

Introduction to OpenDS



Why Simulation?



- Advantages of simulation
 - Simulate rare situations
 - Reproduce previous situations
 - Driving in a safe environment (dangerous, unethical, illegal)
 - Controlled conditions
 - Less expensive
 - Reduce CO₂ emission



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- Validity
 - Are results obtained in the simulator applicable to real-world driving?
 - Validity must be considered individually
- Why not use an existing solution?
 - Expensive
 - Lacks extensibility



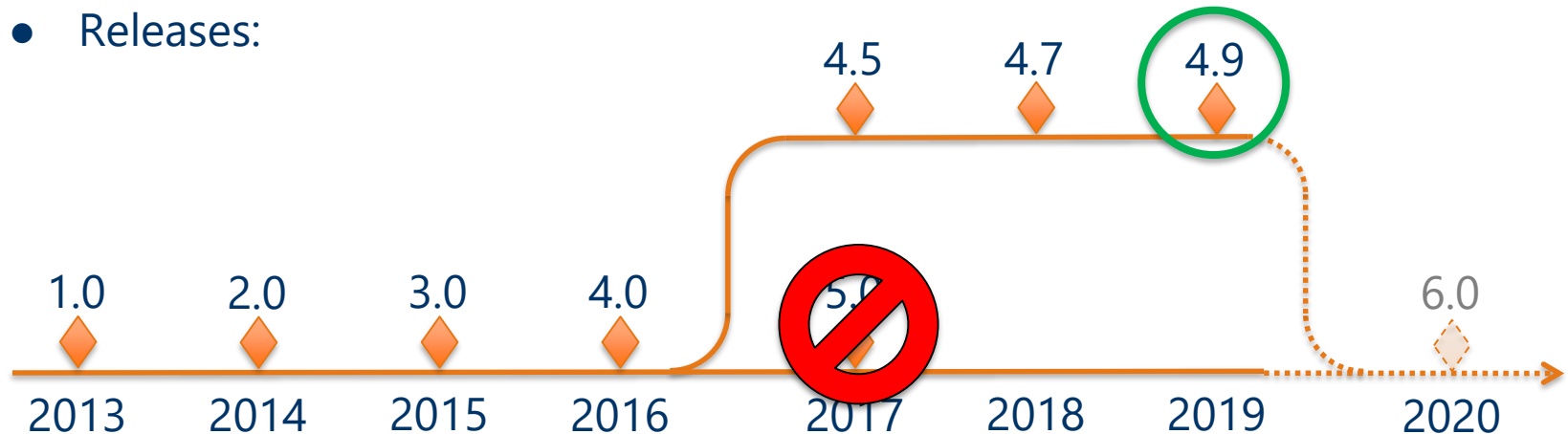
Development of open-source driving simulation for research

History



- Initiated at DFKI 2011
 - Master Thesis
 - CARS project
- Funded by European Union
 - 2012 - 2014 "GetHomeSafe"
 - 2013 + 2014 "Apps For Your Car" (EIT Digital)
 - 2015 "Fit To Perform" (EIT Digital)
 - 2017 - 2019 "Dreams4Cars"

- Releases:



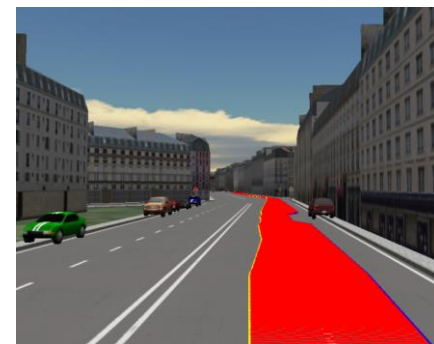
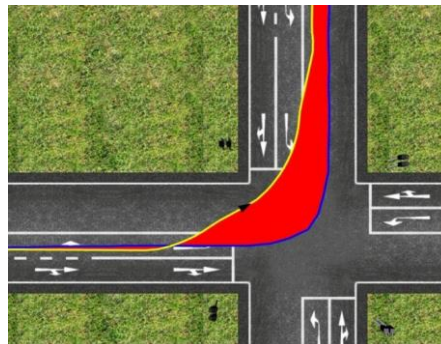
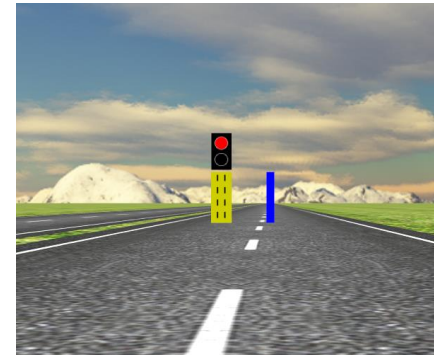
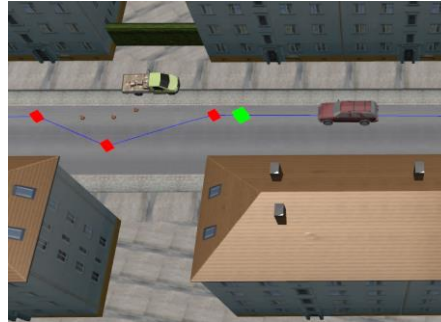
Available from:
www.opens.eu

Feature Summary by Version



OpenDS 1.0

Traffic Simulation	Event Triggering
Traffic Light Simulation	Engine & Transmission Simulation
Weather Conditions	Drive Analyzer
ContRe Task	Basic Audio Support

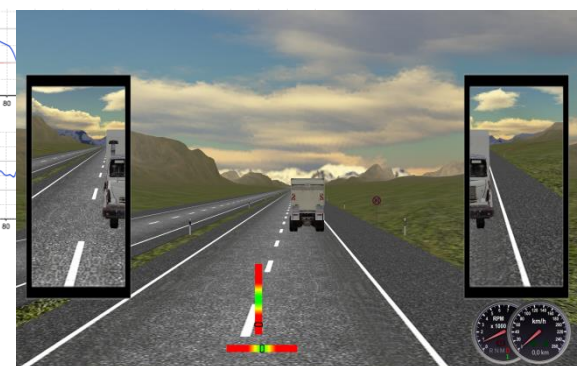
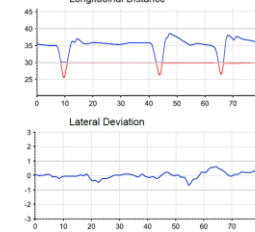
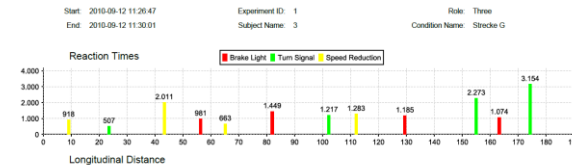
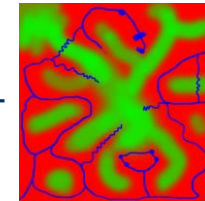
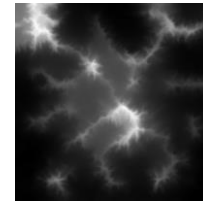
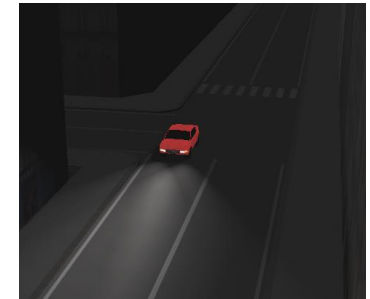
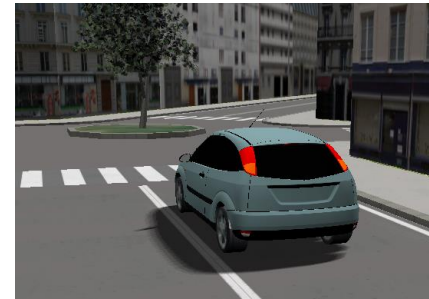


Feature Summary by Version



OpenDS 2.0

Traffic Simulation	Event Triggering	Shadow Rendering
Traffic Light Simulation	Engine & Transmission Simulation	Terrain Generator
Weather Conditions	Drive Analyzer	Data Connector
ConTRe Task	Basic Audio Support	3 Vehicle Platooning Task



Feature Summary by View



OpenDS 2.5

Traffic Simulation	Event Triggering	Shadow Rendering	Multi-Driver Simulation
Traffic Light Simulation	Engine & Transmission Simulation	Terrain Generator	Eye-Gaze Analysis
Weather Conditions	Drive Analyzer	Data Connector	Adaptive Cruise Control
ConTRe Task	Basic Audio Support	3 Vehicle Platooning Task	Video Capturing



Feature Summary

OpenDS 3.0



Traffic Simulation	Event Triggering	Shadow Rendering	Multi-Driver Simulation	Oculus Rift Support
Traffic Light Simulation	Engine & Transmission Simulation	Terrain Generator	Eye-Gaze Analysis	Motion Seat Support
Weather Conditions	Drive Analyzer	Data Connector	Adaptive Cruise Control	Data Acquisition Interface
ContRe Task	Basic Audio Support	3 Vehicle Platooning Task	Video Capturing	Lane Change Task (rebuilt)



Feature Summary by Version



OpenDS 3.5

Multi-Driver
Simulation

Oculus Rift
Support

Pedestrian
Support

Eye-Gaze
Analysis

Motion Seat
Support

HMI Bundle

Adaptive
Cruise
Control

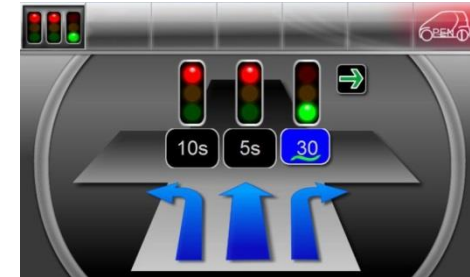
Data
Acquisition
Interface

Force
Feedback
Support

Video
Capturing

Lane Change
Task (rebuilt)

Motorway
Entrance
Task



Feature Summary by Version



OpenDS 4.0

Multi-Driver Simulation	Oculus Rift Support	Pedestrian Support	Bicycle Support
Eye-Gaze Analysis	Motion Seat Support	HMI Bundle	Video Playback
Adaptive Cruise Control	Data Acquisition Interface	Force Feedback Support	Game Engine Update
Video Capturing	Lane Change Task (rebuilt)	Motorway Entrance Task	New Driving Scenes



Feature Summary by Version



OpenDS 4.5

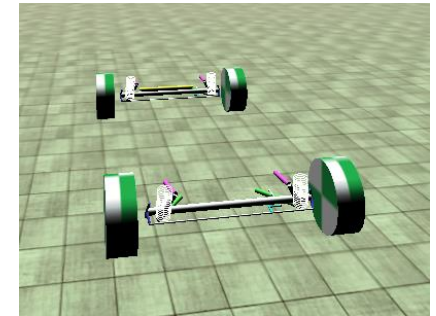
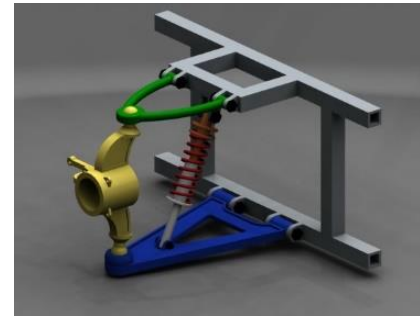
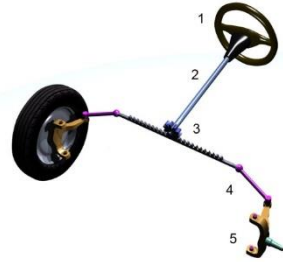
Multi-Driver Simulation	Oculus Rift Support	Pedestrian Support	Bicycle Support	Autonomous Driving
Eye-Gaze Analysis	Motion Seat Support	HMI Bundle	Video Playback	Performance Optimisation
Adaptive Cruise Control	Data Acquisition Interface	Force Feedback Support	Game Engine Update	Manual Transmission
Video Capturing	Lane Change Task (rebuilt)	Motorway Entrance Task	New Driving Scenes	New Models (Cars, Signs, Animation)



Feature Summary by Version



OpenDS 4.7



Bicycle Support

Autonomous Driving

Chrono Integration

Video Playback

Performance Optimisation

OpenDRIVE Support

Game Engine Update

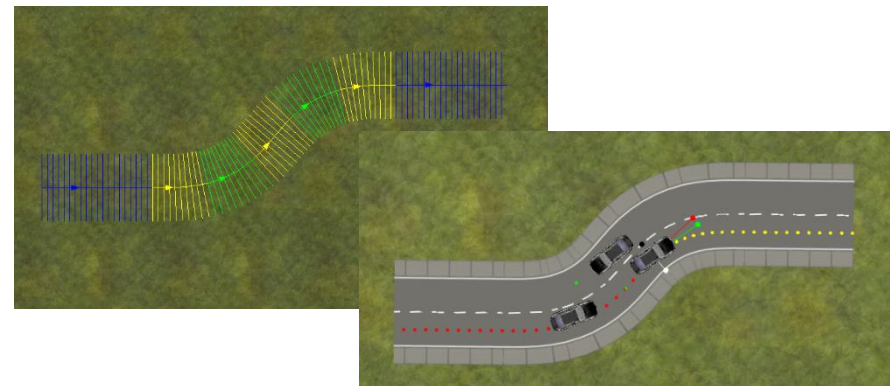
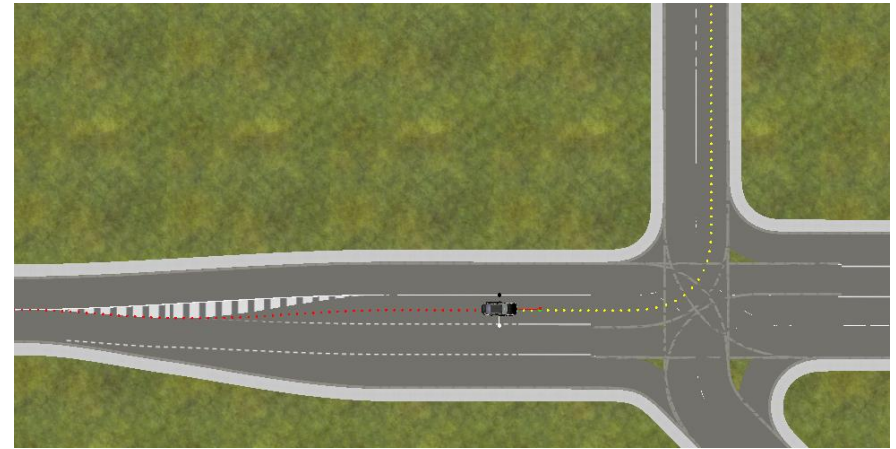
Manual Transmission

Road Network Logic

New Driving Scenes

New Models (Cars, Signs, Animation)

Road Scripting

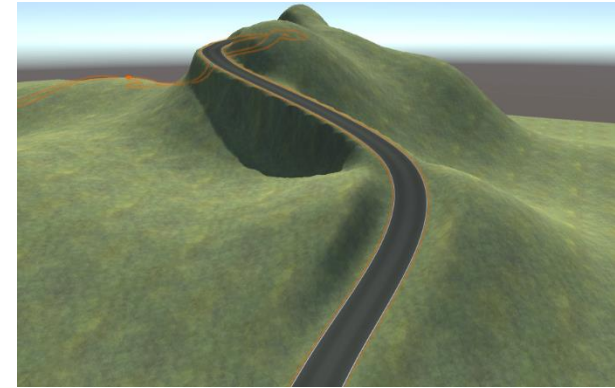


Feature Summary by Version



OpenDS 4.9

Bicycle Support	Autonomous Driving	Chrono Integration	Codriver Interface
Video Playback	Performance Optimisation	OpenDRIVE Support	Road and Terrain Generation
Game Engine Update	Manual Transmission	Road Network Logic	Deterministic Simulation
New Driving Scenes	New Models (Cars, Signs, Animation)	Road Scripting	Documentation

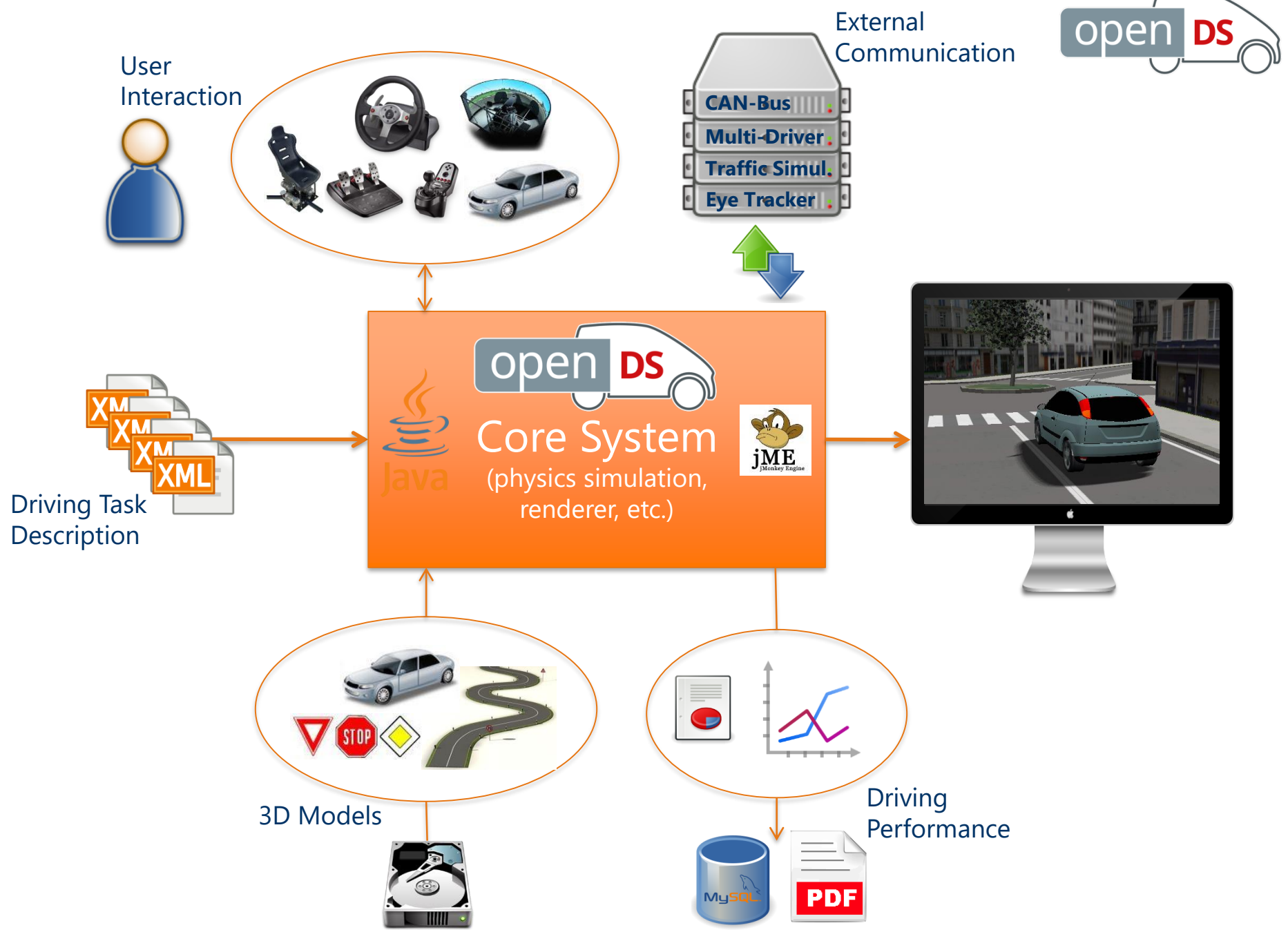


Game Engine



- Cross-platform open-source implementation (Java)
- Based on the jMonkeyEngine framework:
 - High performance scene graph based graphics API
 - Renderer: Lightweight Java Game Library (LWJGL)
 - Bullet Physics library (jBullet) allows mesh-accurate collision shapes, experience of acceleration, friction, torque, gravity and centrifugal forces
 - Nifty GUI: platform independent graphical user interfaces
 - Basic audio support (positional and directional sound)
 - Support of common 3D-model and media formats





Visualization



Demonstration

