

Simulators for motorsport

Professional engineering tools that help race teams get ahead

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- ❖ Motion simulator packages
 - ❖ Static simulator packages
 - ❖ Panthera simulator software
 - ❖ Upgrade programmes for existing simulators
 - ❖ Vehicle dynamics models
 - ❖ Cars and LIDAR-scanned tracks

It's time to get serious about simulators



Almost every race team and driver now has access to a driving simulator of some description. But do not be confused between game-based systems, which can be useful for circuit familiarisation, and advanced professional simulators, which have the power to bring a step-change in on-track results. It's not your business or ours, to be rearing the next generation of sim racers – so isn't it time you considered a driver-in-the-loop motorsport simulator that is a core engineering tool for race car development and set-up? We've been helping motorsport teams in almost every series take their simulators and track performance to the next level in a way that is affordable, future-proof and in synch with internal capability.

We offer:

- ✦ Motion and static simulator packages
- ✦ High fidelity control-loading force feedback
- ✦ Panthera simulator software

- ✦ Simulator upgrade programmes: e.g. software, projection systems, hardware integration, also for non-Cruden simulators
- ✦ MATLAB Simulink vehicle dynamics models
- ✦ 3D models for LIDAR-scanned tracks and cars

A Cruden simulator will open new doors to more accurate, realistic and data-driven off-track testing, that will save time, accelerate learning and improve vehicle performance and ultimately race results. Our products are designed to slot into your tool chain, to support:

- ✦ Race car development
- ✦ Race car set-up
- ✦ Race preparation and strategy
- ✦ Training drivers on the effects of set-up changes
- ✦ ECU / software development

Customers and race series

Our customers range from engineers progressing from running desktop vehicle simulations and junior race teams, to Formula One and leading international motorsport engineering houses. We have built simulators or teams racing in a wide variety of race series.



Prema

Cruden MSX simulator software upgrade

Mahindra Racing

Cruden MS1 static simulator

HWA DTM and Formula E

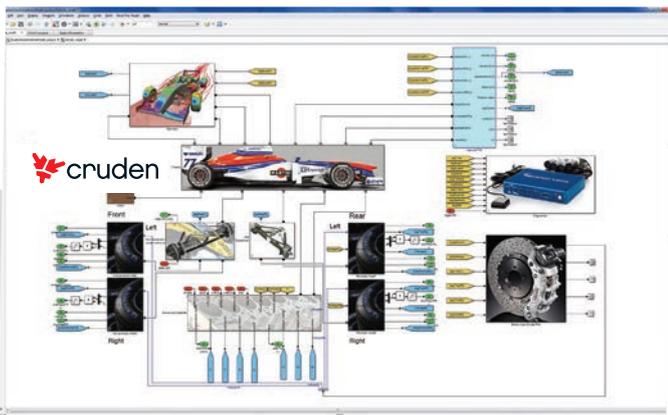
Cruden MS2 motion simulator

Why work with Cruden technology?

Whether buying a complete new simulator, or upgrading an existing system, there are seven key elements to building a simulator for motorsport engineering.

1. Professional simulator software

All Cruden simulators run on our Panthera software suite, which can also be purchased as a stand-alone desktop simulator application and used with any motion or static simulator system. Panthera is the gateway to running simulations, either by integrating a third party model or Cruden's (see below), or using an internal vehicle model if the need is primarily driver training. Panthera allows teams to modify and expand their vehicle model, add interfaces to race car hardware and use custom cars and tracks. It uses high-end physics and an excellent rendering engine and contains controllers for motion platforms, steering feedback, pedals, dashboard, visual systems and audio etc. as well as a scripting engine to define and customize the simulation. It is the ideal progression for race teams currently using gaming-style software such as rFactor, allowing access to highest quality 3D content.



2. Advanced vehicle dynamics model

Working with a vehicle dynamics model, as opposed to lap time simulation, is essential for teams taking an engineering-focussed approach to race car simulation. Cruden has developed its own highly detailed Simulink vehicle model, CSVM, which is a white box solution that is fully parameterizable and represents every element of the car, offering endless set-up possibilities.

For additional performance, this model can be compiled through Simulink Coder and either run on the Master PC or on a separate machine in both a hard or soft real-time environment

For customers already using a third party vehicle model, such as Canopy, SimPack or VI-CRT, Panthera ePhyse enables a seamless integration with the simulator.

3. Visual feedback

Visual input is the most important feedback for the driver. The graphics need to be accurate and realistic to provide the right reference, particularly in fast-panning visuals. Cruden delivers this through a high frame rate and resolution, and solid-state projectors.

4. Motion you can trust

Motion enables racing drivers to feel the grip of the car like they would out on the race track, ensuring more realistic driver behaviour during simulator work.

To evaluate the simulated race car in operation, it is essential that the driver feels immersed and behaves as naturally as possible. The car must operate with near perfect real-world-correlation, down to the last bump on the track, where the vehicle model, visual system, audio system and motion system are not only of sufficient quality, but they have been tuned to operate in sync and with minimal added latency. Our extensive experience and research shows that in achieving this, accurate timing of motion cueing and synchronisation with the visual system are key. We have developed technology for system synchronisation and latency mitigation, as well as specific motorsport 'Cruden Cueing' algorithms, which prevent the need for latency-inducing acceleration filters.

5. Hardware integration

To generate natural driving behaviour and for maximum immersion, it is necessary to integrate the actual race car hardware with the simulator, such as tub, pedal box, steering wheel and all driver interface equipment. Cruden undertakes the integration between customer-supplied hardware, vehicle model and software, resulting in a highly customized simulator which feels like the actual race car. Cruden's expertise is demonstrated in Formula E, where complex steering wheel controls are needed to alter the characteristics of the electric powertrain during the race. Cruden's simulator uses the exact same steering system connected to the actual ECU from the real car, which is integrated with the simulator as hardware-in-the-loop (HIL).

6. Integration with third party data logging tools

The ability to correlate track and simulator sessions is essential if the simulator is to be used for race car development and to verify that what is seen and felt in the simulator is matched in the real car. The best way to do that is with the tools already being used. Cruden simulators therefore integrate with all data logging systems and we have modules that integrate with Wintax and Pi Toolbox live telemetry tools.

7. Tracks and content

Cruden creates content and has built up a library of race and test tracks from around the world. The use of full LIDAR-scanned data provides the most accurate circuit representation, from a reassuring bump in the track to precisely defined slopes and banking and input for vehicle and tire models.

Products

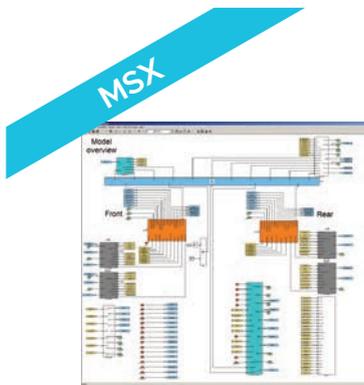
All Cruden simulators come with:

- ❖ Panthera simulator software
- ❖ High quality control loading: our in-house developed direct drive force feedback steering system, which is a purposely designed, multi-turn actuator for high-speed steering wheel applications.
- ❖ Multi channel visuals with high quality rendering and a professional projection system
- ❖ Content package of a skid pad and three spline tracks
- ❖ Integration with data analysis tool.

- ❖ High-end multi-channel audio system that uses top-class DA conversion, low latency signal processing, balanced signal distribution and high-end audio components.
- ❖ Harness loader

Upgrade options are available for each simulator, which include: display/projection system upgrades; external vehicle model integration; support for LIDAR track surfaces; hard real time (HRT) system for hardware-in-the-loop (HIL) integration; and motion upgrades such as additional degrees of freedom (DOF) and direct drive actuators.

Cruden has three standard motorsport simulator packages. More details can be found in our product information sheets. Our experts will help you choose the right solution for your situation.



A Panthera simulator software upgrade for any existing simulator. Cruden integrates all available team hardware, software and a vehicle model into a seamless, high performing package that progresses a gaming simulator into a realistic driving experience with high quality visuals, low latency, improved steering feedback and motion cueing.



A static simulator using a team-supplied tub/chassis, integration with vehicle model (CSVM included) and team hardware, set up with Panthera simulator software. A high-end low latency visual system, high fidelity force feedback steering, support for LIDAR track surfaces. Set up for future upgrades, to a motion platform for example.



A motion simulator, with Cruden's motorsport cueing algorithms, for car engineering development work in addition to driver training and set-up duties. In addition to the MS2 features, it offers HIL simulation through a hard real-time (HRT) system.

Cruden backs up its installations with maintenance, support and consultancy contracts. This can vary from responding to occasional phone and email queries, to providing remote online support, maintenance visits and full support and consultancy.

About Cruden

Cruden's founders have been developing professional driving simulators since the early 1990s. We were the first specialized company to supply motion-based simulators to the market and led the development of simulators in the motorsport automotive and marine industries. As a

result, we have the world's leading experts in simulator hardware and software design, vehicle dynamics and modelling, content and design, professional image generation and motion-cueing. Cruden was born in 2005 and the company is based in Amsterdam, the Netherlands.

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