

AUTONOMOUS VEHICLES SIMULATION



OPAL-RT
TECHNOLOGIES

WWW.OPAL-RT.COM

Autonomy Won't Happen By Itself

With OPAL-RT you can create **Software-in-the-Loop (SIL)** and **Hardware-in-the-Loop (HIL)** simulations to accelerate your autonomous vehicle project timelines, while increasing quality and reducing overall costs. **Autonomy won't happen by itself. OPAL-RT is here to help.**

Developing **autonomous vehicles** is difficult with complex **sensor arrays** and **algorithms** working in coordination to ensure safe and efficient operation in all situations. **Simulation** is an important tool for engineers to **perform tests** that wouldn't be achievable in the real world. Despite great advancements in autonomous road vehicles, **off-highway autonomous systems** have their own challenges. **Task-specific vehicles** and **robots** feature even more **complexity** than their on-road counterparts, requiring their own **specialized simulation tools**.

OPAL-RT is proud to offer both on and off-highway autonomous system engineers a flexible and open simulation platform. Featuring a real-time capable **3D environment** with **sensor simulation**, including **cameras** and **LiDAR**, users can create countless autonomous vehicle **scenarios**. Need to connect an existing **electromechanical Hardware-in-the-Loop** simulation or other **real-time models**? We've got you covered with one of the simulation market's most flexible **co-simulation environments**.



Automotive



Off-Highway



Military



Trucks



Smart Cities



UAVs

Faster testing, great results

Shorten the development cycle and meet the regulatory agencies' strict safety standards. OPAL-RT provides users easy and accessible digital platforms for them to reduce complexity, time, risks, and costs.



Decrease costs

Road/field testing is costly. Perform more tests for less with a high-fidelity Digital Twin.



Shorten timelines

Get work done faster, whether you are bringing a product to market or conducting research.



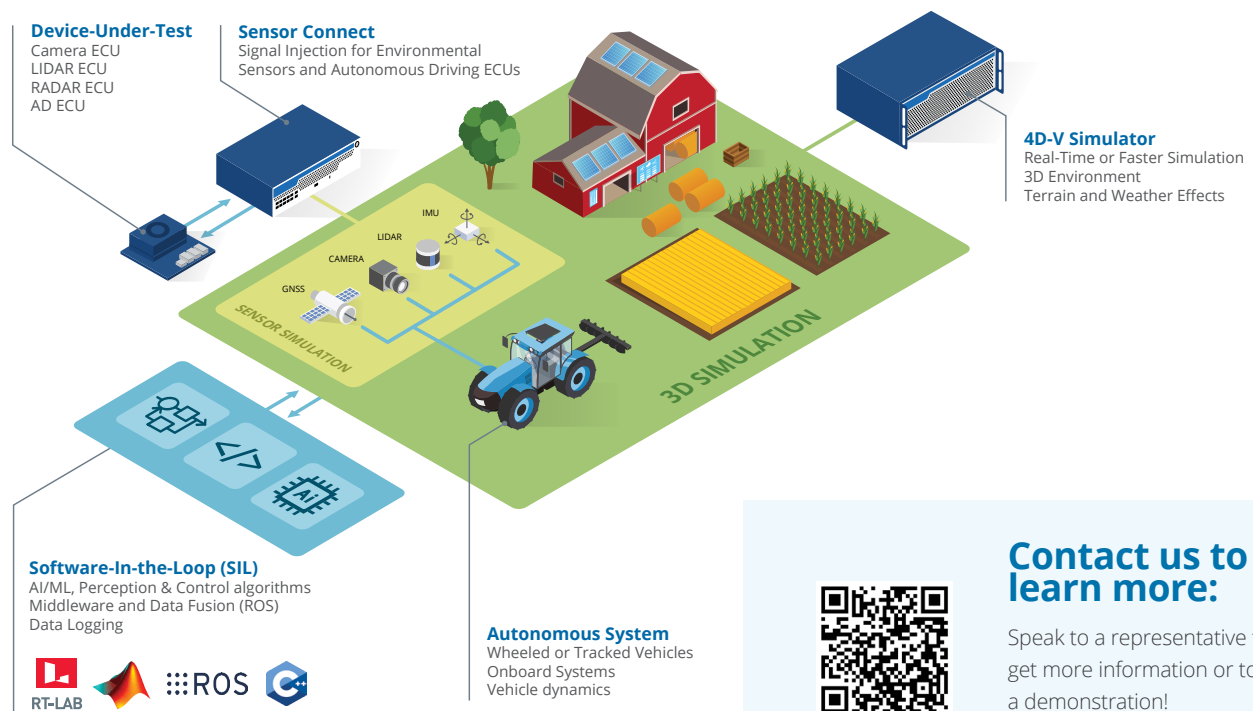
Reduce risk

Virtual environments are not just safe for users. They can prevent bad decisions and reduce financial risk.

A Flexible and Expandable Autonomous Vehicle Simulation Ecosystem for On and Off-Highway

Autonomous Sensor Hardware-in-the-Loop (HIL)

Use OPAL-RT's Sensor Connect module to inject simulation-generated or recorded sensor data directly into sensor or ADAS ECUs.



Software-in-the-Loop (SIL)

Connect your code, applications and/or MATLAB-Simulink models as Software-in-the-Loop (SIL) using ROS/ROS2 and/or RT-LAB to validate your AI/ML-based perception and control algorithms.

Contact us to learn more:



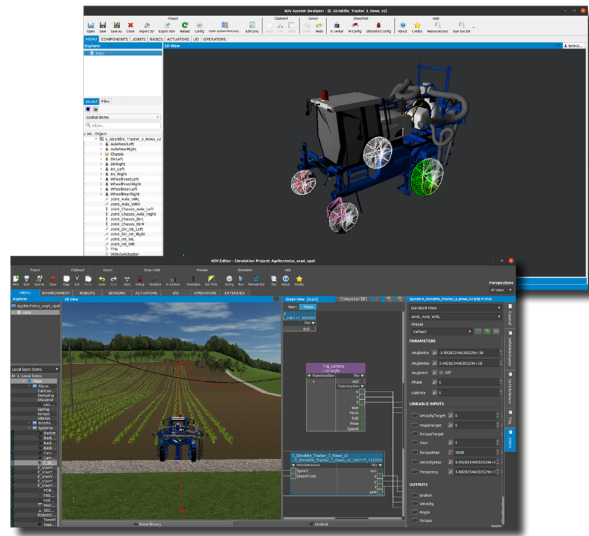
Speak to a representative to get more information or to get a demonstration!

4DV-SIM for Autonomous Vehicle and Robotics Simulation

Your Complete Autonomous Simulation Environment



In partnership with 4D Virtualiz, OPAL-RT is proud to offer 4DV-SIM, an open 3D simulation environment for autonomous vehicles and systems. Featuring realistic environmental simulation, a rich sensor library, and connectivity to 3rd party software, benefit from 4DV-SIM for the research, development, testing, and certification of your autonomous systems and software.



The features you need to support Software-in-the-Loop and Hardware-in-the-Loop Applications



Simulate AV Systems in Real-Time

Create representative digital twins of your complex vehicle, machinery or robot and environment in Real-Time, including with multi-agents.



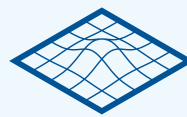
A Rich Drag-and-Drop Sensor Library

Add and configure sensors, such as **LIDAR, RADAR, RGB/Semantic Cameras, and GNSS** to your autonomous system with ease.



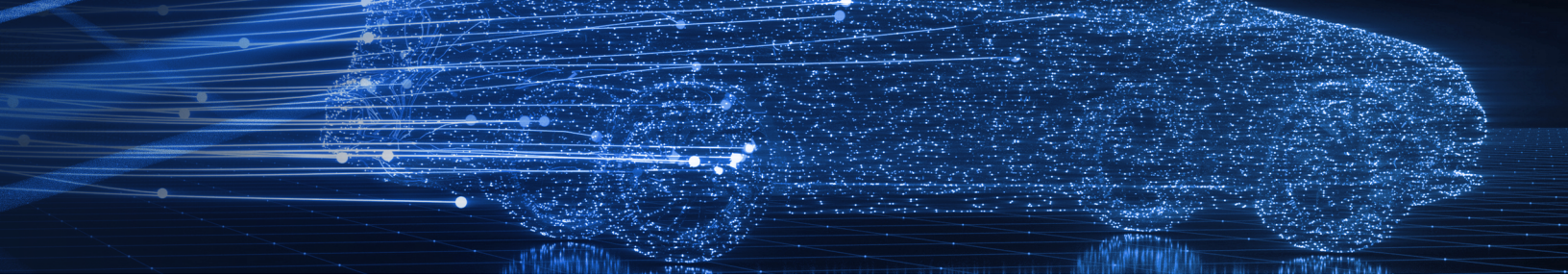
Connect with ROS and other software

Use 4DV-SIM's open framework to connect to common tools such as ROS and MATLAB/Simulink.



Import Existing Models and GIS

Save time in building your digital twin through importing existing CAD, 3D and ROS models, as well as GIS databases.



Bring Sensors and Communication to Real-Time

Sensors and communication systems form the core of autonomous systems. 4DV-SIM can simulate a wide range of these sensors and systems, including using models from leading equipment suppliers:

Velodyne Lidar

SICK
Sensor Intelligence.

PEPPERL+FUCHS

SBG SYSTEMS

HOKUYO

OUSTER

SENSORS



Cameras

- Perspective
- Thermal
- Omnidirectional
- Ground Truth: *depth, normal & semantic*



LIDAR

- 3D
- 2D



GNSS



IMU

- Accelerometer
- Gyroscope
- Magnetometer



OTHER

- Anemometer
- Altimeter
- Position sensor
- Odometer

COMMUNICATIONS



Radio



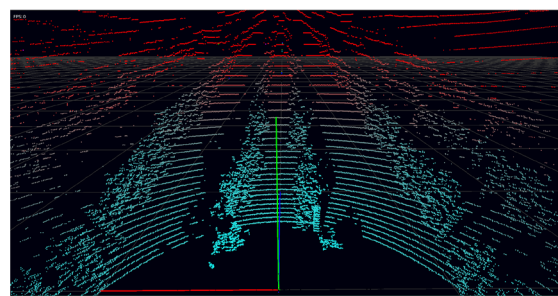
Wifi



UWB



RGB Camera

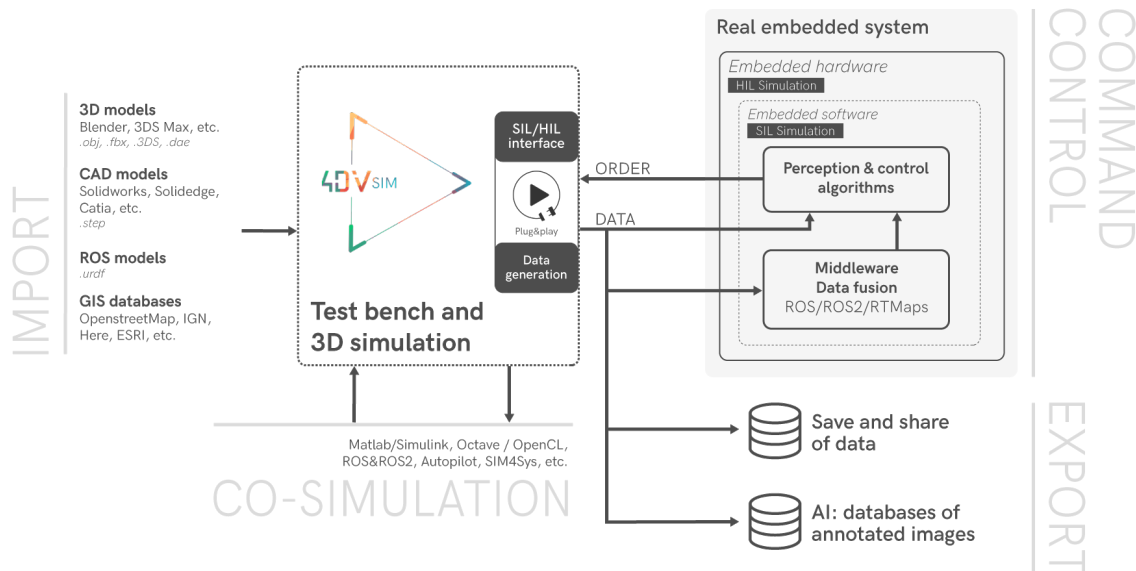


3D LiDAR

4DV-SIM for Autonomous Vehicle and Robotics Simulation

Interfacing and Co-Simulation Made for Your Artificial Intelligence (AI) Projects

As shown in the below diagram, 4DV-SIM offers a flexible and open co-simulation environment that on top of being able to perform Software-in-the-Loop (SIL) can readily interface with real embedded systems in a closed-loop manner.



AI Success Story

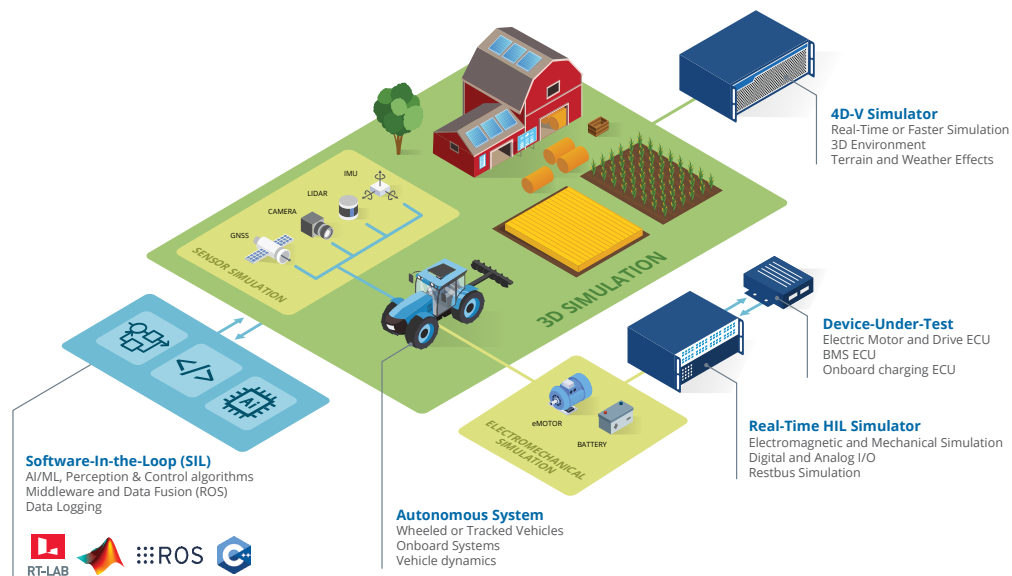
YUMAIN

Virtual data created using 4DV-SIM was used by Yumain to determine the optimum balance between quality of machine learning and modeling. Different types of neural networks were also tested on this data to confirm the compatibility and relevance of this source of information in a broader operational context



Electromechanical Co-Simulation

Have you ever wanted to add sensor simulation to an existing electromechanical HIL setup or vice-versa? No problem! OPAL-RT expandable co-simulation ecosystem and expertise will let you make this a reality.



Proud users of OPAL-RT

Established in 1997, OPAL-RT TECHNOLOGIES is a prominent developer of digital simulators trusted by engineers and researchers globally, spanning leading manufacturers, universities, and research centers. With over 1000 customers, including Fortune 500 companies and academic institutions, OPAL-RT serves a user base exceeding 2000 individuals across 40 countries.

**GROUPE
RENAULT**



CAT



LUCID





ABOUT US

Founded in 1997, OPAL-RT TECHNOLOGIES is the leading developer of open real-time digital simulators and Hardware-In-the-Loop testing equipment for electrical, electro-mechanical and power electronic systems.

OPAL-RT simulators are used by engineers and researchers at leading universities, manufacturers, utilities, and research centres around the world.

OPAL-RT's unique technological approach integrates parallel, distributed computing with commercial off-the-shelf technologies.

The company's core software, RT-LAB and HYPERSIM, enables users to rapidly develop models suitable for real-time simulation, while minimizing initial investment and their cost of ownership. OPAL-RT also develops mathematical solvers and models specialized for accurate simulation of power electronic systems and electrical grids. RT-LAB, HYPERSIM and OPAL-RT solvers and models are integrated with advanced field programmable gate array (FPGA) I/O and processing boards to create complete solutions for RCP and HIL testing.



OPAL-RT CORPORATE HEADQUARTERS

1751 Richardson, Suite 1060 | Montréal, Québec, Canada | H3K 1G6
Tel: 514-935-2323 | Toll free: 1-877-935-2323 | Fax: 514-935-4994

**INTELLIGENT
TRANSPORTATION
SYSTEMS**
**OPAL-RT Intelligent
Transportation Systems**
10 Boulevard Vivier Merle
Lyon
Auvergne-Rhône-Alpes
69393, France
Tel: +33 7 60 80 36 14

U.S.A.
OPAL-RT Corporation
USA - Colorado:
10200 W 44th Avenue,
Suite 239
Wheat Ridge, Colorado
80033, USA
Tel: +1 877 935 2323

U.S.A.
OPAL-RT Corporation
2532 Harte Dr
Brighton, MI
48114, USA
Phone: 734-418-2961
Toll free: 1-877-935-2323
Fax: 1-866-462-5120

POLAND
OPAL-RT Poland
E. Plater 28, 00-688 Warsaw,
Poland
Tel: +48 12 429 41 01

EUROPE
OPAL-RT Europe S.A.
196 Houdan Street
Sceaux, Hauts-de-Seine
92330, France
Tel: +33 1 75 60 24 89
Fax: +33 9 70 60 40 36

CHINA
OPAL-RT China
Unit 608, 6/F Zhongyu
Mansion
No. 6 North Workers'
Stadium Road,
Chaoyang District,
Beijing 100027, China
Tel. 0086 10 56617026

GERMANY
**OPAL-RT Germany
GmbH**
N.Office
Pretzfelder Strasse 15
90425 Nuremberg
Germany

INDIA
**OPAL-RT Technologies
India Pvt. Ltd.**
648/A-4/5, 2nd Floor,
OM Chambers,
100 Feet Road
Indiranagar 1st Stage
Bangalore, Karnataka
560038, India
Tel: 080-25200305

BRAZIL
OPAL-RT Brazil
Alameda Rio Negro
503, 23º andar
Barueri, São Paulo
06454-000, Brazil
Tel: +55 11 2110-1833