Colloquium d'Informatique de Sorbonne Université

Edward A. Lee

Tuesday 25 February 2020

https://www.lip6.fr/colloquium/?guest=Lee

Program

Master classes from 14:00 to 15:40 (Room 24-25/405)

14:00–14:25 François Bidet (LIX, École Polytechnique)
Over- and under-approximation of the reachable set of nonlinear hybrid systems with arbitrary time-varying uncertainties

14:25–14:50 Ismail Lahkim Bennani (École Normale Supérieure)
Falsification of hybrid systems using automatic differentiation

14:50–15:15 Thomas Garbay (LIP6, Sorbonne Université)
Zip-CNN

15:15–15:40 Ning Tang (LIP6, Sorbonne Université)
Evaluation of Age Latency of Real-Time system with LET communication paradigm

Cocktail at 17:15 (in front of Amphi 34A)

Colloquium at 18:00 (Amphi 34A)

Reactors for Real-Time Systems

Master classes – Abstracts

- **Over- and under-approximation of the reachable set of nonlinear hybrid systems with arbitrary time-varying uncertainties**

  François Bidet

  The under-approximation of a reachable set is a set such that for every point, there exists a trajectory of the system's state passing through it. The under-approximation is able to prove that the system can reach some unsafe state, whereas the over-approximation of the reachable set is only able to prove that the system stays safe. From the work of Éric Goubault and Sylvie Putot, the under-approximation can be computed using the mean-value theorem with the over-approximation and the influence of the initial state upon it. This work is about providing a procedure to compute these approximations for hybrid automata with arbitrary time-varying uncertainties, where the influence of the initial state is harder to track due to transitions and uncertainties. We first focus on computing a tight over-approximation of such models, keeping dependencies on the initial state. In addition, we are adapting a compiler of the Zélus language, a synchronous language to model deterministic hybrid systems, to perform reachability analysis of the generated automaton.

- **Falsification of hybrid systems using automatic differentiation**

  Ismail Lahkim Bennani

  The falsification problem is a *property-based* testing problem where the goal is to find an input and an output of the system that contradict its specification. Hybrid systems are programs that combine continuous-time dynamics with discrete control. In these programs, values are continuous-time quantities and numerical variables are defined by ODEs. They are often used as models of embedded systems because they can express software (discrete control) and its environment (dynamical system).

  The state-of-the-art in falsification consists of tools that interpret a specification as a function from an input and an output (usually time-series, that is, sampled dynamics) to a float. The output of such a function is called *robustness*, it can be used as a score for a particular simulation run. These tools then solve the falsification problem using black-box optimization where the score function is the composition of the system and its quantitative specification. They use standard techniques such as Simulated Annealing or the Nelder-Mead algorithm.

  At the moment, my PhD focuses on trying to improve optimization by using gradient-based techniques. A first idea was to implement automatic differentiation for hybrid programs so as to compute the derivatives of the robustness with respect to the inputs of the system. We are also exploring using automatic differentiation to trigger mode switches in a program so as to ensure code coverage throughout test runs.

- **Zip-CNN**

  Thomas Garbay

  Deep learning algorithms proved many times their capacity to solve classification problems, surpassing other approaches. Regarding classification precision, results are impressive. But to embed these algorithms, you have to take into consideration other parameters like power consumption, memory needed or execution time. We develop a methodology to estimate, before the integration stage, the impact of deep learning algorithms on the embedded system, in terms of precision, energy consumption, memory space and execution time. We collaborate with Wisebatt, a spin-off from LIP6, specialized in battery life estimation of embedded systems to validate the new approaches.

- **Evaluation of Age Latency of Real-Time system with LET communication paradigm**

  Ning Tang

  The presentation is about mathematical tools to model precisely the dependency between task executions and an algorithm for computing age latency of a real-time system. These tools allow handling not only chain events but also general precedence graphs and extracting the critical part of a system.