- *The Probabilistic Termination Tool Amber* by Marcel Moosbrugger, Ezio Bartocci, Joost-Pieter Katoen and Laura Kovács. Amber is an open-source tool that takes as input a polynomial probabilistic program and automatically analyzes its termination behavior. The tool can prove/disprove both Almost-Sure Termination (AST) and Positive Almost-Sure Termination (PAST). The article presents the programming model, the workflow of the algorithm and an experimental evaluation comparing the tool with several state-of-the-art tools showing promising results.
- *Concise Outlines for a Complex Logic: A Proof Outline Checker for TaDA* by Felix A. Wolf, Malte Schwerhoff and Peter Müller. The article presents Voila, a proof outline checker based on TaDA, a logic aimed at proving the abstract atomicity of a program based on separation logic. The proof outline checker reduces the burden of using a particular logic, e.g. TaDA here, by introducing some level of automation. Voila is built on top of Viper, a well-established tool based on permission logic (a variant of separation logic) for building verification tools.

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