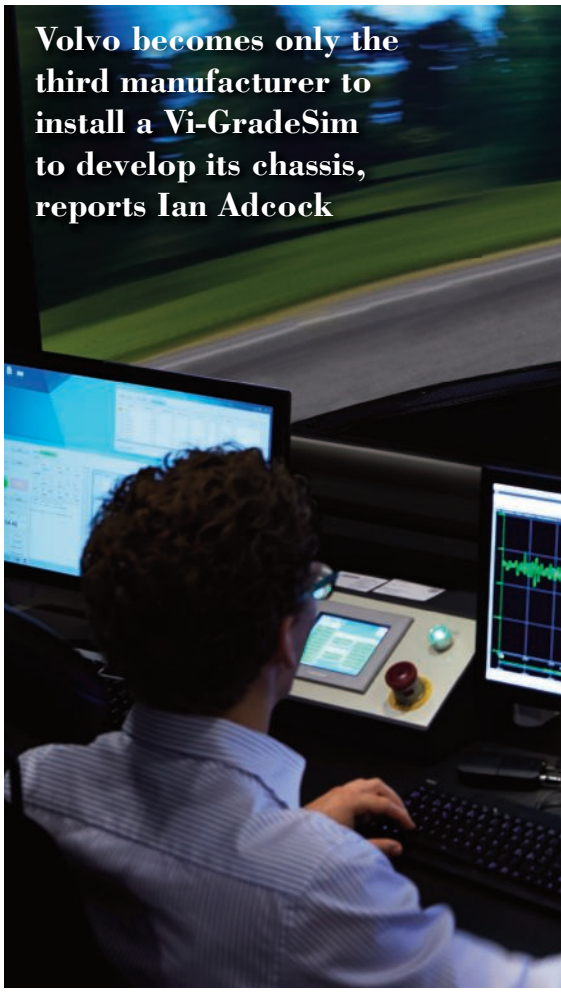
Achieving TOP GRADE

Volvo becomes only the third manufacturer to install a Vi-GradeSim to develop its chassis, reports Ian Adcock



VI-DriveSim is a turnkey solution from VI-grade that provides engineers with a complete set of innovative, integrated driving simulators for a new-generation approach to system-level simulation, allowing companies to bridge the gap between virtual prototyping and testing. VI-DriveSim provides the ability of 'feeling' the simulation results in a totally immersive environment, starting from early phases of the development process. And Volvo becomes only the third manufacturer after Ferrari and Porsche to install such a system.

Employing a patented 9 degrees of freedom (DOF) platform, VI-DriveSim is available in two configurations: static and dynamic. In the static format, users can drive a virtual vehicle model based on VI-CarRealTime, visualising vehicle behaviour on a wide screen with high quality graphics, while sitting on a fixed cockpit that does not move according to car manoeuvres.

The dynamic configuration provides motion feedback to the driver, thanks to an innovative moving platform with reduced overall dimensions and large travels. The new machine architecture, called Driver in Motion, and its kinematics has been designed, for the first time, to implement in the best possible way the motion cueing technology that has been developed and tested by VI-grade since the year 2008.

HOVER FACTOR

The system is based on a 16-ton plate with air bearings, described as "like a Hovercraft" by vehicle dynamics concept engineer Carl Sandberg, connected to the floor by three large actuators that deliver more lateral, longitudinal and yaw degree of freedom.

"We move the complete hexapod, upper frequency motions with the hexapod and the lower frequency motions of those three extra degrees of freedom with the tripod in the bottom," he explains.

This results in higher gains in lateral motion, and in braking and acceleration; and, most importantly, it gives as much yaw angle as possible. "The yaw degree of freedom, once you start operating that with a hexapod, locks up other DOF very quickly. It's much easier to represent the car's balance. As soon as you lose control, you have enough gain to feel what's happening when the car starts to rotate."

> The simulator's biggest benefit is trying new concepts "within days" and that takes months off developing physical models

Volvo used 3D-Mapping to get both the visual and point cloud data for the imaging with 5mm resolution in both longitudinal and lateral. That data is transferred to the road surface and then surrounding that is a virtual image of the environment. The laser

also captures a grey scale image of the road surface. Winter testing is still in the development phase. “Ice can be quite a challenge, as it differs; whereas, in the virtual world, it’s quite constant, unlike the real world. We’re working with the University of Chalmers and Gothenburg’s VTI research on snow model tyres.”

CLOSED LOOP

The simulator’s biggest benefit is trying new concepts “within days” and that takes months off developing physical models. Effectively, there is a closed loop between the physical and virtual models, so that, as the engineers home in to launch models, the importance of the physical testing increases and the CAD work diminishes. “The last few per cent is not what we aim for, but the preceding 95%,” says Sandberg. “It does require some training,” he admits, adding that it does help, if the test driver has some video game experience. “But what is important to remember is that the simulator is not trying to be reality, but a representation of reality.

“And so far in our simulator, we have focused on chassis hardware, suspension, and the important parts of body flex to create the correct balance and primary ride to start with. Secondary ride is under development, because of tyre models primarily.

“As we have very limited physical space on the simulator, compared to the 22kms long Nordschleife race track or our own Hällered Proving Ground, it means we cannot represent static accelerations when developing the chassis, so you won’t have centrifugal force under cornering. But you still get an input from steering actions or inputs from the road surface; or lose grip. You feel the changes and the car’s stability, but it still needs some drver training as to how the car feels in reality, compared to the simulator.

“I am still doing a lot of physical testing and chassis development to keep this link between the two very close. It’s important both for me to develop the simulator technically as good as I can, but it’s also important to gain trust from the simulation and physical engineers.”

Also, Volvo used the simulator in conjunction with a development mule code-named Costello. Based on a Ford-derived platform of the current S80, but fitted with an integral link independent rear suspension and double wishbone front set-up, it was powered by a tuned version of the current five-cylinder turbo engine, and made extensive use of lightweight carbon fibre body panels to imitate the new car’s power-to-weight ratio and weight distribution.


Carl Sandberg