An Example of Hybrid System: The Bouncing Ball

Hybrid systems combine
- Discrete behavior
- Continuous behavior

Parameterized Hybrid Automata

- Hybrid Automata (HA): Sets of variables, actions, locations, and discrete transitions
- Parameterized Hybrid Automata: HA augmented with a set of parameters (unknown constants)

Example: Water Tank

Parameter Synthesis for Hybrid Automata

- Inverse Method [Fribourg and Kühne, 2011]
  - Given an HA and a reference valuation \( \pi_0 \) for the parameters, synthesize a constraint \( K_0 \) guaranteeing the same time-abstract behavior as for \( \pi_0 \)

- Behavioral Cartography [André and Fribourg, 2010]
  - Performs a tiling of the parametric space, and partition it between good and bad tiles w.r.t. a given property

Example of “good” constraint for the water tank:

\[
M + \text{delay} \geq m \land m \geq \min + 2 \cdot \text{delay} \land \max \geq M + \text{delay}
\]

Features of HyMITATOR

- Algorithms of Parameter Synthesis for Hybrid Systems
  - Implements the inverse method and the behavioral cartography
  - Includes local partitioning with linear over-approximations
  - Makes use of predicate abstraction techniques
  - Features an efficient merging technique [André et al., 2012]

- User-friendly Features
  - Numerous options for analysis
  - Graphical output

- Implementation [André and Kühne, 2012]
  - Implemented in OCaml, using the Parma Polyhedra Library

Try it!

- Distributed under the GNU General Public License
  - www.lsv.ens-cachan.fr/Software/hymitator/

References