

# Dynamic Adaption in **FLUENT 6.1**

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fronts, thereby efficiently targeting the computational effort on the features of the unsteady blast. Without adaption, it would not be feasible to model unsteady wave propagation, since the refined grid needed throughout the region of activity would dramatically increase the number of cells. Using adaption, the grid can be not only refined as needed, but coarsened once a shock wave passes a given location. In order to develop a methodology and to validate FLUENT for this class of problem, the CFD results were compared to an experimental data set from a 7.62mm NATO G3 rifle<sup>1</sup>. A series of experimental shadowgraph images acquired from test firings of the G3 were used.

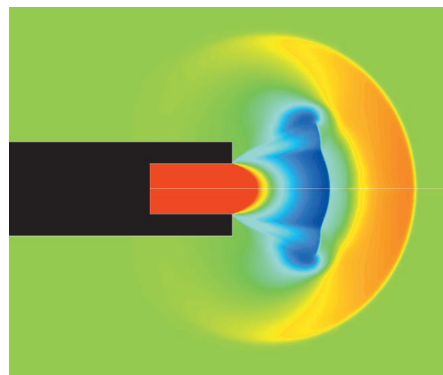
Early calculations using the coupled explicit solver in FLUENT 6.0 accomplished the dynamic adaption by means of text user interface (TUI) commands that were executed at regular time intervals using the "Execute Command" functionality. FLUENT's adaption routines were written primarily for steady flow fields, so this comprised a new application. For each adaption, the refinement was unproblematic and could be done in a single step. By contrast, the coarsening had to be done in several steps in order to keep the number of marked cells low. In addition, maintaining stability while solving the second order flow equations was difficult. Nonetheless, the results were promising, with FLUENT's shock structures matching the shadowgraph very closely. ■

## references:

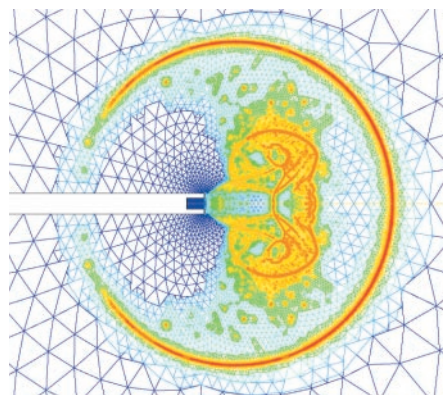
1. Günter Klingenberg and Joseph M. Heimerl. "Gun Muzzle Blast and Flash." Volume 139, Progress in Astronautics and Aeronautics. American Institute of Aeronautics and Astronautics: Washington, D.C., pp. 134-148 (1992).
2. *ibid.* Copyright © 1992 by the American Institute of Aeronautics and Astronautics, Inc. Reprinted with permission.

In contrast to the creative but cumbersome approach of using FLUENT's "Execute Command" functionality for dynamic solution-based adaption, FLUENT 6.1 provides an easy to use dynamic adaption capability for transient, as well as steady state computations. In addition to the derivatives FLUENT 6.0 uses to control the adaption, FLUENT 6.1 provides scaled and normalized derivatives (gradient and curvature) that do not require the user to readjust the adaption parameter during the computation.

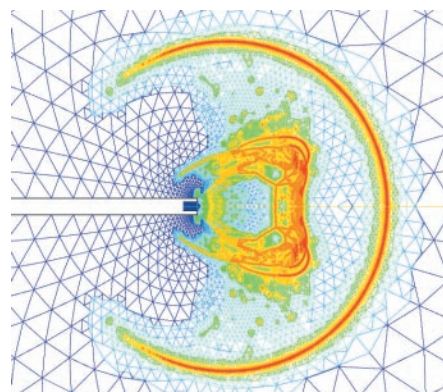
Recent simulations have made use of the new dynamic adaption capability. Benet Laboratories has kindly provided the geometry and flow conditions, and this challenging case will become part of the test matrix used to validate future versions of FLUENT 6. Density contours at 350 $\mu$ s are in very good accordance with the experimental results from the previous article. The resolution of the shocks has improved, because a higher level of refinement can now be used. Finally a sobering statistic on the efficiency of dynamic adaption: if the entire domain (a rectangle of 7,000 by 3,500mm) were resolved to the same level as the resolution of the shock in the present example, about 133 million cells would be required. Given the 135,000 cells used for the adapted case, the cell count is better by a factor of 1,072! ■



Contours of density at 350 microseconds before the shot exit (compare with the top figure from the previous article)



Grid colored by cell refine level (100,000 cells) at an intermediate time



Grid colored by cell refine level (135,000 cells, with a maximum adaption level of seven) shortly before the shot exit

