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Software Verification

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New Haven, CT, USA, October 18–19, 2021
and 14th International Workshop, NSV 2021
Los Angeles, CA, USA, July 18–19, 2021
Revised Selected Papers

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VSTTE 2021 Preface

This volume contains the papers presented at the 13th Working Conference on Verified Software: Theories, Tools, and Experiments (VSTTE 2021), held virtually during October 18–19, 2021. The conference was co-located with the 21st Conference on Formal Methods in Computer-Aided Design (FMCAD 2021).

The Verified Software Initiative (VSI), spearheaded by Tony Hoare and Jayadev Misra, is an ambitious research program for making large-scale verified software a practical reality. VSTTE is the main forum for advancing the initiative. VSTTE brings together experts spanning the spectrum of software verification in order to foster international collaboration on the critical research challenges.

There were 17 submissions to VSTTE 2021, with authors from 11 countries. The Program Committee consisted of 23 distinguished computer scientists from all over the world. Each submission was reviewed by three Program Committee members in single-blind mode. In order to obtain domain-specific expertise, we also involved seven external reviewers: Robby Findler, Antti Hyvärinen, Makai Mann, Andres Noetzli, Rodrigo Otoni, Alex Ozdemir, and Daniel Riley. After a comprehensive discussion on the strengths and weaknesses of papers, the committee decided to accept seven papers. The technical program also included two invited talks by Tom Henzinger (IST Austria) and Michael Whalen (Amazon Web Services and University of Minnesota, USA), as well as two invited tutorials (joint with FMCAD) by Matteo Maffei (TU Wien, Austria) and Frits Vaandrager (Institute for Computing and Information Sciences, Radboud University Nijmegen, The Netherlands). We greatly appreciate the help we got from the members of the Formal Verification Lab of the University of Lugano, Switzerland, and in particular from Masoud Asadzadeh for setting up and maintaining the VSTTE website. We are thankful to EasyChair for providing an easy and efficient mechanism for submission of papers and management of reviews.

December 2021

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Natasha Sharygina

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NSV 2021 Preface

This volume contains the contributed papers presented at the 14th International Workshop on Numerical Software Verification (NSV 2021), which was held virtually during July 18–19, 2021. NSV 2021 was co-located with the 33rd International Conference on Computer-Aided Verification (CAV 2021).

Numerical computations are ubiquitous in digital systems: supervision, prediction, simulation, and signal processing rely heavily on numerical calculus to achieve desired goals. Design and verification of numerical algorithms has a unique set of challenges, which set it apart from the rest of software verification. To achieve the verification and validation of global properties, numerical techniques need to precisely represent local behaviors of each component. The implementation of numerical techniques on modern hardware adds another layer of approximation because of the use of finite representations of infinite precision numbers that usually lack basic arithmetic properties, such as commutativity and associativity. Finally, the development and analysis of cyber-physical systems (CPS), which involve interacting continuous and discrete components, pose a further challenge. It is hence imperative to develop logical and mathematical techniques for the reasoning about programmability and reliability. The NSV workshop is dedicated to the development of such techniques.

This edition of NSV had strong emphasis on the challenges of the verification of cyber-physical systems with machine learning components. This topic was featured both in invited presentations and in contributed papers.

A highlight of NSV 2021 was the presence of high-profile invited speakers from computer science and from control theory, who gave the following talks:

- Stanley Bak (Stony Brook University, USA):
  "Verifying Neural Networks and Cyber-Physical Systems using Reachability"
- Eva Darulova (Max Planck Institute for Software Systems, Germany):
  "Soundly Approximating Numerical Kernels & Beyond"
- Sanjit A. Seshia (University of California, Berkeley, USA):
  "Verified AI-Based Autonomy: A Numerical Software Perspective"
- Yu Wang (Duke University, USA):
  "Statistical Verification of Hyperproperties for Cyber-Physical Systems"
- Bai Xue (State Key Laboratory of Computer Science, Institute of Software, Chinese Academy of Sciences, China):
  "Convex Computations for Reach Sets"

Regarding the contributed papers, NSV 2021 received three submissions, each of which received three or four reviews, and all of the submissions were accepted. We would like to thank the CAV 2021 organizers, in particular, the workshop chair Arie

Gurfinkel, for their support and the organization of the video conferencing and messaging system, and the NSV Steering Committee, in particular Sergiy Bogomolov, for giving us the opportunity to organize NSV 2021.

December 2021

Rayna Dimitrova
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