9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Search-Based Testing and Automatic Reconfiguration of a Path Planner

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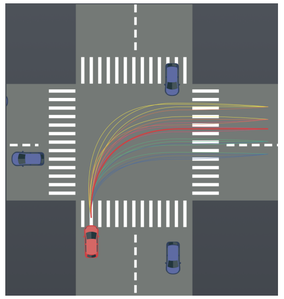
(1) Path planner for autonomous driving

We consider an industrial path planner (PP)
The PP decides the path to follow by

- enumerating a set of possible paths
- scoring them with a *weighted* cost function
- selecting the least costly one (e.g., red path in the figure)

The PP behavior depends on the cost function *weights*

We consider *alternative* versions of PP (by changing the weights)

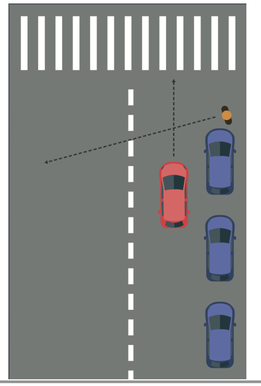


(2) Oracle problem in testing the PP

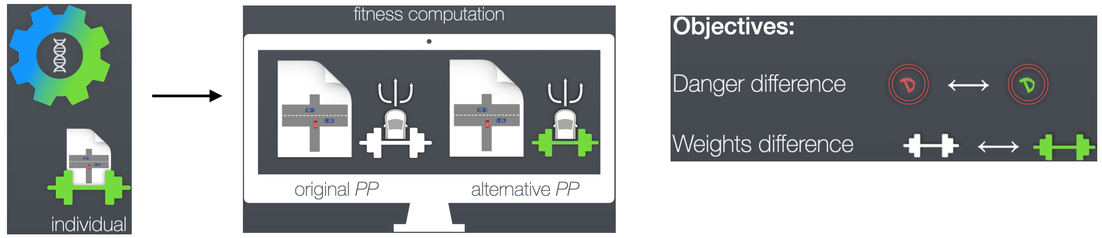
Testing the PP poses several challenges

- Huge search space
- *Oracle problem*
  - A collision is sometimes *unavoidable* (see example)
  - How to find collisions that are *avoidable*?

We deem a collision **avoidable** if the PP configured with different weights does not lead to a collision



(3) Searching for Avoidable Collisions [ICST'20]

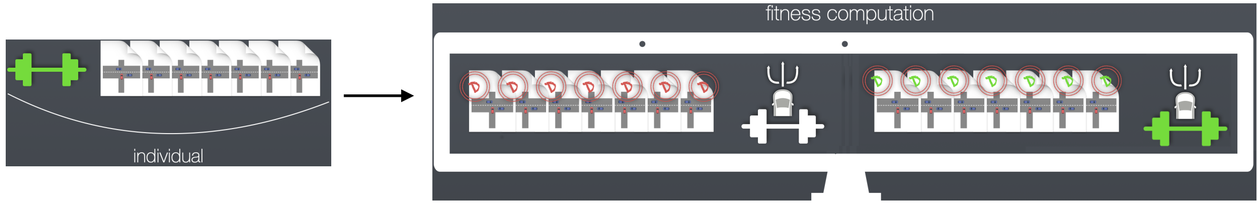


We proposed an approach based on genetic algorithms to find avoidable collisions

- A solution (individual) is a scenario and alternative weights
- Two objectives
  - Maximize the danger difference between the executions of the scenario in the original PP and in the alternative one
  - Minimize the difference between original and modified weights

The alternative weights for solving a collision may *overfit*, i.e., they do not solve other collisions (see solution in GECCO'20 work)

(4) Avoiding overfitting of solutions [GECCO'20]

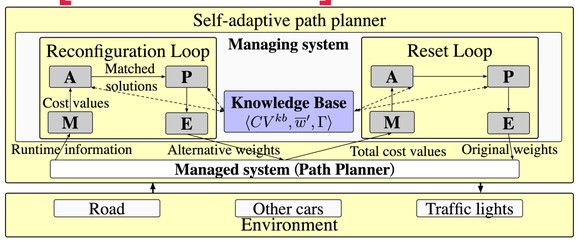


We proposed an approach for finding weights solving *multiple* collisions

- A solution (individual) is given by *multiple* scenarios and alternative weights
- Two objectives
  - Maximize the danger differences between the executions of the scenarios in the original PP and in the alternative one
  - Minimize the difference between original and modified weights

(5) Self-adaptive path planner [SEAMS'20]

- There is no *best* PP configuration
- We re-engineered the PP such that it modifies the weights at runtime (according to the observed environment)
- We follow the MAPE-K loop architecture



References

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