TLT: Multi-fidelity fusion for ADS testing

Olek Osikowicz

What will we do today?

- Introduction
- Multi-fidelity in practice (ADS testing)
- Discussion

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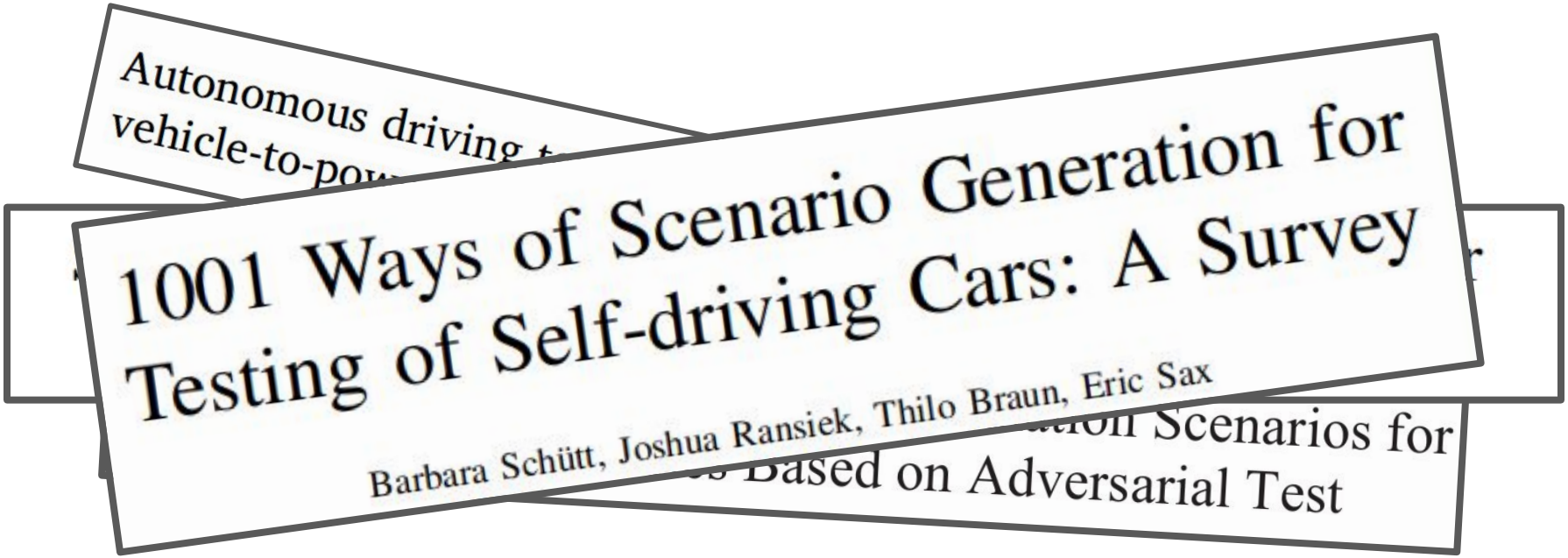
What kind of ADS testing?

- end-to-end
- black box
- scenario based

How does one generate scenarios?

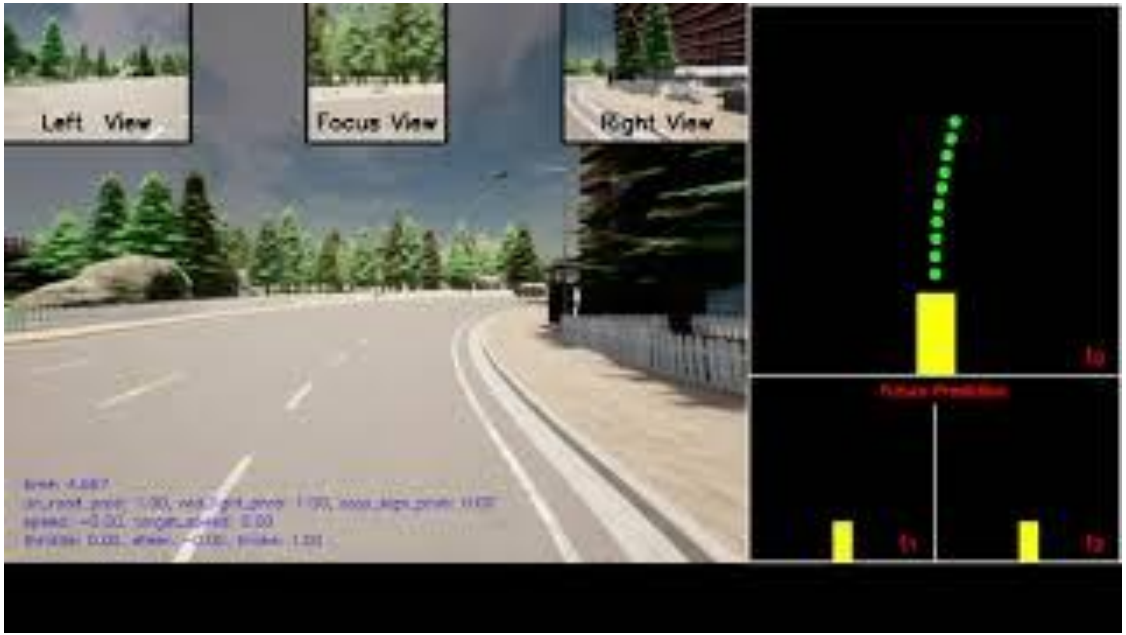


How does one generate scenarios?

In nutshell:

- A lot of involve generating iteratively many scenarios
- And executing them
- But there is one problem…

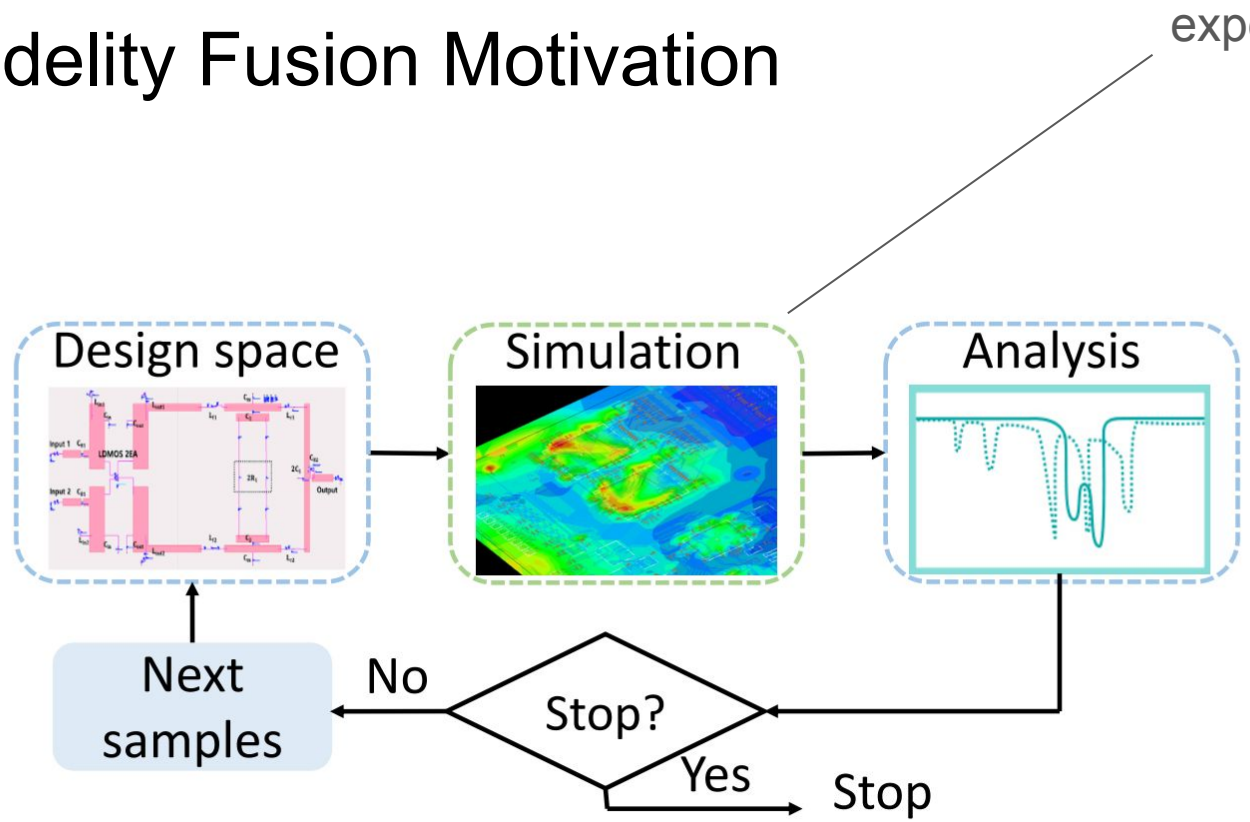
Problem: Running ADS scenarios is slow…



1s in simulation time ~ 5s real time

TLT: Multi-fidelity fusion for ADS testing

Multi-Fidelity Fusion Motivation



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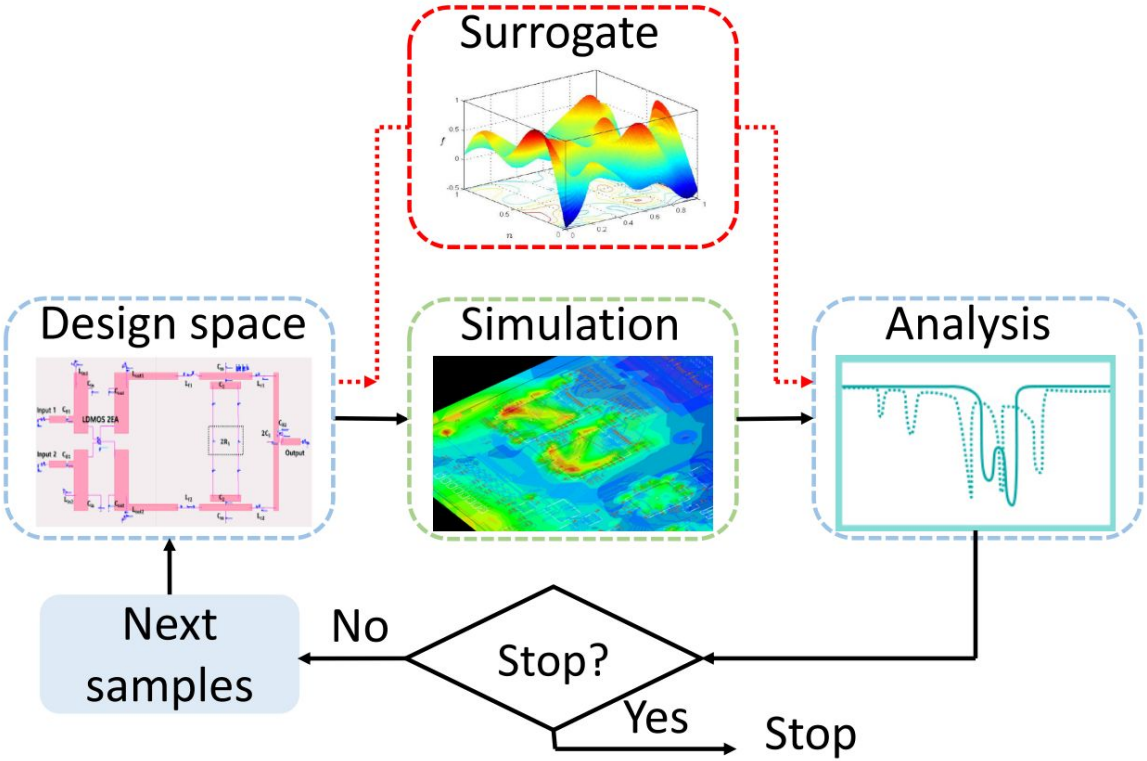
Multi-Fidelity Fusion Motivation



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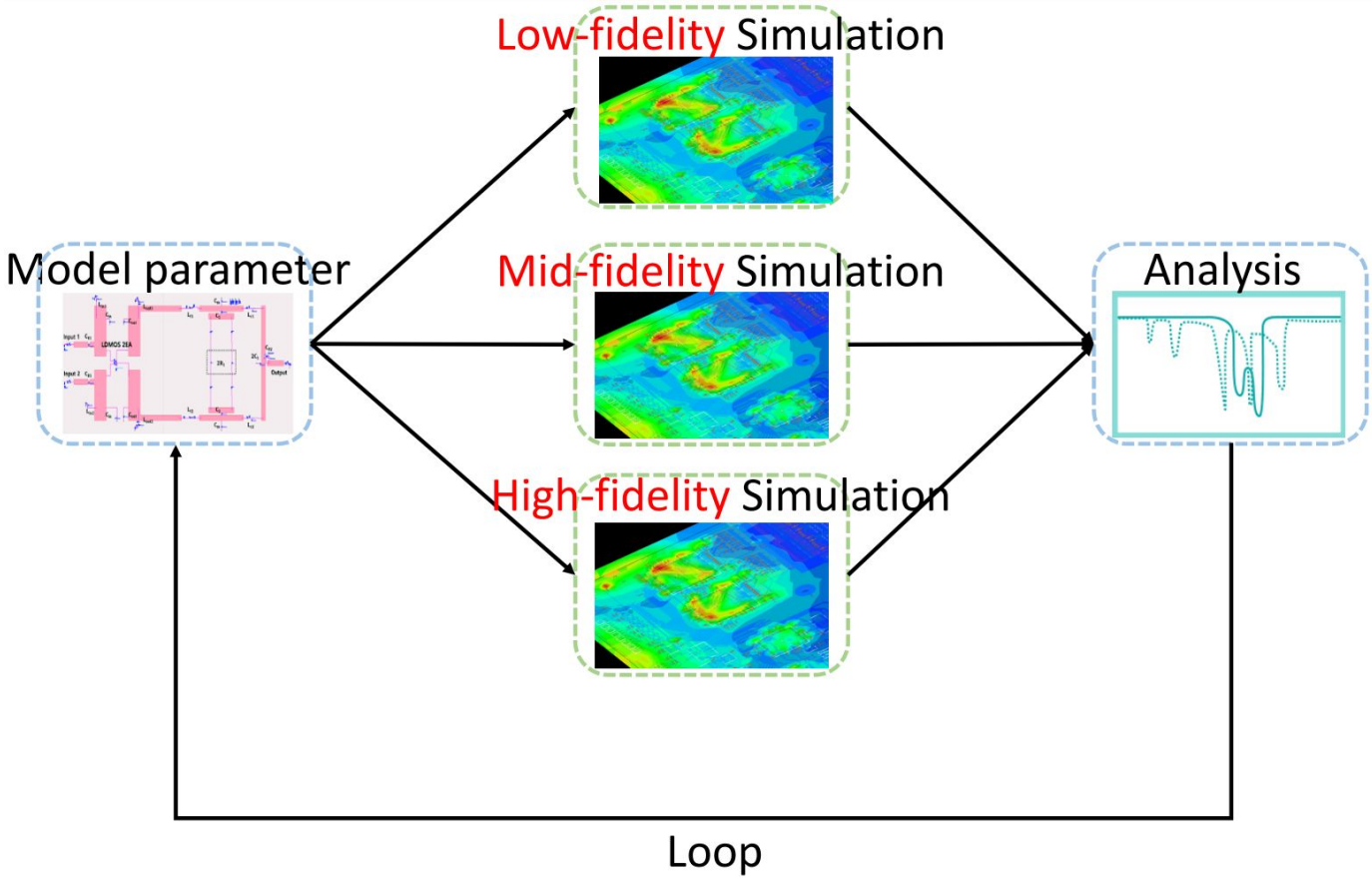

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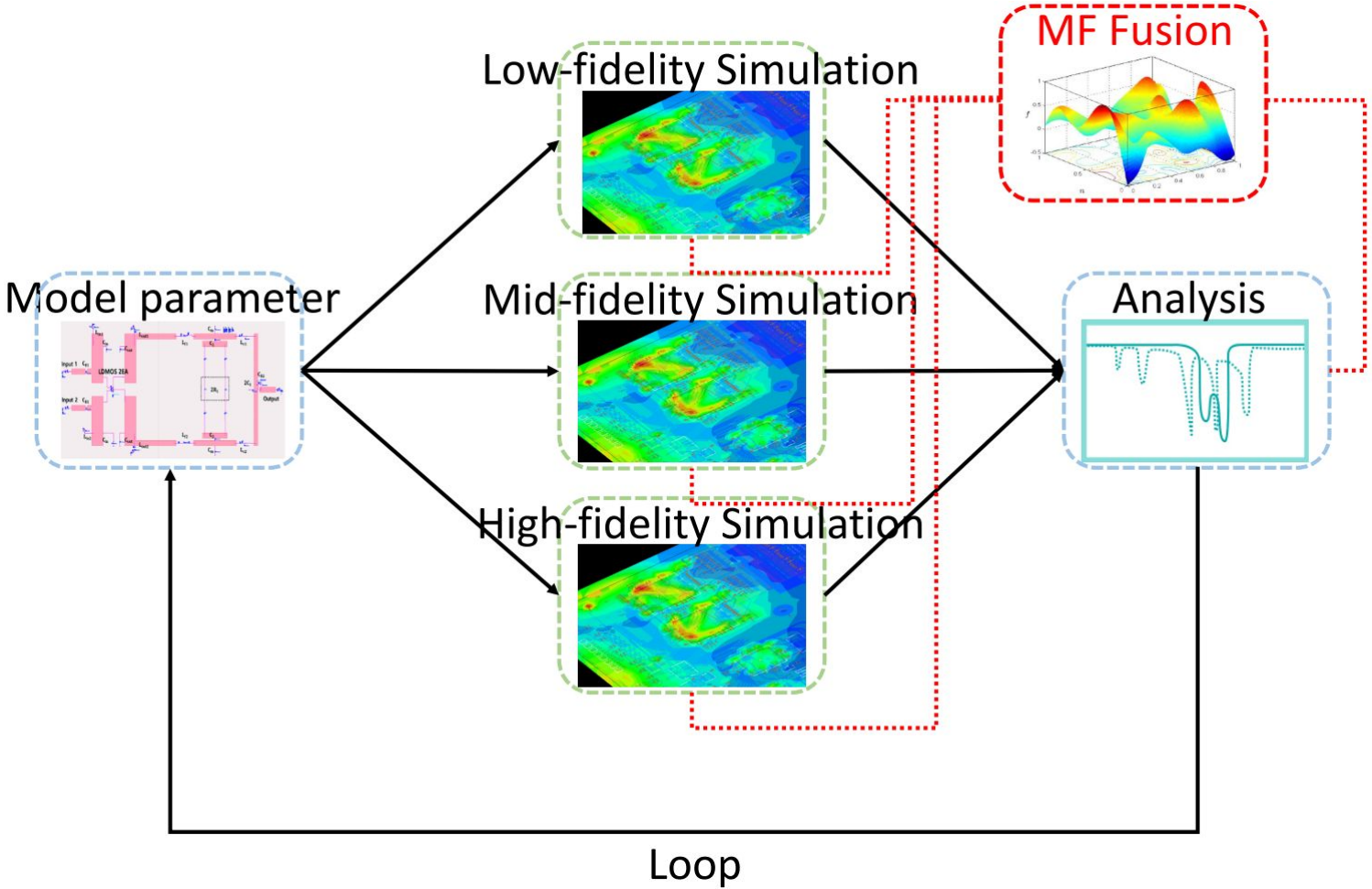

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General idea

Varying fidelity trade of:

- Quicker evaluation
- Less accurate results

\+ MF Fusion algorithm that puts that together

How to use it in your application

1. Find fidelity parameters you can change
2. Check if they reduce evaluation cost
3. Use FidelityFusion framework to optimize your search

What will we do today?

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Multi-fidelity in practice

Objective:

Reduce time it takes to run scenarios of CARLA

so we can execute more at same cost

1. Find fidelity parameters you can change

CARLA fidelity params:

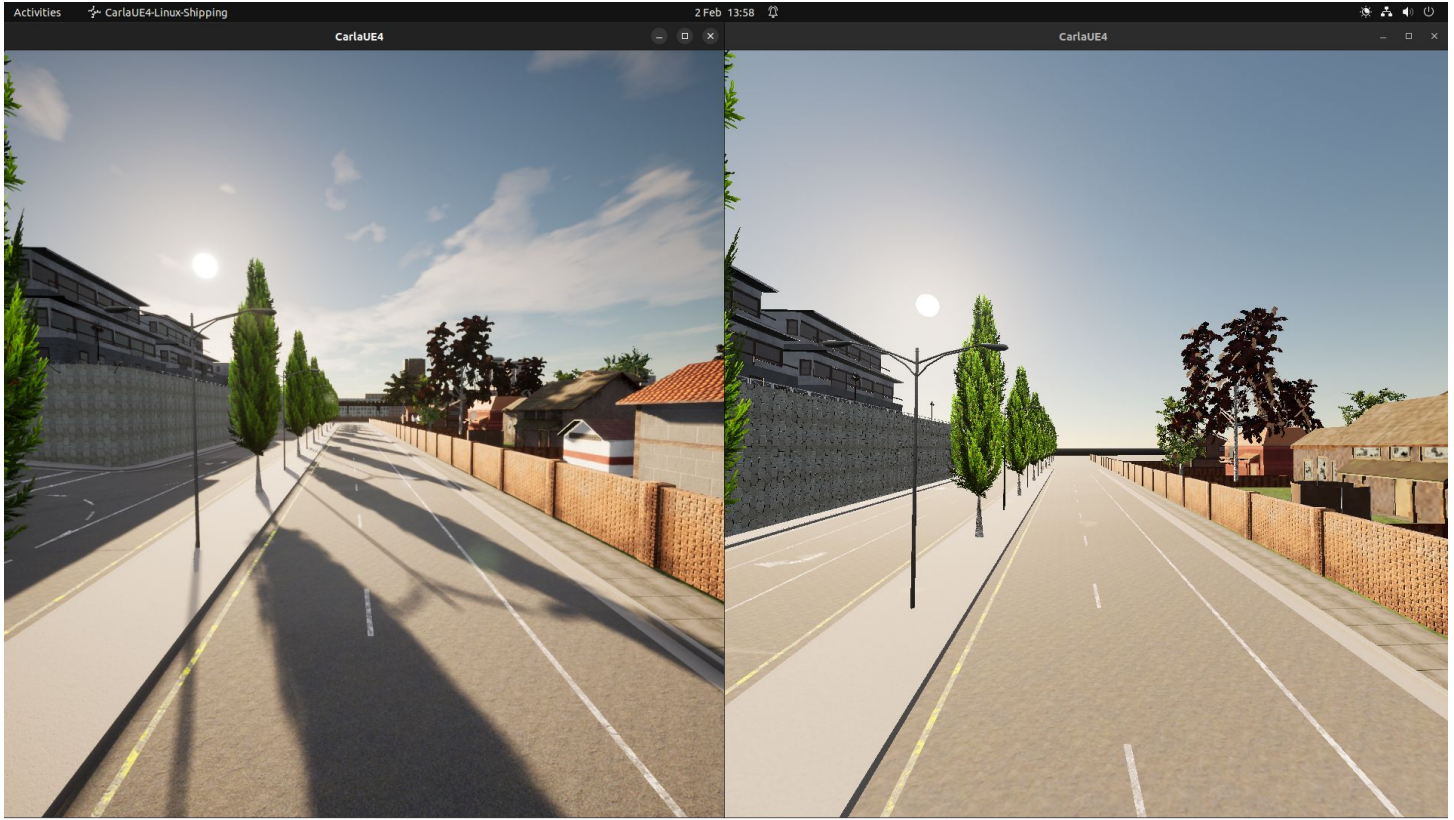
- Render quality
- Substepping (extra physics simulations)
- Frames per second (FPS)

CARLA render quality

‘Epic’ quality

‘Low’ quality

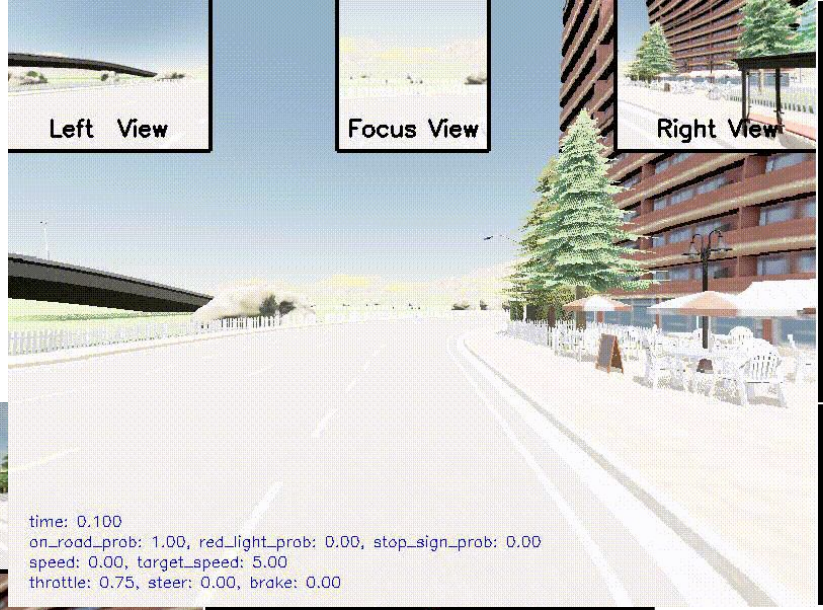
CARLA render quality

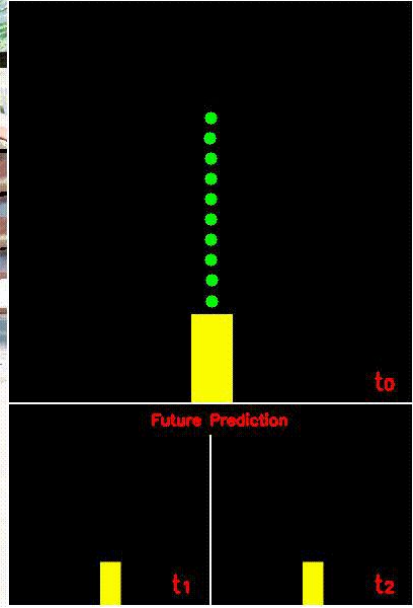


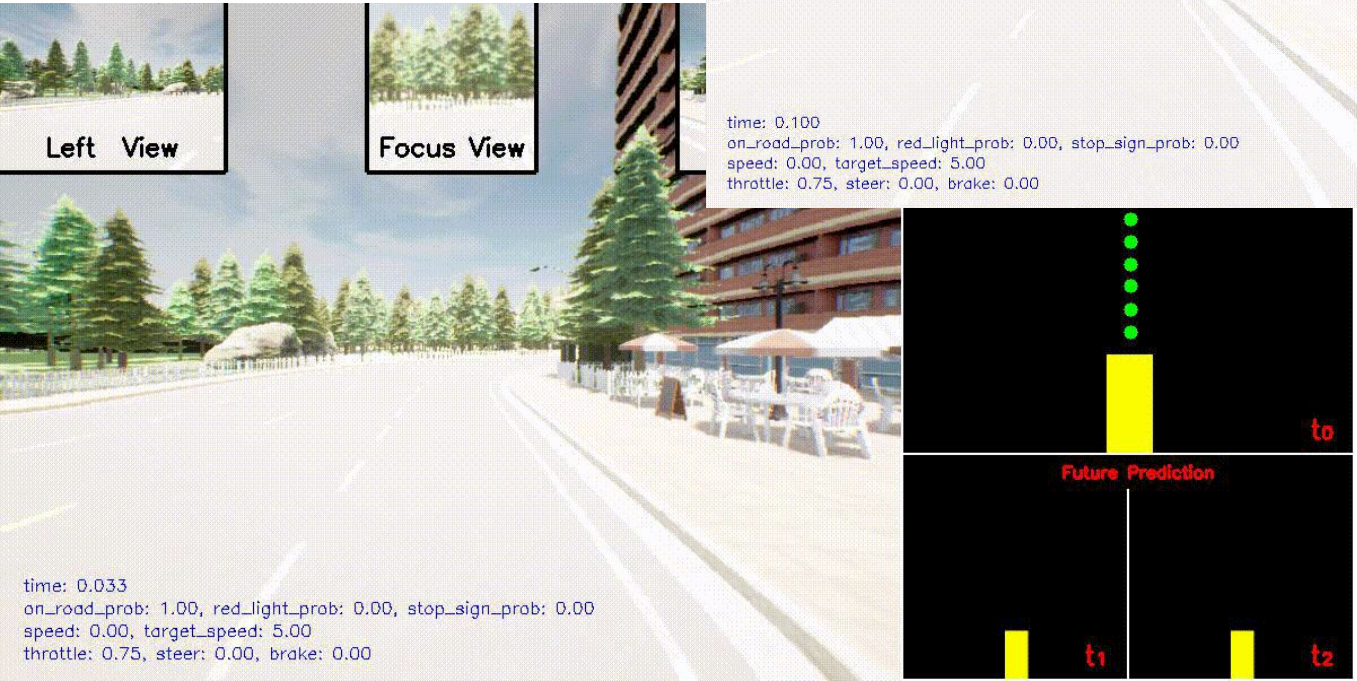
‘Epic’ quality

‘Low’ quality

10 FPS
‘Low’ graphics







30 FPS
‘Epic’ graphics

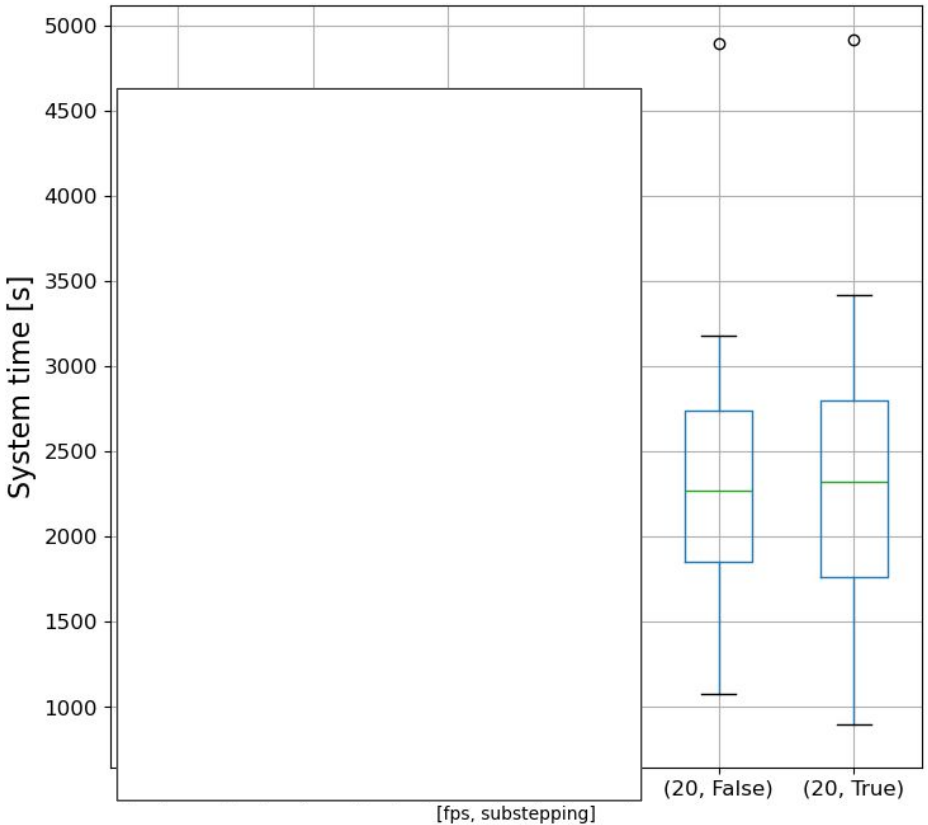
2. Check if fidelity params reduce evaluation cost

Expectation:

- The lower `FPS` the quicker the simulation is
- Turning off `substepping` reduces execution time

2. Check if fidelity params reduce evaluation cost

Reality:



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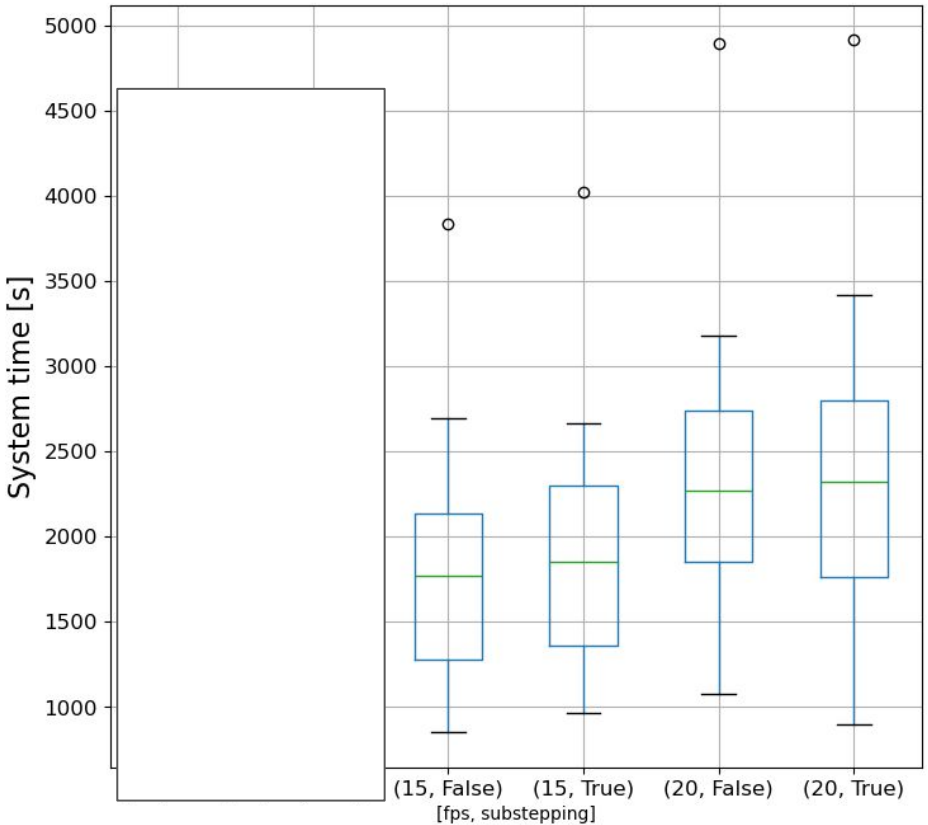

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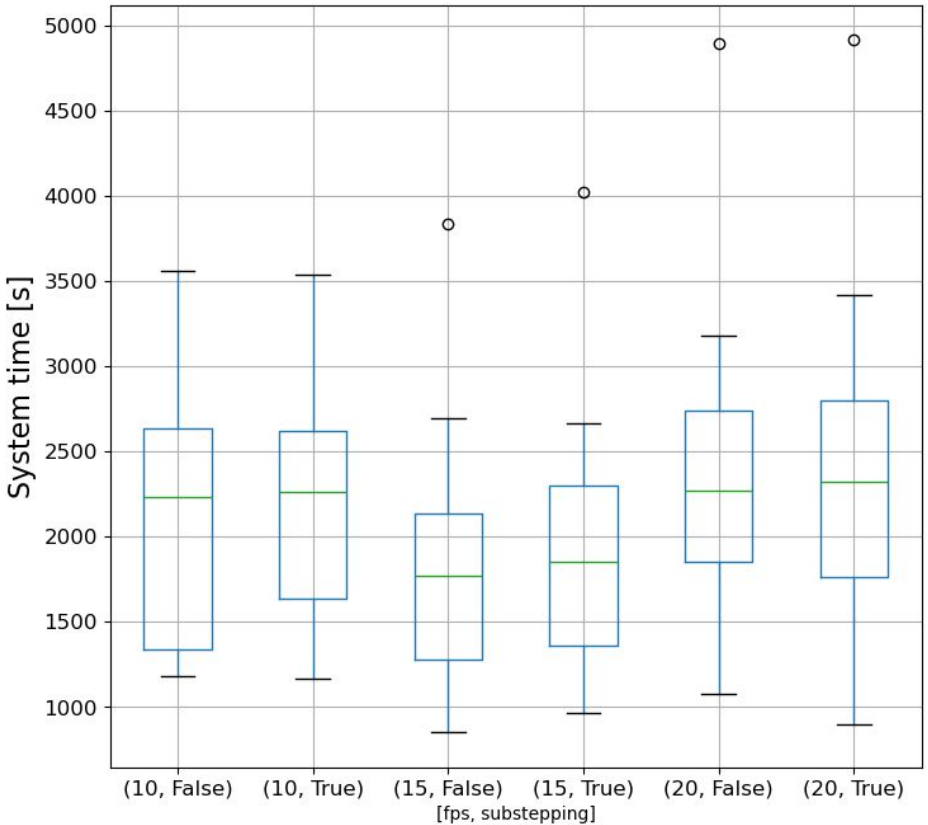

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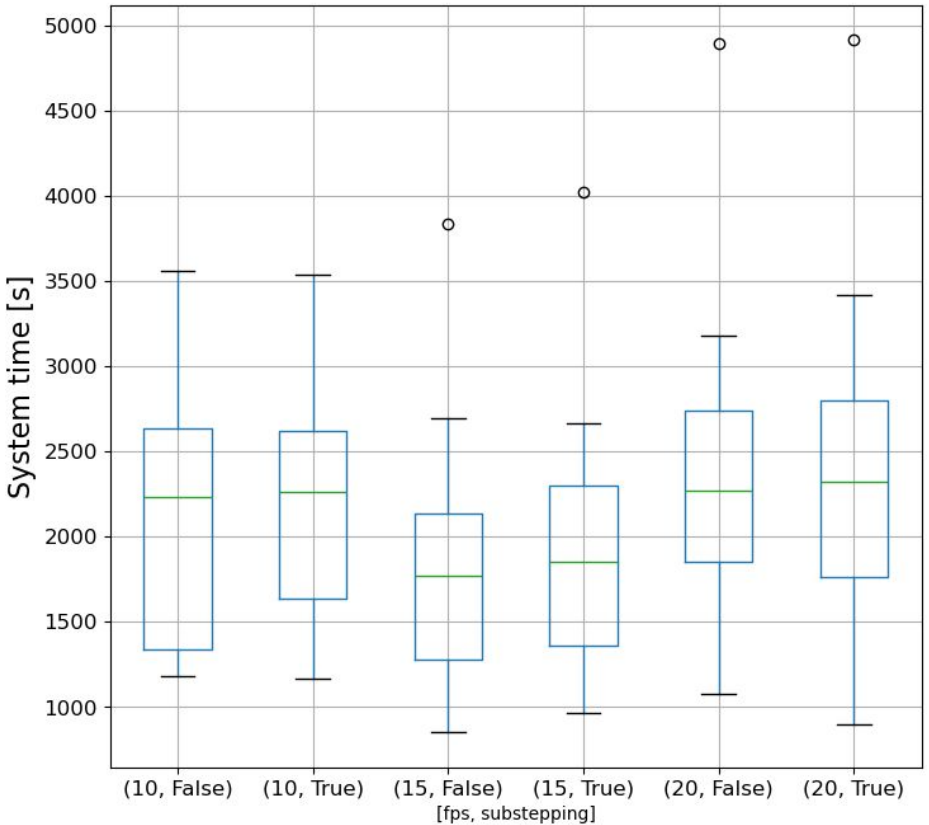


Why my results are ‘inconsistent’?

I don’t know... maybe:

- Hardware was not isolated (was working at the time)
- ADS is not deterministic
- Too little executions

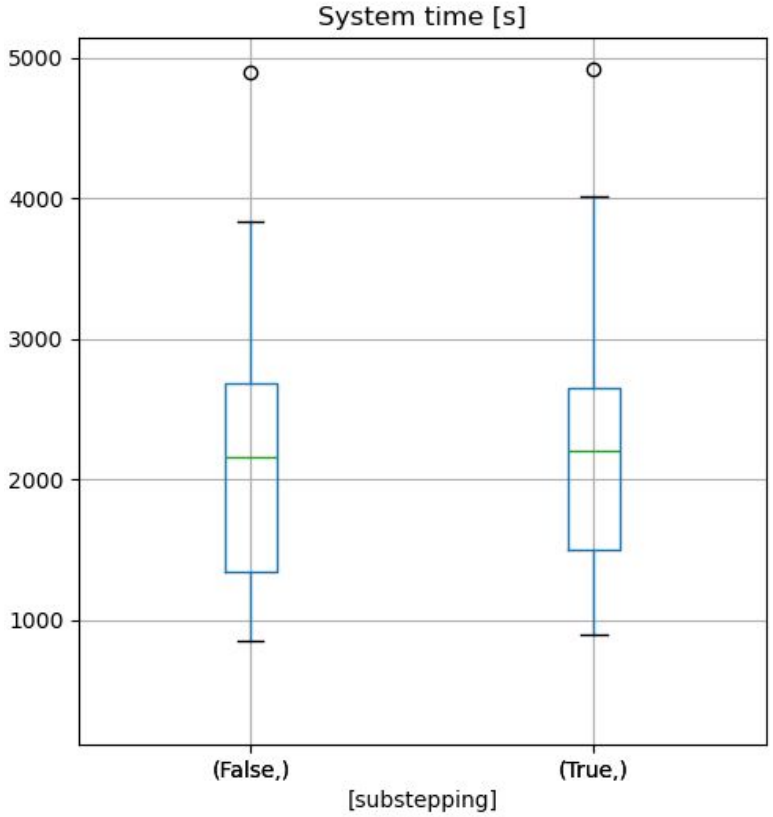
2. Check if fidelity params reduce evaluation cost

Reality:

`Substepping`

does not affect

execution time



Next steps

- Redo experiments, more executions + after office hours
- Check other fidelity params
  - max drawing distance
  - rendering options
- *3. Plug FidelityFusion framework to optimize search for scenario generation*

Discussion

Where else multi-fidelity fusion can be applied?