

Gridgen Enables Joint Strike Fighter Optimization

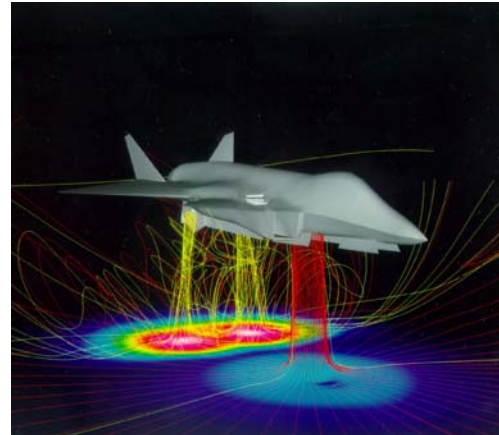
Northrop Grumman Corporation used Gridgen to develop a computational fluid dynamics (CFD) model that helped to optimize the performance of an advanced fighter aircraft. Northrop Grumman used the 5,000,000 grid point model to investigate vertical landing for the Joint Strike Fighter, the U.S. Air Force's next generation combat plane. The model, which covered the entire exterior of the proposed aircraft, helped engineers investigate the effects of entrainment. Entrainment produces negative lift and must be counteracted by additional engine thrust. Gridgen automated most of the model creation process, including strategically distributing grid points for high accuracy while minimizing computation time.

Northrop Grumman is a principal member of the Lockheed Martin team in the competition to develop the Joint Strike Fighter (JSF). The JSF employs a direct lift system for short takeoffs and vertical landings, with uncompromised up-and-away performance.

The JSF is an affordable, multi-service aircraft that will enter service in the next century with the U.S. Air Force, Marine Corps, Navy and the United Kingdom Royal Navy. America's armed forces will need as many as 3,000 JSFs to replace several different aircraft in service today.

The Advanced Short Takeoff/Vertical Landing (ASTOVL) design was a previous concept tested at near full-scale in the wind tunnel. One of the critical issues that arose during the development of the ASTOVL, and the JSF, was a concern over negative lift caused by close ground effects during vertical landing.

Simulating an object as complex as the ASTOVL, however, is a difficult challenge. The problem is the analytical model must include the entire aircraft exterior and at the same time capture many small details in order to achieve an accurate simulation. Conventional CFD preprocessors are not suited to the task. Meshing the entire aircraft is not difficult but maintaining the level of detail required to define such complex areas as the engine inlets would require a model with an enormous number of grid



Northrop-Grumman used Gridgen for this CFD study of entrainment and flow patterns around a JSF model in VTOL mode

points. Such a model couldn't be solved in a reasonable period of time, even on the Cray C90 computers at NASA Ames Research Center that Northrop Grumman engineers have available.

The irregularity of the ASTOVL geometry meant that the initial grid had areas of negative and zero volume that would have made it impossible to analyze. With a conventional grid generator, Northrop Grumman engineers would have been forced to modify the grid element by element to improve its quality, a process that would have taken months or even years. Fortunately, Gridgen provides an elliptic smoother that allowed the engineers to improve the quality of the mesh automatically applying elliptic partial differential equation methods. Engineers applied smoothness, clustering and orthogonality controls to improve the mesh. The program provided a graphical display of negative and skewed volume cells. In only a few hours, they had produced an excellent quality mesh ready for analysis with Northrop Grumman's proprietary CFD solver.

Article by Mike Malone, Engineering Specialist at Northrop Grumman Corporation, Pico Rivera, CA.



Pointwise, Inc., 213 South Jennings Avenue, Fort Worth, Texas 76104-1107
888-GRIDGEN 817/377-2807 FAX 817/377-2799 www.pointwise.com gridgen@pointwise.com

App Sheet—NG JSF

Reprinted from the *Focal Point* Spring 1999

Pointwise and Gridgen are registered trademarks and GridgenGlyph is a trademark of Pointwise, Inc. All other trademarks are property of their respective