NVIDIA Maximus Success Story

NVIDIA Maximus Technology Helps Astrobotic Ignite New Era of Moon Exploration

When the Google Lunar X PRIZE was announced in 2010, Astrobotic Technology was among the first to heed the call. The reward: a total of $30 million, the largest international incentive prize of all time, available to privately funded teams. The challenge: be the first to safely land a robot on the surface of the moon, control the robot to travel 500 meters over the lunar surface, and send high-definition (HD) video, images, and data back to earth.

"Astrobotic is a bit like UPS, but for the moon," said Jason Calaiaro, director of Information Systems for Astrobotic Technology. The company's primary service is the delivery of payloads – scientific instruments, space agency exploration gear, data collection devices, etc. – to the lunar surface. The Lunar X PRIZE fit nicely with Astrobotic's goals and business model and promises to provide some high-profile publicity to the company.

To help keep its competitive dreams on track, Astrobotic needed to be able to do its complex robot design, structural and vibration analysis, and visualization more quickly and completely. The company upgraded its hardware to include NVIDIA® Maximus™ technology powering Dassault Systèmes SolidWorks, ANSYS, and MathWorks MATLAB software. Not only is this sophisticated technology helping position Astrobotic for Lunar X success, it is also helping to ramp up the company's main commercial ventures.

CHALLENGE

Astrobotic was founded in 2008 as a spin-off from the Robotics Institute of Carnegie Mellon University in Pittsburgh, PA, with the mission to build robots able to explore and deliver payloads to the moon, Mars, and beyond. Despite its lofty goals, Astrobotic is a small company, with about 20 people either on its staff or collaborating at the University, and without the budget to support a centralized server. Instead, its engineers rely on a distributed network of workstations to design their products.

The company's two primary products – a lander and an attached rover – are devised to travel joined to their destination, such as the moon, after which the rover separates to roam the surface. The rover can send HD video in near real time.

"There's tremendous scientific interest in exploring the moon," said Calaiaro. "For instance, scientists believe that moon soil contains enough rare metals (such as platinum), rocket fuel, oxygen, and water to build and fuel what's needed to go to Mars and other planets. Robots could be used to set up a moon base, extract materials, and even assemble equipment."

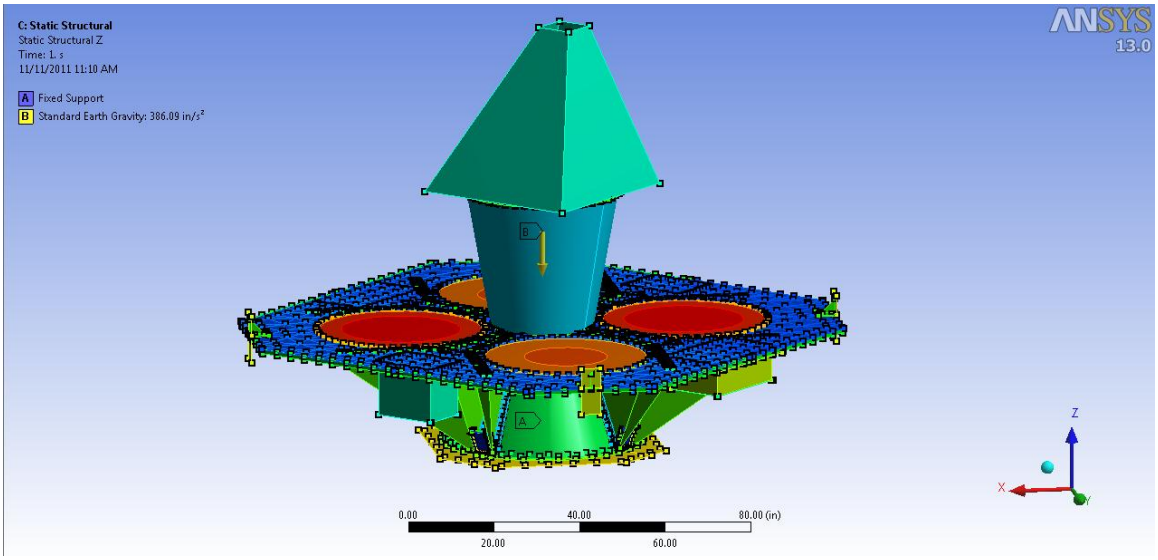
Remote robots working autonomously obviously require extremely precise design and direction. Before using NVIDIA Maximus technology, each step of Astrobotic's engineering process took too long. More seriously, doing any data-intensive step – 3D design, or analysis, or rendering – completely consumed the computer.

“Running through any engineering problem, such as doing the underlying calculations in MATLAB or refining a part’s final shape in ANSYS, turned the computer into a dead node,” said Calaiaro. “The engineer would have to walk away from the machine and often had to just sit around for a few hours. In a small operation like ours, it’s never a good thing when an engineer is forced to sit idle for any length of time.”

In the past, Astrobotic had to depend on its excellent working relationship with ANSYS, a sponsor of the robotics company, to run many of its calculations for them. “While we appreciated the help from ANSYS, not being able to do our own analysis in-house led inevitably to schedule delays and inefficiency caused by communication barriers,” said Calaiaro. “Little errors that our own engineers would have noticed immediately went undetected for weeks or months. It was not an ideal situation.”

SOLUTION

Astrobotic implemented NVIDIA Maximus technology, which brings together the industry-leading, professional 3D graphics capability of NVIDIA Quadro® professional graphics processing units (GPUs) with the parallel-computing power of the new NVIDIA Tesla™ C2075 companion processor, to enable simultaneous 3D design, simulation, and visualization at the desktop. On this hardware base, Astrobotic runs its SolidWorks 3D CAD, MATLAB mathematical modeling, and ANSYS analysis software.



“In our line of work, it’s always a good idea to fail early in a project, so we can investigate our failures and fix them early, as well,” said Calaiaro. “We are now able to do some very useful and interesting investigations with ANSYS that wouldn’t have been possible before.”

For instance, Astrobotic might want to find the best materials to use to build a particular part. They might have 10 materials to consider, and the analysis for each one might take half an hour. With their previous set-up, it would have meant monopolizing a computer for five hours to work out this one piece of analysis, during which the computer – and the engineer using it – couldn’t do anything else.

“Now we can create large analysis profiles and ask all our questions at the same time, and while the computer is figuring it out the engineer can continue doing CAD with SolidWorks or calculations in MATLAB,” said Calaiaro.

IMPACT

“The NVIDIA Maximus-powered system is like getting three people’s worth of use on a single machine,” said Calaiaro. “This system is a beast. We haven’t yet found anything it can’t handle, even simultaneous CAD, analysis, and additional number crunching in remote rendering jobs.”

For ANSYS analysis, file sizes are expressed as degrees of freedom. “Previously with our lander model, we had to keep file sizes small to get analyses done in a reasonable time, restricting ourselves to about half a million degrees of freedom,” said Calaiaro.

“Maximus shines when you get above about 1.5 million degrees of freedom. Now we can do complete analyses on our lander that run 2 million to 3 million degrees of freedom, which means we can refine and test our models more completely and in less time.”

By enabling parallel processing of even compute-intensive tasks, the Maximus technology is ideal for Astrobotic’s distributed computing environment.

“We can do all our highly complex analysis or rendering without interrupting other work going on locally,” said Calaiaro. “That’s such a powerful capability for a small company like us. It means all our engineers can keep working full-tilt without sitting around while their computers are tied up.”

In addition to being able to work more efficiently and get more work done in the same amount of time, Astrobotic is also taking advantage of additional opportunities that it wouldn’t have been able to fit into its workflow before.

“There are many opportunities within NASA for new designs of rovers and other types of robots,” said Calaiaro. “The Maximus-powered system lets us take on more projects, which boosts our revenues and eventually will allow us to get to the moon faster.”

The phrase “the sky’s the limit” used to mean unlimited possibilities. Astrobotic is putting a new spin on that old adage, by proving that even “in the sky” (i.e., in space), it’s possible to encounter and overcome limitations.

“We intend to win the Google Lunar X PRIZE, while also working to revolutionize so much more about the exploration and practical use of the moon and nearby planets,” said Calaiaro. “The computer should never be the limiting resource for a company. With NVIDIA Maximus, it’s not a limit for us any more. The whole environment here is much more pleasant and productive.”

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Images courtesy of Astrobotic Technology.