AUTOMOTIVE ARTIFICIAL INTELLIGENCE

# “Create a Replica of the World”

## Using HD Maps for the Virtual Testing of HAD

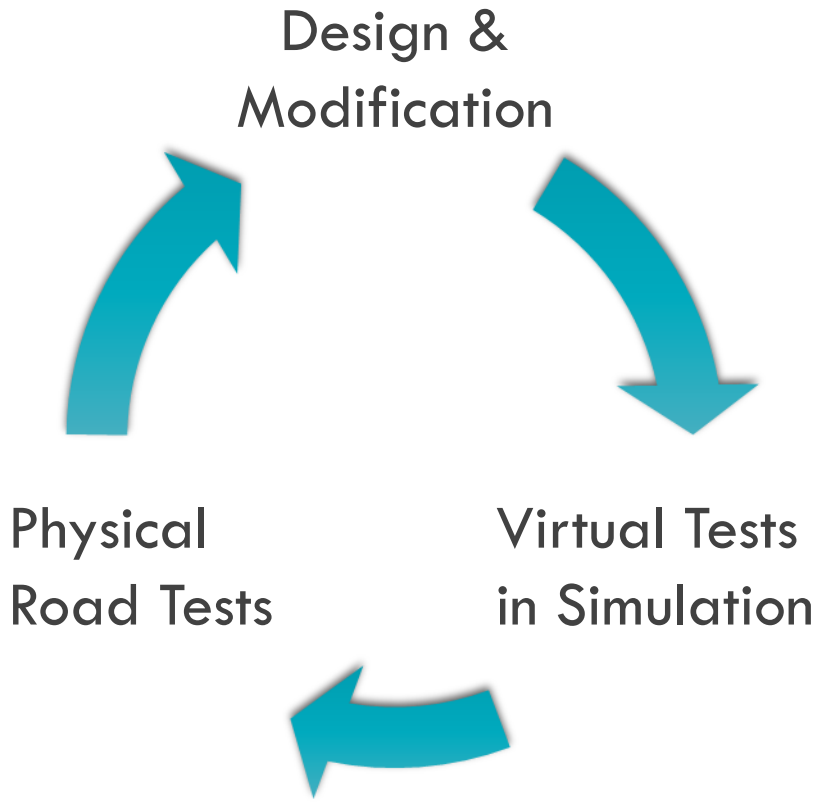
1st NDS Public Conference

13th June 2019

# The Growing Importance of Simulation

**Physical test drives**
**(closed-course and public-road)**

- Safety concerns → limited opportunities
- High investments
- Time consuming
- Problems with reproducibility




**Virtual test drives**
**(simulation)**

- Safe → no physical harm possible
- Computational scaling
- Automatization
- Broad test coverage

In order to achieve adequate coverage for proof of safety, future test and validation protocols will draw from **simulation, closed-course testing**, and **public road testing.**

# The Vision of AAI

## Create a replica of the world

We provide the tools for developing **safer and trustworthy mobility solutions,** acting as a reliable partner for highly automated driving.

**Digital Twins**
of real roads and cities as virtual test beds

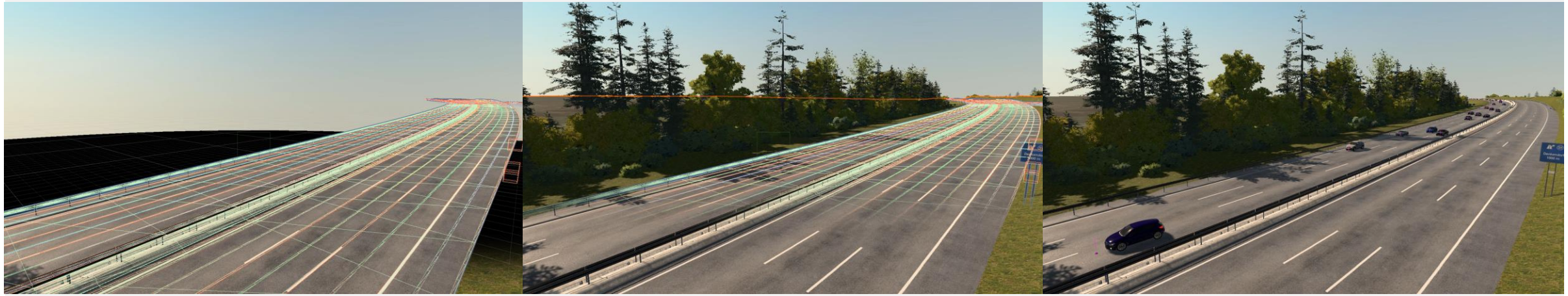
**Human-like Traffic**
populating the roads of the virtual environment

**Realistic Perception**
of the virtual world with sensor simulation

# Using HD Maps as the Basis for Simulation

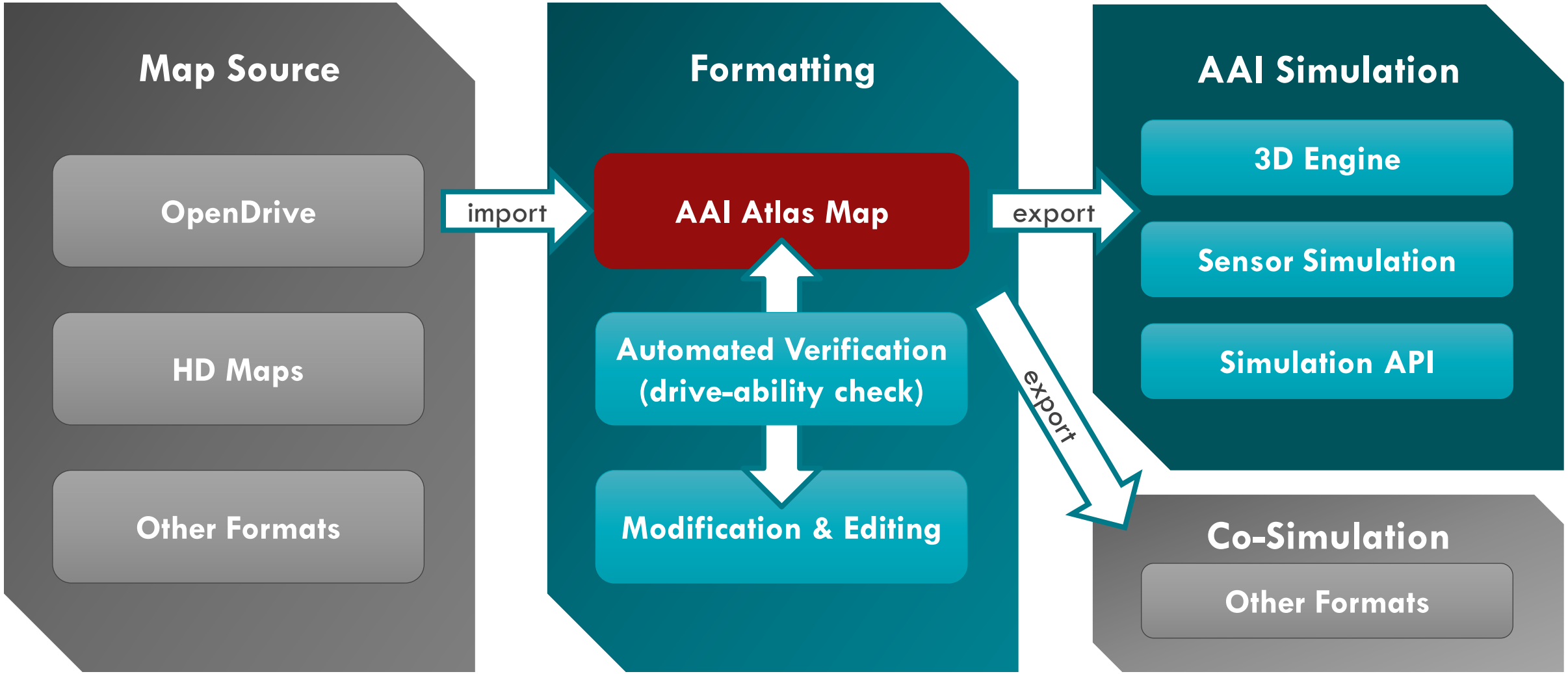
## Creating Digital Twins of the Real World

- Automated modelling of 3D meshes for streets and environments
- Automated integration of traffic signs
- Automated integration of lane information for traffic simulation



Germany A9 Highway

# Optimizing Performance with Internal Map Format

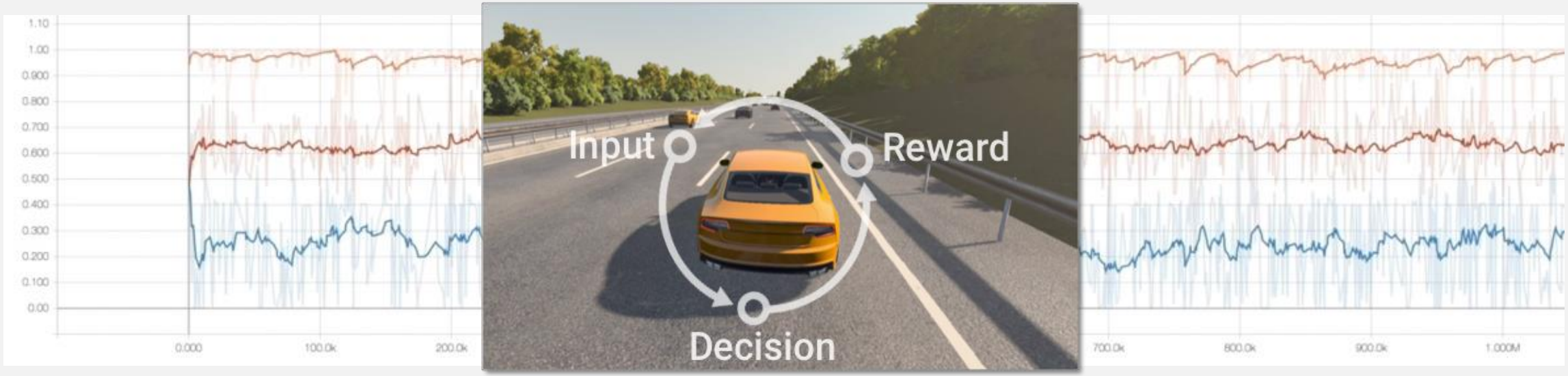


# Application of ML for Traffic Simulation

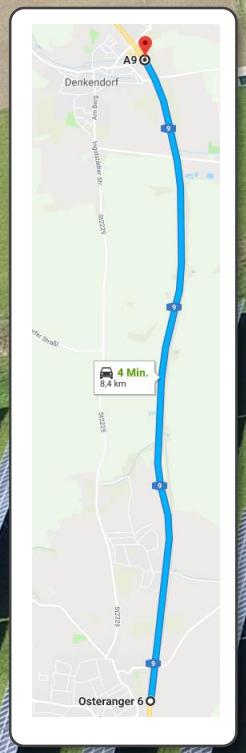
## Reinforcement Learning for Distinguishable Nanoscopic Driving Behavior

Various profiles for AI-trained traffic agents for dynamic traffic configuration

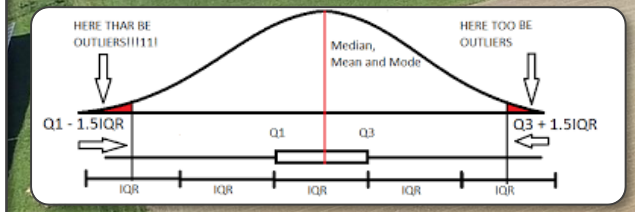
Defensive ⟷ Moderate ⟷ Aggressive



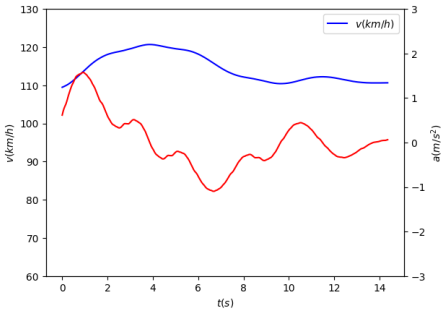
# Using Naturalistic Driving Data for Comparision



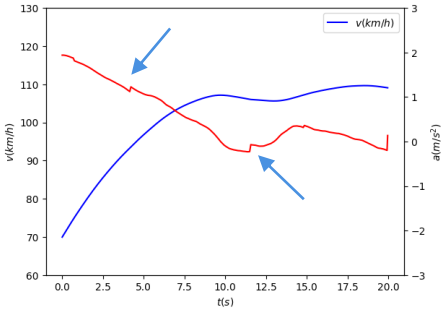

A9 Highway Germany
4K drone video @ 25 FPS
>37,000 Vehicles observed
~2% outliers removed



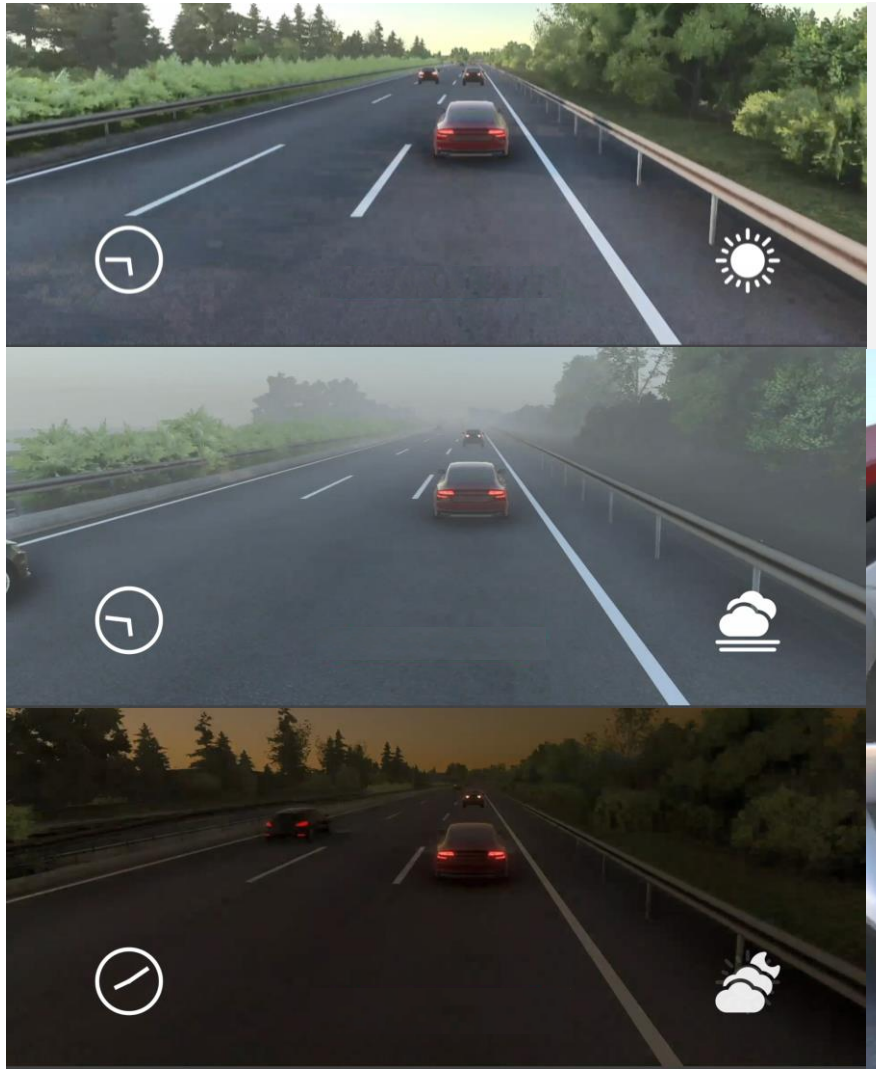

## Naturalistic Data



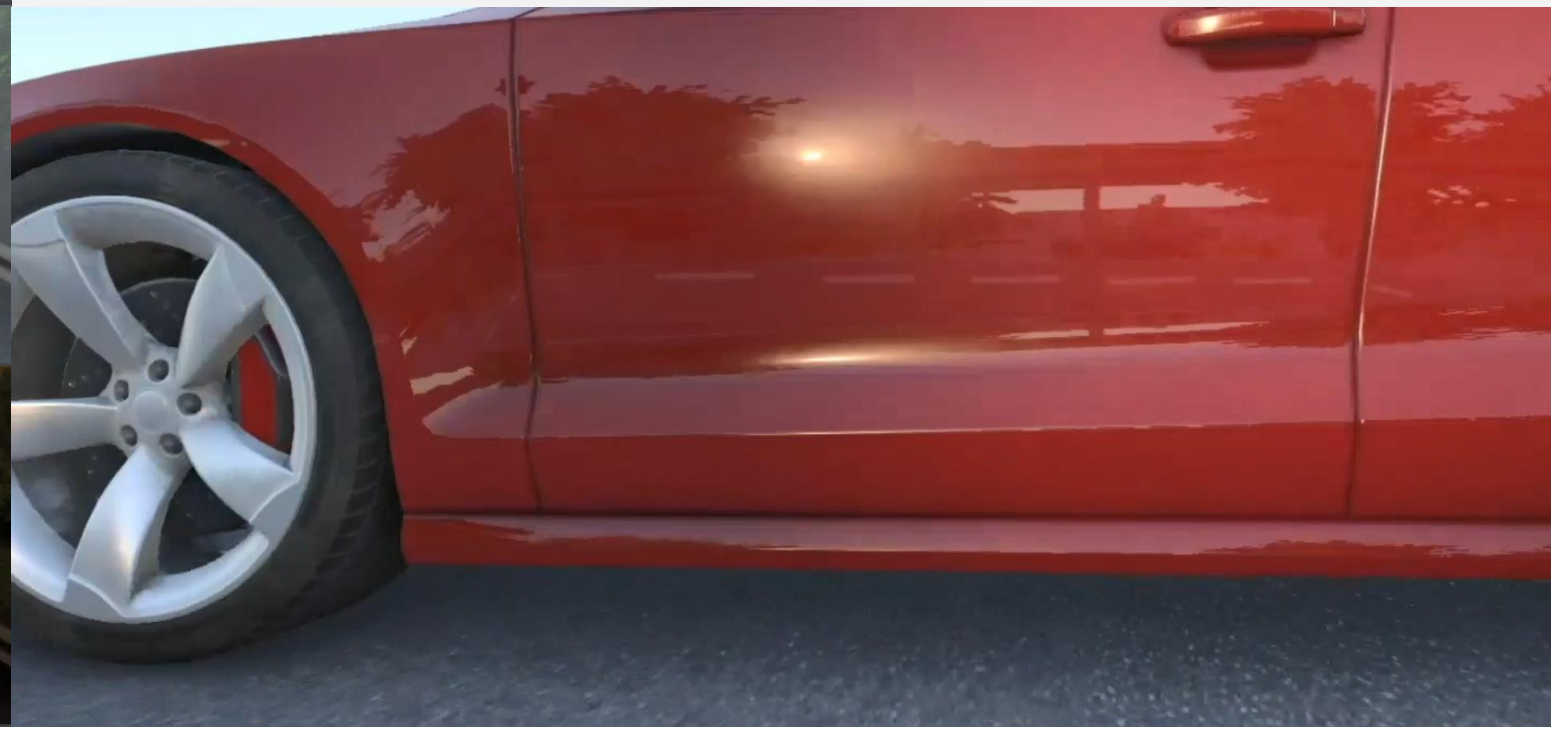

## AAI Traffic



# High Fidelity Graphics for Sensor Simulation



Besides Ground Truth, raw data output from **camera, lidar, and radar** simulation can be provided for use by the algorithms under test – including realistic **reflectivity, lighting conditions and weather effects.**



# Our Approaches for Validation of HAD Software

## Scenario Test

Directly challenge specific driving functions based on relevant scenarios and a multitude of concrete test cases.

- Deterministic with predefined trajectories of agents
- One specific type of interaction only
- Parameterizable for automated testing
- Reliably cover specific situations

## Endurance Test

Prove the capabilities of your ego vehicle or algorithms through driving millions of miles under realistic conditions.

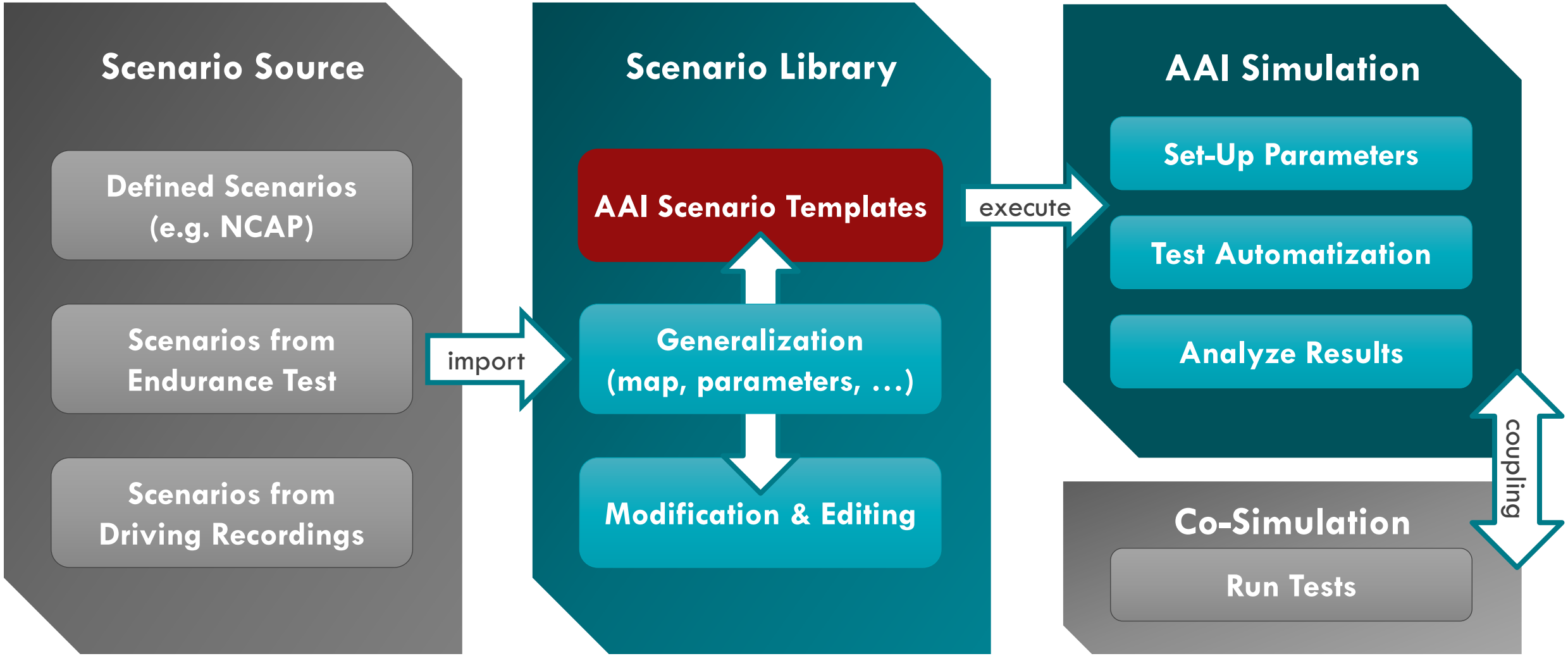
- Explorative with long-distance drives
- Natural traffic flow with spontaneous interactions
- Arbitrary, situations emerge unexpectedly
- Discover unforeseen edge cases

## Functional Targeting

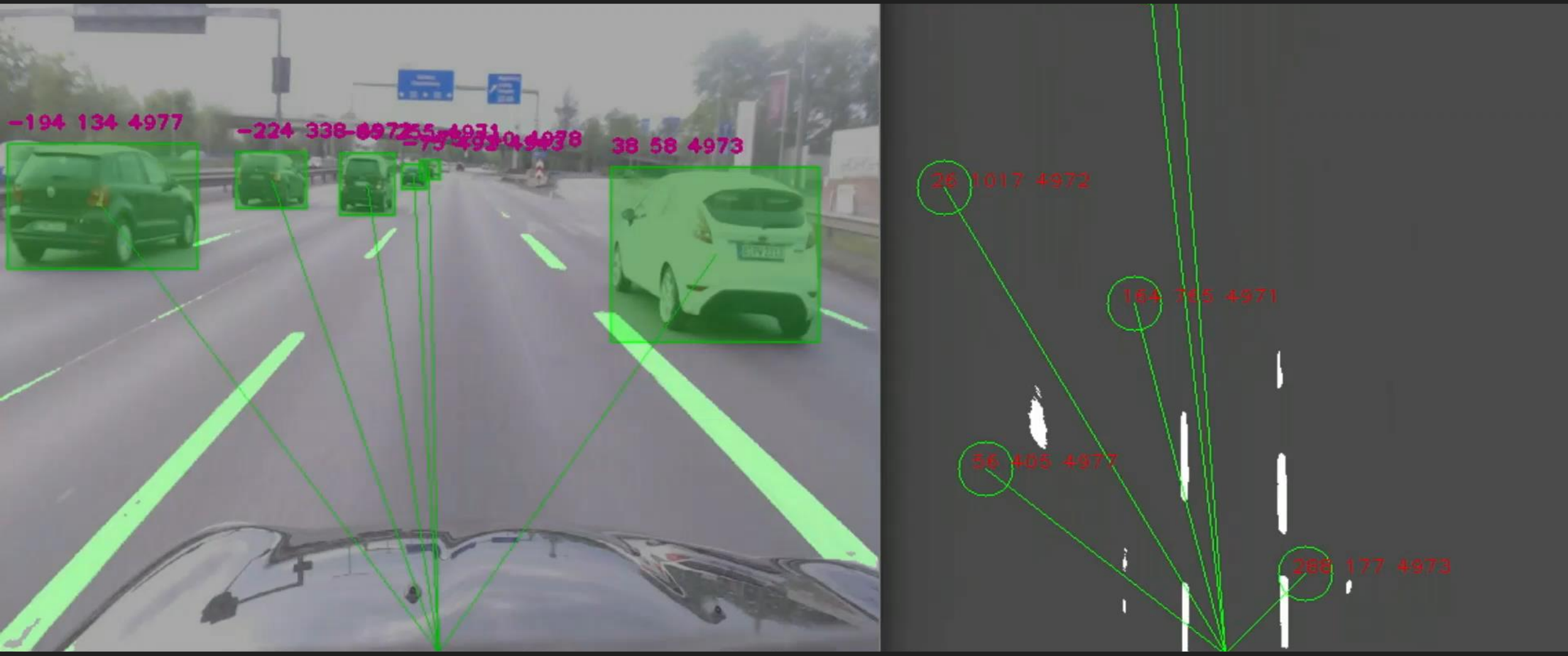
New approach combining the strengths of Scenario and Endurance Tests (customization service based on customer requirements):

- Long distance test runs without predefined trajectories
- Specialized agents purposely provoke ego vehicle

# AAI Scenario Test Workflow



# Scenario Cloning based on Minimal Inputs



# The AAI Portfolio

## AAI Traffic

We also provide
our intelligent traffic
as an independent module

## AAI ReplicaR

## AAI Scenario Test

## AAI Endurance Test

## AAI Modular Architecture

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# Thank you!

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