Projet VALMEM

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Analyse de SPSMALL avec IMITATOR 2

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Outline

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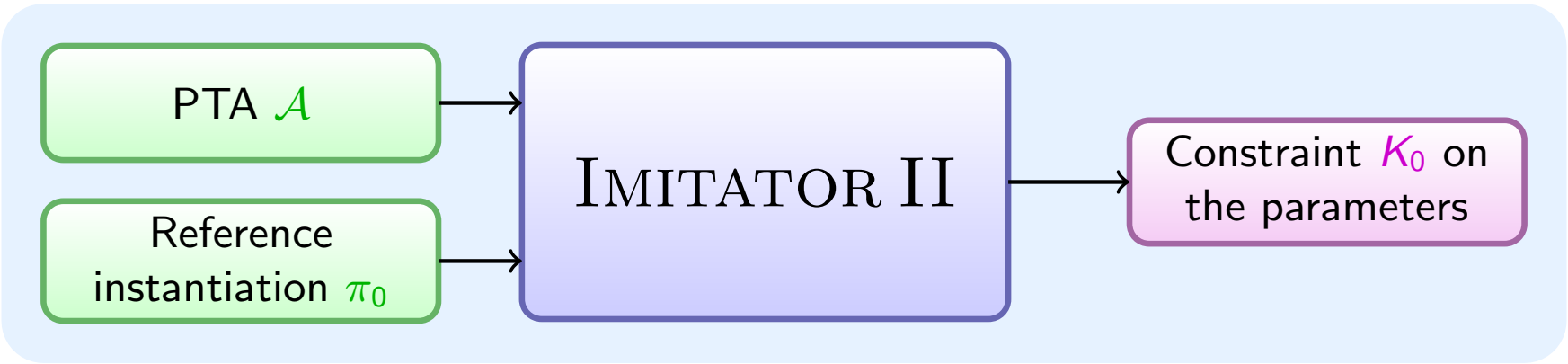
Inputs and Outputs



The General Idea of Our Method

Start with $K_0 = True$

REPEAT

1. Compute the set S of reachable parametric states under K_0
2. Refine K_0 by removing a π_0-incompatible state from S
   - Select a π_0-incompatible state (q, C) within S (i.e., $\pi_0 \not\models C$)
   - Select a π_0-incompatible inequality J within C (i.e., $\pi_0 \not\models J$)
   - Add $\neg J$ to K_0

UNTIL no more π_0-incompatible state in S

The Algorithm

Algorithm 1: *InverseMethod*$(\mathcal{A}, \pi_0)$

input : A PTA $\mathcal{A}$ of initial state s_0
input : Reference point π_0 of the parameters
output: Constraint K_0 on the parameters

1 $i \leftarrow 0$; $K_0 \leftarrow True$; $S \leftarrow \{s_0\}$
2 **while** $True$ **do**
3 **while** *there are* π_0*-incompatible states in* S **do**
4 Select a π_0-incompatible state (q, C) of S (i.e., s.t. $\pi_0 \not\models C$) ;
5 Select a π_0-incompatible J in C (i.e., s.t. $\pi \not\models J$) ;
6 $K_0 \leftarrow K_0 \wedge \neg J$;
7 $S \leftarrow \bigcup_{j=0}^{i} Post^j_{\mathcal{A}(K_0)}(\{s_0\})$;
8 **if** $Post_{\mathcal{A}(K_0)}(S) = \emptyset$ **then return** $K_0 \leftarrow \bigcap_{(q,C)\in S}(\exists X : C)$
9 $i \leftarrow i + 1$;
10 $S \leftarrow S \cup Post_{\mathcal{A}(K_0)}(S)$; // $S = \bigcup_{j=0}^{i} Post^j_{\mathcal{A}(K_0)}(\{s_0\})$

Features

- Improved Features
  - Optimization of the *InverseMethod* algorithm
    - ★ Do not start from the beginning at each iteration, but simply update the reachable states
    - ★ Increase speed
  - Dynamic computation of the reachable states
    - ★ Allow to treat more automata in parallel
    - ★ Increase speed
- New Features
  - Computation of the traces in both instantiated and parametric analysis
  - Implementation of a cartography algorithm (work in progress)

Implementation

- New standalone tool
  - About 8000 lines of code
  - No call to HyTech
  - Use of a standard library for polyhedra (Apron)
- Language: OCaml
  - Safety
  - Various facilities to build compilers
  - Interface with external libraries (Apron, PPL)

Outline

Abstract Model

- Model considered in the *Blueberry* project
  - Model built manually
  - File `spsmall_blueb_lsv`
- Abstraction of the memory for the write operation
  - 10 automata, 10 clocks, 26 parameters, 450 lines of code
- Constraint generated by IMITATOR II in 1 second (31 states, 30 transitions)
  - To be compared with 1 hour and 20 minutes using IMITATOR
- After projection onto T^D_{setup} and T^{Wen}_{setup}:

$$\begin{aligned} & 110 \geq T^D_{setup} \\ \wedge \quad & T^{Wen}_{setup} + 61 > T^D_{setup} \\ \wedge \quad & 54 > T^{Wen}_{setup} \\ \wedge \quad & T^{Wen}_{setup} > 46 \\ \wedge \quad & T^D_{setup} > 99 \end{aligned}$$

Generated Model

- Generated model
  - File `lsv`
  - Automatically generated by LIP6
  - 28 automata, 28 clocks, 62 parameters, 32 discrete variables, 1500 lines of code
- File successfully parsed and treated by IMITATOR II
- Inverse method fails after about 20 iterations (out of memory)
  - Too many states?
  - Bad representation of the constraints?

Full SPSMALL 1*2

- Full SPSMALL memory 1*2
  - File `sp_1x2_md_no`
  - Automatically generated by LIP6
  - 101 automata, 101 clocks, 200 parameters, 130 discrete variables, more than 6000 lines of code
- File successfully parsed by IMITATOR II
- Conversion to the abstract structure fails
  - Most probably a bad representation of the constraints (matrices)
  - Solution: use polyhedra instead of matrices

Future Works

- Improve the generated constraint
  - Use an extension of IMITATOR II allowing to get a maximal constraint
- Improve IMITATOR II
  - More efficient representation of the polyhedra (PPL?)
- In the VALMEM project
  - Analyze bigger parts of the SPSMALL memory
  - Fully automated analysis from the transistor level to the constraint K_0