

# Innovation in the loop

Bring product designs to life in an **interactive simulation & visualization platform**

As mechatronic products become more sophisticated and control systems increase in complexity, predicting system-level behaviour is more challenging. Product success is increasingly reliant on innovation and a multidisciplinary, system engineering approach.

Vortex<sup>®</sup> Studio by CM Labs is a simulation and visualization software that allows for:

- **Evaluation of design ideas** by engineers, product managers, and product stakeholders through in-the-loop, experiential testing.
- **Modelling of mechatronics** and mechanical equipment through high-fidelity, multi-body simulation at the worksite level.
- **Shortening of the development cycle** and encouraging innovation, with tools to support integration and distributed visualization.
- **Creation of complex virtual worksites** and environments to test your virtual prototype—allowing you to identify operational issues earlier in the design process.
- **Confirmation of your product's ability** to complete critical objectives long before deployment.

**Discover how Vortex Studio helps create better products.**



## Your key to **innovation**



### **Beat Competitors to Market**

Perform system-level testing earlier in the engineering process: explore more design concepts, identify issues and performance gaps sooner, and reduce the number of physical prototypes.



### **Create Exceptional Client Experiences**

Conduct human-in-the-loop testing and implement user feedback into your design, resulting in earlier iterations and solutions that surpass client expectations.



### **Control Project Risks & Overruns**

Vortex Studio provides a safe way to validate designs and prevents the need to deploy costly prototypes in dangerous real-world conditions.

# Enhance your engineering process with **interactive, real-time simulation**



## Create Real-time Simulations

- ✓ **Rapidly create equipment simulation models** from 3D model geometry to place equipment within realistic scenarios for performance testing.
- ✓ **Prepare visually stunning immersive environments** and machine simulations using existing 3D models.
- ✓ **Easily extend Vortex Studio through a simple plugin architecture**, embedded Python, and C++ API to integrate control logic, software- and hardware-in-the-loop.

## Advanced Immersive Visualization

- ✓ **Create stunning immersive visuals** with state-of-the-art shader-based GPU-accelerated rendering on desktop systems, head-mounted VR displays, or synchronized multi-channel visual systems.
- ✓ **Simulate optical sensors** such as cameras, ray-cast, and depth sensors or extend their capabilities with tools to model advanced technologies—such as lidar or sonar.
- ✓ **Use pre-packaged tools** to create realistic scenes with 3D visual effects and advanced real-time rendering, including shadows, skydome, weather, trees, and water to enhance the user experience.



## Deploy Driver-in-the-loop Simulators

- ✓ **Leverage a robust software stack**, including core Vortex Studio applications, a distributed computing framework, cross-platform libraries, and embedded Python.
- ✓ **Save considerable time and resources required to build in-the-loop simulators** with a centralized workflow providing direct interfaces to motion and audio systems as well as control hardware through CAN, OPC, and others.
- ✓ **Quickly debug and optimize simulations**, manage scenes and participants, and play back simulations with integrated tools.

# Simulate Mechatronic Systems

Simulate complex ground and maritime equipment in real-time with professional engineering tools for multi-body dynamics and physics-based contact.



## Vehicles:

Model wheeled or tracked vehicles including individual components, such as powertrain, tire-ground interaction, steering, suspension, and brakes.



## Cable Systems:

Model systems of cables, pulleys, blocks, and other features to create complex hoisting systems and test slack cables or cable systems under tension.



## Earthworks:

Simulate real-time soil mechanics that incorporate advanced DEM and particle physics models to recreate realistic excavation, filling, dumping, and compaction.



## Hydrodynamics:

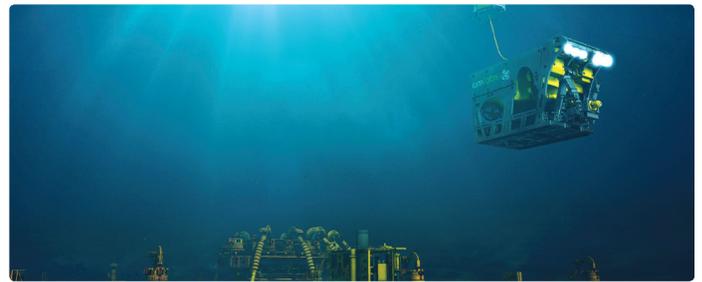
Combine mechanical dynamics, hydrodynamics, cable simulation, advanced 3D graphics, and the tools engineers need to create simulations of marine environments.

## Industry Applications



### Heavy Equipment & Off-Highway:

The movement toward autonomous mobility and control means that off-highway equipment has become more complex and requires more features, such as software, sensors and driver-assistance systems. The human-machine experience is also changing, affecting how products are sold, operated, and maintained. From the engineer's desktop to immersive HIL simulators, Vortex Studio allows engineers to simulate and visualize equipment operation in real-time.



### Marine:

Offshore companies face a shifting energy landscape and the need to operate in ever more challenging conditions at greater efficiencies. With high-fidelity dynamics, cable systems, and ocean modelling, Vortex Studio lets marine engineers integrate real-time engineering models, advanced visualization, and in-the-loop simulation to solve the challenges of designing and creating equipment for offshore and subsea operations.



### Mobile Robotics:

Mobile robotics applications in traditional industrial applications—as well as newer applications such as home care, security, and last-mile delivery—are ideal targets for Vortex Studio. Simulation of mobile and task-based robotics systems allow engineers to develop control algorithms that perform nearly identical to the real hardware.



### Defense:

Vortex Studio is a COTS, real-time simulation platform offering high-fidelity modelling for military training applications including ground vehicles, heavy equipment, and maritime operations. It is an efficient tool for rapidly building, testing, and validating simulation content and is simple to integrate into existing simulator frameworks or game-engines for enhanced training applications.

# A complete multi-body dynamics simulation and visualization platform

Vortex Studio is a complete off-the-shelf platform, covering the entire simulation process, from creation and integration, to validation and deployment. With intuitive desktop editing tools, out-of-the-box integrations, validated simulation models and immersive visualization capabilities, Vortex Studio reduces the effort required to create engineering-grade, real-time simulations of complex machines. Combined with CM Labs' training and professional services, Vortex Studio lets you focus on creating innovative products.



## Trusted, proven, experienced

Vortex Studio is trusted on the worksite, on the battlefield, in the ocean depths and even in space. That is why NASA, John Deere, Volvo, Liebherr, Lockheed Martin, Subsea7, Oceaneering and many leading organisations have selected Vortex Studio to improve their products and processes.

CM Labs' dedicated team of mechanical dynamics experts, engineers, and 3D software specialists are focused on delivering the accuracy and flexibility you need to support your design projects. With 20 years of experience developing simulation solutions, we can help you maximize real-time simulation and visualization technology to make informed and effective decisions. Vortex Studio is a mature commercial product that includes routine upgrades, comprehensive documentation, and dedicated support.

When you choose Vortex Studio, you are in good company.

## About CM Labs

CM Labs Simulations builds simulation-based solutions to help clients design advanced equipment and prepare for skilled operations. Through its Vortex Studio platform, CM Labs provides capabilities for in-the-loop simulators, training simulators, mission rehearsal, digital twins, virtual prototyping, and testing.

The CM Labs team features experts with decades of experience and wide-ranging backgrounds in training, vehicle dynamics, heavy equipment, maritime, and robotics engineering.

With proven expertise ranging from worksite to deep-sea to space-based projects, CM Labs engineers, scientists, and computing professionals excel at all aspects of visual simulation, from initial concept and R&D to integration, training, and beyond.

For more information about CM Labs, visit [www.cm-labs.com](http://www.cm-labs.com).



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