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

- 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

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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 Perfom ” (EIT Digital)
  - 2017 - 2019 “Dreams4Cars”

- Releases:
  - 1.0 2013
  - 2.0 2014
  - 3.0 2015
  - 4.0 2016
  - 4.5 2017
  - 4.7 2018
  - 4.9 2019
  - 5.0 2020
  - 6.0 2020

Available from: www.opends.eu

Latest version Used today!
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 Version

**OpenDS 2.5**

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<tr>
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<th>Shadow Rendering</th>
<th>Multi-Driver Simulation</th>
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<td>Terrain Generator</td>
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Feature Summary

OpenDS 3.0

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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

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<th>Feature</th>
<th>Image</th>
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<tr>
<td>Oculus Rift Support</td>
<td><img src="image2.png" alt="Image 2" /></td>
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<td><img src="image3.png" alt="Image 3" /></td>
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<td>Bicycle Support</td>
<td><img src="image4.png" alt="Image 4" /></td>
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<td>Motion Seat Support</td>
<td><img src="image6.png" alt="Image 6" /></td>
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<tr>
<td>HMI Bundle</td>
<td><img src="image7.png" alt="Image 7" /></td>
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<td>Video Playback</td>
<td><img src="image8.png" alt="Image 8" /></td>
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<td><img src="image10.png" alt="Image 10" /></td>
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<tr>
<td>Force Feedback Support</td>
<td><img src="image11.png" alt="Image 11" /></td>
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<tr>
<td>Game Engine Update</td>
<td><img src="image12.png" alt="Image 12" /></td>
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<td>Video Capturing</td>
<td><img src="image13.png" alt="Image 13" /></td>
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<td>Lane Change Task (rebuilt)</td>
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<td>Motorway Entrance Task</td>
<td><img src="image15.png" alt="Image 15" /></td>
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<tr>
<td>New Driving Scenes</td>
<td><img src="image16.png" alt="Image 16" /></td>
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R. Math
## Feature Summary by Version

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## 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
Core System
(physics simulation, renderer, etc.)
Demonstration