Theory of Hybrid Systems Informatik 2
RWTH AACHEN UNIVERSITY

Satisfiability Checking - WS 2023/2024

Series 10

teaching@ths.rwth-aachen.de
https://ths.rwth-aachen.de/teaching/

Exercise 1: Interval arithmetic

Apply basic interval arithmetic as presented in the lecture.

$$x \in I_x = [-1; 3], y \in I_y = [2; 6]$$

Calculate:

1. $2 \cdot x + y$
2. $x^2 - 4 \cdot x + 7$
3. $x \cdot x \cdot y$
4. $\frac{2 \cdot x}{y}$
5. $z \in (3; 4]$, calculate: $x + z - y$

Exercise 2: Propagation

a) Given the following constraints

$$c_1 : 2 \cdot x - 3 \cdot y = 0, \qquad c_2 : x^2 - 2 \cdot y = 0,$$

perform two interval propagation steps with the first contraction method from the lecture. In each step choose the contraction candidate with the highest relative contraction (which you have to compute first). The initial intervals of x and y are $x, y \in [1; 10]$.

b) Given the constraints

$$a^2 + b^2 \leq 1 \text{ and } a \cdot b \geq 1$$

preprocessing yields the following equations and initial bounds:

		$a \in [-\infty; \infty]$
		$b \in [-\infty; \infty]$
c_1 :	$h_1 + h_2 \leq 1$	
c_2 :	$h_1 = a^2$	$h_1 \in [0; \infty]$
c_3 :	$h_2 = b^2$	$h_2 \in [0; \infty]$
c_4 :	$h_3 \geq 1$	
c_5 :	$h_3 = a \cdot b$	$h_3 \in [-\infty; \infty]$

Use the first contraction method from the lecture and propagate using these equations until one of the variable domains gets empty.

Exercise 3: Questions

Give a short answer to the following questions:

1. The ICP algorithm from the lecture maintains two threshold values as parameters. Describe the purpose of these values.
2. Which are the two events causing a split in the ICP algorithm presented in the lecture?
3. ICP is not a complete method. Why does it still make sense to use it as a preprocessing to a complete method, such as CAD or VS?