Success Story

Fraunhofer Institute for Industrial Engineering

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Silicon Graphics Prism™ System Accelerates Vehicle Design and Lowers Development Cost

Zooming down the freeway at top speed, twilight fading to night and traffic gets heavier. You hit the button to power up the windows, lean over to turn on the air conditioning, flip the headlights on, and fiddle with the radio. Not sure of your exit, you'd like to hit the GPS, but the landscape is a blur, and just how long can you take your eyes off the road? This may sound like a typical drive on any major highway anywhere in the world, but it's all taking place in a virtual reality (VR) CAVE® in Stuttgart, Germany, where only the driver, a seat and a steering wheel are physically present.

Using Virtual Drive, created by the Fraunhofer Institute for Industrial Engineering (IAO), physical prototypes become unnecessary and test drives of many different variants can be performed in the early stages of vehicle design – reducing costs, accelerating work flows and resulting in more mature products. The VR driving simulation has a number of other important applications including driver training, and safety investigations.

Virtual Testing, Safer Designs

While the use of VR simulation in the auto industry is not new, the degree of realism in Fraunhofer's Virtual Drive 4-sided CAVE is a giant leap forward. The leather on the virtual passenger seat and dashboard, for example, is so real you can almost smell it. To create such an intense, immersive experience requires the use of huge data sets and a computer that can deliver the high-resolution visualization needed. Scientists at Fraunhofer use a Silicon Graphics Prism visualization system to solve a new class of data and rendering-intensive problems never before possible in virtual environments.

"Virtual Drive brings it all together – classic driving simulation, digital mock-up plus virtual reality technology," says Professor Dr. Ing. Dieter Spath, head of institute, Fraunhofer IAO. "This opens up completely new perspectives for virtual engineering. This approach allows – in a very early stage of the development

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The scientists at Fraunhofer IAO are always striving to improve their simulations and their ability to evaluate the effect of design on driver safety. The scalable computing and rendering capabilities of the Silicon Graphics Prism system allows scientists to maximize the realism of a virtual test drive with high resolution models, physically accurate dynamics and the latest in rendering algorithms.

"Data sets and models keep growing, the methods become ever more detailed, and the rendering processes more CPU intensive," says Matthias Bues, senior scientist, Fraunhofer IAO. "We decided in favour of the SGI system due to its shared-memory architecture and single system image capability. Due to the high bandwidth and low latency of the architecture, the traditional bottlenecks inherent in cluster networking are avoided. And, very importantly, we chose a Silicon Graphics Prism system because we think that there will be an increasing number of industrial customers who want to implement this kind of system. On the Silicon Graphics Prism system, we will be able to complete many tasks very quickly, very easily, and in some cases for the first time or with reduced expense"

With Franhofer's current project, one big advantage of their Virtual Drive on Silicon Graphics Prism system is that some weather conditions may be experienced much more accurately with a simulation than with a physical mock-up. A further advantage is that these simulations can take place anywhere and at any time of year.

"Rain or ice on the windshield, or moving fog formations, are quite difficult to achieve realistically using a real car at a test site," Bues notes. "You could project it on a display but it's not very convincing to a person's senses. With this virtual environment on the Silicon Graphics Prism system, we will be able to apply appropriate rendering methods to realistically simulate rain or ice or fog and evaluate the driver's performance under those conditions, in combination with other functions the driver controls."

Designing dashboards for optimal driver accessibility and safety is one of many projects at Fraunhofer, a non-profit research institute that works with European industries to help identify and then, under contract, develop relevant technology. Fraunhofer IAO has produced various VR applications resulting in prototype implementations in project partners' factories, including BMW, Daimler Chrysler, EDAC, Bosch, Siemens, and Peugeot-Citroen.

Maximizing Performance and Research Flexibility

Virtual Drive integrates the simulation of vehicle interiors with a classical driving simulator to create a fully immersive environment. By maximizing the realism of the external landscape, Virtual Drive creates an environment that helps test a driver's level of distraction. Houses, trees, traffic lights, exit signs and billboards, as well as varying traffic conditions are all rendered to match the rate of speed of the car.

"Virtual Drive poses a considerable challenge to the visualization system," adds Bues. "On one hand, image quality with highly accurate rendering and high resolution is necessary when we provide a visual of the interior with all details of cushioning and cockpit via fine texturing and shading methods; on the other hand, the visual simulation requires high frame rates in order to provide a smoothly running outside world view to the interactive drive simulation."

In addition to being able to drive all four sides of the CAVE at Fraunhofer IAO, the Silicon Graphics Prism system visualization system can also be used with a Scalable Graphics Compositor to combine the rendering power of the four graphics pipes into a single display. This scalable rendering capability allows Fraunhofer to stay at the forefront of VR development by creating virtual environments with very high resolution and scene complexity well before standard graphics cards are able to handle them.

Deployable, Industry Oriented VR Solutions

Bues' stated goal is to implement the Virtual Drive simulation environment throughout automotive manufacturing because the cost-savings of not having to build physical prototypes for sections of cars or entire vehicles will be quickly realized and far outweighs the initial price tag. The most important criteria for the choice of the Silicon Graphics Prism visualization system was its industry-leading shared-memory architecture, which gives scientists easy-to-use, flexible high-performance deployment options. The Silicon Graphics Prism system at Fraunhofer IAO is equipped with four ATI® graphics pipes, eight Intel® Itanium® 2 CPUs and 16GB of main memory and runs the Linux® operating system.

"An added benefit of the Silicon Graphics Prism, especially in an industrial user environment, is that it's simpler to administer than, say, a cluster, which is much more work, and more tedious to administer and run," concludes Bues. "When installing the entire Virtual Drive solution – the display system, input devices and core computer component – the Silicon Graphics Prism system is much easier to handle. Plus, being able to

The driver adjusts the rear-view mirror in the Virtual Drive environment

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Silicon Graphics Prism visualization system running the Virtual Drive environment

provide a smoothly running operational system seven days a week is an important criterion I hear from industry all the time. The availability of the overall system and ease of administration is a big advantage for the Silicon Graphics Prism system."

At least two times a year Fraunhofer IAO holds events or conferences to highlight new trends in virtual reality. In February 2005, the Institute unveiled the Silicon Graphics Prism system running the Virtual Drive prototype. They showed how the flexible the system will be used not only for the development of methods and tools for advanced VR applications, but also to provide services to small- and medium-sized architectural, construction, and manufacturing companies. These companies often do not have the visualzation and computational resources required to work with their data in virtual reality, but now they will have the opportunity to exploit the productivity advantages of the Silicon Graphics Prism system and even work with the Institute to create pilot projects.

The powerful and flexible design of the Silicon Graphics Prism system enables Fraunhofer IAO to efficiently press ahead with its industrially oriented research activities in the area of innovative production method development.

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