



## 3D Visualization Software driving the latest Drive Simulators

Although drive simulators have been around for many years there has never been better interactive 3D visualization & simulation software available than there is today.

In addition, there have never been so many different applications for this 3D simulation technology. Software that enables the 'real' driver within a 'virtual' 3D space to have a 'real' driving experience, on or off-road.

While this technology has traditionally been used in human factors research, driver training and transport planning, due to the advances in software development it is also now becoming a significant element in the research into advanced vehicle safety and autonomous driving systems.

The choice of drive simulation hardware depends primarily upon the available budget and project objective. While all users would like a multi-million dollar hexapod based system, not everyone has the wherewithal. However, professional applications tend to demand more than a simple steering rack and LCD screen.

FORUM8 provides driving simulation customers with the widest choice of modern hardware systems based on both cost and technical specification. The company also provides an interactive 3D VR simulation software solution that can move seamlessly from a basic desk top driving simulator, to the most complex hexapod based system. Software that can be used to mimic the real world, thereby providing the driver with the most realistic driving experience technically possible – this software is FORUM8's **VR-Design Studio DS** (VR-DS).

The primary objective of VR-DS is to enable the simulation of the real world as accurately as technically possible. This includes being able to reproduce and control every conceivable environmental effect including time of day, location, shadows, lighting, headlights, puddles, rain, snow etc... The next is to enable traffic to be set and controlled including speed, volume and direction, along with the inclusion of a scenario editor to enable an infinite number of 'what-if' driving and infrastructure events to take place. The ability to import and then interact with 3D traffic networks from 2D micro-simulation data is also possible with this software.

Sound is added to complete the virtual driving experience. This includes the sound of the engine, horn, tyres (on different road surfaces), wind, rain, thunder, as well as other sounds associated with a normal drive, including crashes. VR-DS also features the ability to monitor and record the driver's carbon footprint through its Eco Drive system. In addition the dynamics of the driven vehicle can be set and altered dynamically, or alternatively more complex and comprehensive vehicle dynamics data can be imported from one of the industry standard 3<sup>rd</sup> party dynamics packages.

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Apart from providing the driver with the most realistic driving experience technically possible, VR-DS can record, report and replay all the actions of the driver and how he or she responds to the various drive scenarios they had to contend with during the driving period. This is achieved through the use of the Driver Diagnosis, Data Log-Export and Replay software plug-ins. These drive scenarios can be preset within the simulation to be triggered when the driver passes various 'way points' along the road, or they can be turned on or off remotely by a trainer (or researcher) connected by a wireless tablet, or directly via the control PC.

In addition to the fact that the actions of the driver and the vehicle can be monitored, recorded and replayed for both research and training purposes, multiple drivers can be networked together within a clustered system and can hence drive and interact with each other within the same 3D driving environment. Audio communication is also available from trainer to trainee(s).

In addition, the VR-DS software development kit (SDK) enables the production of a range of interfaces that enable such items as eye tracking devices and head mounted displays such as Oculus Rift to be integrated within the overall driving simulator system along with Hardware-in-the-loop (HILS) simulation systems.

There are a number of different HILS systems which can be integrated into a FORUM8 driving simulator system. In such cases they provide a 'virtual vehicle' for systems validation and verification thereby saving research and development time and hence reducing cost. HILS systems also enable all the variable factors within a test to be controlled and hence repeated when necessary thereby making the overall test 100% reproducible, something that is hard to achieve with a 'real' vehicle.

One of the latest applications of DS systems and in particular the VR-DS software is in the research into vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communication. This work is possible through the ability to incorporate the data from various warning systems & cameras into the software and the use of the VR-DS cluster software which enables multiple drivers to drive within the same 3D VR networked environment.

For example the FORUM8 ADS (Assisted Driving System), developed by one of our Partners, is an innovative new program which will help a driver to keep in his lane automatically whatever the road and weather conditions. Using a simulated 3D space within VR-DS drivers can be trained on the system in a safe environment. They will demonstrate an understanding of when it is appropriate to activate the ADS automatic mode lane assist and they will also be able to practice taking control back of their vehicle and continuing the drive in manual mode. Basic features of the ADS system, based on a simple USB camera, a PC and a step motor with its control card are:

- Lane keeping mode: re-centre's the vehicle and hands over to manual
- Full ADS mode: automatic centre lane keeping
- Audio and visual alerts to switch to fully manual
- Speed Sign Notification: beginning and end of speed restrictions detected and announced with on board vocal facilities
- Headlamp height and direction adjusts to road conditions in real time
- Road and travel condition recording system.

It is suggested that the new experience of not having to be constantly in contact with the steering wheel may mean less muscle strain, less fatigue leading to increased alertness.

Where necessary, audible and visual alerts warn the driver – for instance, white lines indistinct or absent, other vehicles too close, tailgating etc.

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One of the other great benefits of VR-DS is the ease with which 3D driving environments can be created. Whether building upon one of the existing pre-built road networks or starting from scratch there are a number of low cost ways in which to create either a hypothetical road system or a real cityscape.

For example, in previous versions of VR-DS, roads were usually defined by first pasting ortho aerial photographs onto the model's terrain, then developing the network and drawing the curves by entering turning points along the road in a 2D transverse section of the network.

The latest version of VR-DS (version 11) now enables the import of GPS data directly into the software to automatically create the road network.

This is achieved through the new Curve Calculation Function. By importing information via GPS tracking, or by means of a few simple clicks of the mouse along the road's aerial image, the road centreline, horizontal / vertical curves will be automatically generated as opposed to manual inputs in pre-ver.11 software.

Horizontal curves mostly consist of straight lines, arcs and transition curves and are calculated using these elements. This new function will first search for the straight lines and arcs before progressing any further. Once found, it moves on to calculate the transition curves that link together the straight lines and circles, or circles and circles (a.k.a. clothoid curves), and connects and combines everything together.

The vertical curve calculation is also done under similar logic to its horizontal equivalent. First it searches for straight lines and arcs, then calculates the turning points, and finally adjusts the VCL so it matches the point sets according to the road.

Another new way to develop an accurate road network as well as the surrounding infrastructure is by means of data captured by an unmanned aerial vehicle or drone.

MAPSs is Forum8's novel low cost method of producing a range of Geo, GIS & 3D interactive mapping products through the use of such a pilotless unmanned aerial vehicle (drone), coupled with the latest photogrammetric technology.

Data captured by the drone can be processed into a range of products:

- Aerial & Digital Terrain Maps
- 3D Point Clouds & 3D Meshes
- Real-time Interactive 3D VR Simulation Models
- Delivered with a full license of VR-Design Studio

A rapidly developing new method of generating 3D road and infrastructure networks is in the use of mobile laser scanning technology. Point cloud data collected by the laser scanners along with the RGB (colour) data can be directly imported into VR-DS using a plug-in to automatically generate a millimetre accurate representation of the target roadway. This can then be augmented as required and used immediately in a driving simulation. This technology is both being used and developed by FORUM8 in Japan and also by our US partner Mandli Communications ([www.mandli.com](http://www.mandli.com)).

For more information about FORUM8 Driving Simulation Systems contact: Patrick Hafferty at [patrick@forum8.com](mailto:patrick@forum8.com) or take a look at [http://www.forum8.com/idrive\\_simulator.htm](http://www.forum8.com/idrive_simulator.htm)

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