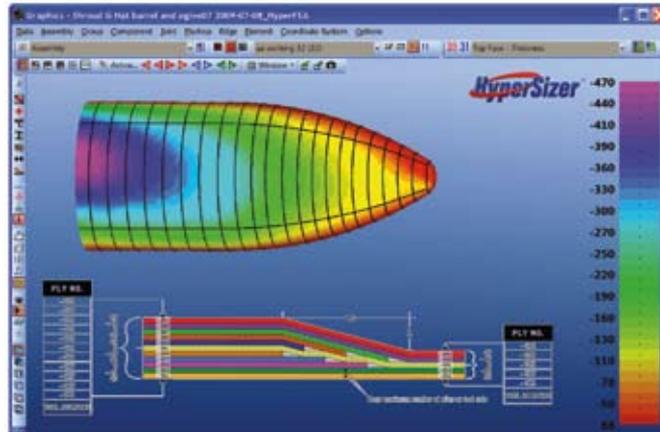


## Preliminary Design of NASA's Ares V Launch Vehicle Optimized with HyperSizer for Abaqus

NASA's newest and largest space launch vehicle, the Ares V Heavy Lifter, includes three major composite structures: the payload shroud, interstage, and core intertank. To streamline the optimization of NASA's composite structures, Collier Research Corporation used HyperSizer combined with Abaqus FEA from SIMULIA.

The Ares V payload shroud is the most challenging design as its bullet shape structure separates into four petals to release the lunar lander. Aerodynamic pressure on the shroud is resolved into internally distributed forces. Abaqus was used to compute the internal load path and load amount in the stiffened panel and the ringframes. HyperSizer was then used to analyze, or "size," the panels' cross-sectional dimensions and layups. HyperSizer was able to predict the stresses and strains in the composite laminates and at each ply level for strength failure using damage tolerance allowables, test data, and correction factors. Buckling and crippling analyses were also performed. The newly "HyperSized" structure was then exported into Abaqus for redistribution of loads. This iterative process continued until convergence of load path was achieved.



HyperSizer optimized model of the NASA Ares V Composite Shroud showing computed forces. Below the shroud is an optimized Composite Ply Sequence showing minimum ply drop-offs for streamlined manufacturability.

One key challenge is developing the most efficient composite layup sequences. The "Ply Compatibility" feature in HyperSizer helps stress analysts as well as design and manufacturing teams develop more practical composite lay-ups. HyperSizer generates the Global Sublaminates Stack (GSS), intended to maximize the number of plies that can be put on the composite layup tool. The key is to minimize the number of ply "drops," allowing for fewer non-continuous plies. HyperSizer is capable of assessing well over a million possibilities to determine both the lightest-weight design and the most easily manufacturable design.

The NASA Advanced Composite Technology Team (ACT) performed multiple trade-off studies to design the strongest, lightest, most manufacturable composite launch vehicle—making the Ares V the next "giant leap for mankind" in large-scale optimized composite vehicles for future space flight.

For More Information  
[www.hypersizer.com](http://www.hypersizer.com)