



UNIVERSITÀ
di VERONA
Dipartimento
di INFORMATICA



Second Summer School on

Formal Methods for Cyber-Physical Systems

Verona, 3-7 June 2019

The School on Formal Methods for Cyber-Physical Systems addresses the foundations, techniques, and tools for analysis, verification, control, synthesis, implementation, and applications of cyber-physical systems (CPS). Applications mainly deal with engineering and natural systems, including signal circuits, robotics, automotive and avionics, large-scale infrastructure networks, as well as biochemical and physiological processes.

Title

Numerical and Symbolic Methods for Reachability Analysis of Hybrid Systems

Abstract

Hybrid systems are complex dynamical systems that combine discrete and continuous components. As such, they represent a sufficiently rich model for describing cyber-physical systems in their full complexity. Reachability questions, regarding whether a system can reach a certain subset of its state space, stand at the core of verification problems for hybrid systems.

The school focuses on applied verification for continuous and hybrid systems. Verification is increasing in importance due to the emergence of cyber-physical systems that are safety- or operation-critical. This school in particular addresses reachability analysis techniques, with a special focus on the transfer from theory to practice.

Technical Theme

There are several successful methods for verification of hybrid systems based on reachability analysis. Some methods explicitly construct flow-pipes that approximate the set of reachable states over time. In that case, proper control of the numerical error is a particularly important aspect, possibly suggesting the use of symbolic representations in order to obtain an efficient and effective computation of the resulting over-approximations. Other methods based on satisfiability checking technologies symbolically encode reachability properties as logical formulas, while solving such formulas requires numerically-driven decision procedures. Finally, automated deduction by means of theorem provers is able to lead to efficient analysis

approaches while avoiding the numerical criticalities mentioned above. The goal of this school is to discuss different reachability analysis techniques aimed at verification of hybrid systems (either deterministic or stochastic/probabilistic) and to promote synergies among the different approaches.

Outline of the Topics

The scope of the school includes, but is not restricted to, the following topics:

- Reachability analysis approaches for hybrid systems
- Flow-pipe construction
- State set representations and operations
- Trajectory generation from symbolic paths; counterexample computation
- Abstraction techniques for hybrid systems
- Reliable integration
- Automated deduction
- Stochastic/probabilistic hybrid systems
- Logics to reason about hybrid systems
- Domain-specific approaches in biology, robotics, etc.
- Tools, benchmarks, and case studies

Organizing Committee

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Registration Fees Structure

Free for PhD students and researchers from the University of Verona, otherwise 150 euros for PhD students, 200 euros for researchers (PostDocs, etc.) from other institutions.

Tentative Program

Period: 3-7 June 2019

The event will consist of three and a half days of lectures, along with demonstration and laboratory sessions, followed by a one day workshop covering the same topics. Lectures will start on Monday, June the 3rd in the morning (around 8:30) and will be concluded around 13:00 on Thursday afternoon. The Workshop will be held on Thursday afternoon and on Friday morning, ending around 13:00. A social dinner is planned, which will be tentatively held on Wednesday the 5th.

We plan to allocate 7 hours (i.e., 60 minutes) per day, specifically 4 morning hours and 3 afternoon hours, ending each working day by 17:00~17:30. The overall time budget for lectures will be 25 hours. For the Workshop, the budget will be 7 hours, with 50 minutes slots which include any discussions.

Acknowledgements

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