NVIDIA Maximus Case Study

NVIDIA Maximus Drives Better Performance, Higher Fidelity For Delphi

Delphi is a leading global supplier of electronics and technologies for automotive, commercial vehicle and other market segments. Operating major technical centers, manufacturing sites and customer support facilities in 30 countries, Delphi delivers real-world innovations that make products smarter and safer. To deliver top quality products with optimal efficiency, Delphi runs extensive digital prototyping, testing, analysis and simulation from the earliest stages of the development cycle.

Delphi designs and manufactures many of the systems that go into a car with the help of high-performance workstations, many of which are equipped with NVIDIA® Quadro® professional graphics processing units (GPUs). Designs include engine and transmission control modules, safety features, rear seat entertainment, navigation systems, audio systems and more. Delphi works with almost every major automotive manufacturer and at the recent Geneva Motor Show demonstrated Delphi technologies and systems developed for Volvo, Ford, Ferrari and Audi.

Senior Mechanical Engineer Fereydoon Dadkhah works in the Mechanical Analysis and Simulation group for Delphi's Electronics and Safety Division. He is part of a group based in Kokomo, Indiana that is a center of analysis expertise for the product development team. Additionally, Delphi maintains a staff of over 40 engineers who focus on product development analysis using ANSYS at facilities across India, Poland and Mexico. In order to streamline their analysis workflow, Dadkhah has been working with NVIDIA to evaluate the NVIDIA® Maximus™ system. The Maximus system combines NVIDIA Quadro GPUs for visualization and interactive design and NVIDIA Tesla® GPUs for high-performance computing. In testing, Maximus has enabled Dadkhah to simultaneously use ANSYS and CAD tools on a single workstation.

"As a 20-year user of ANSYS, and as an engineer who has seen all types of solutions, I can attest that the GPU helps significantly shorten the time needed to get results, and streamlines workflow by providing the ability to use CAD tools while simultaneously running simulations," said Dadkhah.

CHALLENGE

To achieve the most accurate indication of how a product will perform in the field requires analysis of very large, complex models. The problems engineers face are twofold: the fidelity of the data and the efficiency of the analysis—both issues that can be addressed with greater processing power. "We're often trying to duplicate something that's happened in the real world and it's not always easy to get that data accurately," explained Dadkhah. "We often have to pare down and simplify complex models or make assumptions about data just to be able to run a simulation. We've been looking for ways to enhance analysis performance, and efficiency."

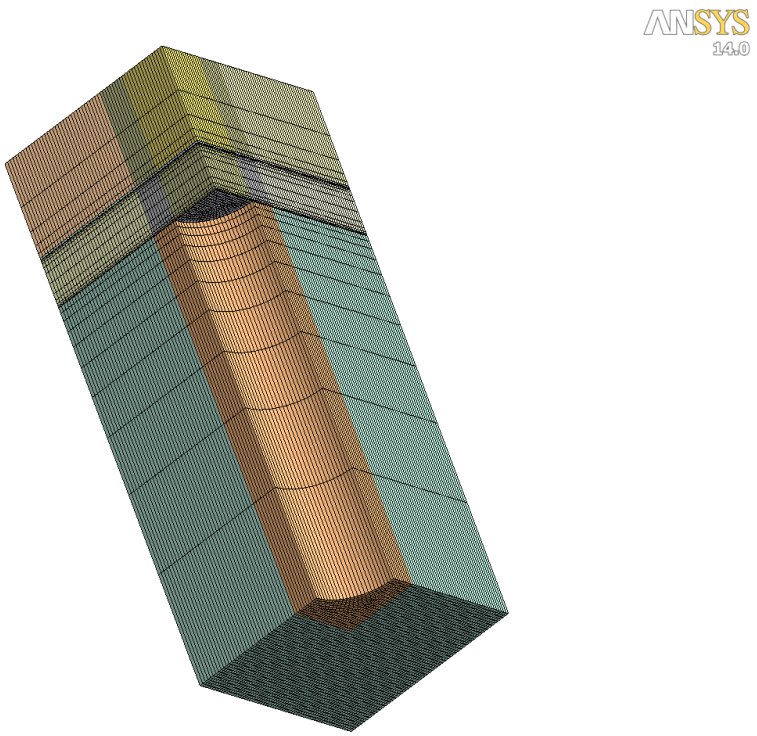

Figure 1- Silicon/substrate assembly model consisting of over 1 million nodes

"As the product development cycle evolves, analyses get more and more sophisticated and have to take into account all of the non-linearities, transient inputs and other unexpected results in testing. Modeling that can require many, many analysis iterations can be a very time consuming process, tying up a workstation for days as simulations run overnight," said Dadkhah.

The ability to do both CAD work and run ANSYS simulations simultaneously poses a distinct workflow advantage. "Waiting until the FEA work is done to move on to the CAD work is a slower, sequential process. It's much more efficient to be able to simultaneously work on the next phase of the problem, such as preparing a model for analysis, or to be able to make necessary changes while an analysis is still running," said Dadkhah. This is due to the fact that the Tesla GPU reduces the computational load on the workstation's processors, freeing resources that can be used for tasks such as CAD modeling.

SOLUTION

To enhance Delphi's analysis workflow without having to set up a big compute server or cluster, Dadkhah tested a desktop workstation that could leverage NVIDIA's latest GPU workflow solutions.

“One of the projects I’m working on is a transmission control module. The specific part that we’re evaluating is the connector for this module. To get accurate results, however, we’ve had to include the entire transmission controller model in our analysis. Working with that entire model—over a million nodes translating to 4.5 million degrees of freedom—is impractical with a traditional workstation, but on the Maximus system, most runs were finished in approximately 20 minutes. Obviously this number fluctuates significantly depending on the complexity of the model and simulation that we’re running, but it represents a huge improvement over our present situation where runs can routinely take many, many hours, often overnight,” Dadkhah explained. “Plus, with the GPU, my workstation can handle all the data. I don’t need to simplify the model as much for the simulation to run, and I can keep working even while simulations are running.”

In most cases, Delphi has seen anywhere from 20 percent up to 40 percent improvements in simulation runtime evaluations on the Maximus system, which adds up significantly when working with large models. This enables the team to iterate more frequently and thoroughly during the development process.

IMPACT

The results of this benchmark show that NVIDIA Maximus technology can enable Delphi to run analyses on more complete models and avoid making simplifications that are required for efficient performance on systems with less GPU power. “I recently had a situation for a vehicle window lifter switch where, at first glance, I envisaged having to make many assumptions and simplifications to enable the model to run on my workstation. With Maximus, I was able to run a large version of that model including all critical product features and get accurate results,” concluded Dadkhah.

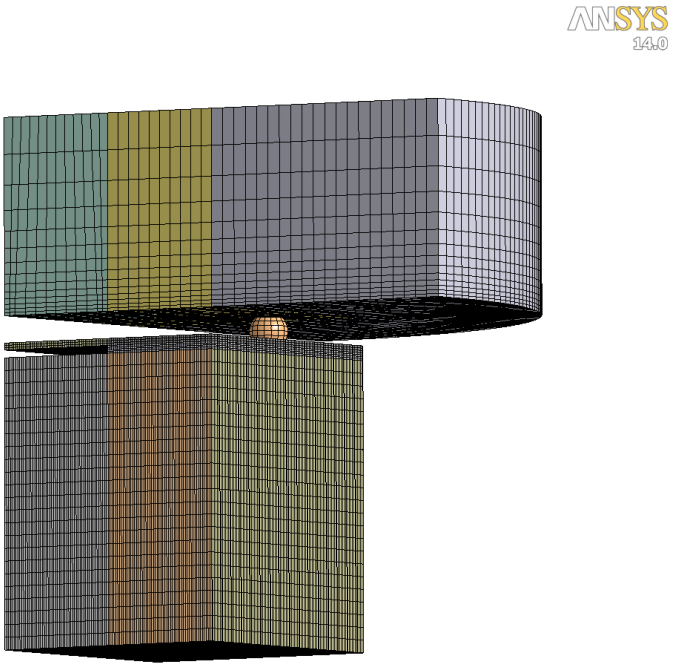

Figure 2 - Sensor model consisting of 1.6 million nodes

The ability to run ANSYS and CAD programs simultaneously can provide significant improvements in speed and efficiency for Delphi engineers. Moving from a sequential to a simultaneous process saves time and increases productivity by allowing engineers to make changes to the CAD model while a separate simulation is running, without having to wait for that portion of the analysis to end before working on a possible design or material optimization.

At Delphi, faster speed and the ability to iterate more frequently allows the analysis team to run simulations using better, more complex stress models for more accurate real-world performance predictability. Being able to use design and simulation tools together frees up valuable wait time, boosts productivity and makes it possible to maximize usage of workstations without the time and logistical challenges involved in moving to another system.

Analysis is an essential part of the product development cycle to Delphi and their larger customers who have very exacting design standards. As a result of this evaluation Dadkhah has concluded that NVIDIA Maximus technology provides the performance boost that allows him to run finite element analysis using larger models, drive faster simulations and provide accurate results that help bring better, more reliable products to market.

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