

# **Verimag - TEMA Toyota**

2017- 2018

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October 23, 2018

# Falsification of Cyber-Physical Systems (CPS)

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**Problem:** Finding behaviors that do not satisfy a specification

**Approach:** Falsification formulated as black-box optimization

## *Black-box optimization*

- Existing search methods (Genetic Algorithms, Evolutionary Strategies, Simulated Annealing, *etc.*)
- Pros: no gradient information required, large classes of problems (continuous/discrete), practical efficiency
- Cons: local optimum traps, no guarantee of global optimality

*Our goal:* exploit the advantages (CPS as black boxes) and propose a method to detect and escape local optima

# Coverage-based Combination of Search Methods

Two (orthogonal) measures defined on the search space

- *Coverage* to quantify search "exploration" progress (diversity of tested behaviors)
- *Robustness* to quantify "exploitation" progress (improvement of objective values)

## Results

- *Detection of local optima* by monitoring evolution of these measures
- Strategies to *combine search methods*, based on their exploration/exploitation features
- *Experiments*: on vehicle control benchmarks, the combination is more efficient (than search algorithms used individually)