NUMERICAL SIMULATION OF SHOCK WAVE INTERACTION WITH COMPLEX THREE- DIMESNIONAL BODIES USING UNSTRUCTERED ADAPTIVE GRIDS

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This paper describes the application of a new three-dimensional adaptive finite element scheme to the simulation of shock interaction with complex geometry bodies such as tanks, trucks, etc. The classic h-enrichment/coarsening is employed in this scheme in conjunction with a tetrahedal finite element discretization in three dimensions. In order to simplify the refinement/coarsening logic and to be as fast as possible, only one level of refinement/coarsening is allowed per mesh change, which occurs every 4-7 time steps. A high degree of vectorizability has been achieved by pre-sorting the elements and then performing the refinement/coarsening groupwise according to the case at hand. The results of shock wave interaction side-on with generic tank will be examined and discussed in detail. The analysis will identify and discuss several three-dimensional shock diffraction processes. Finally, pressure-time histories at several locations will be compared to available experimental data. This comparison should indicate the level of accuracy which may be obtained using the current 3-D model and available computational recourses.

The attached figures demonstrate the ability of the new 3-D grid adaptation routines to adapt the mesh (using 2 refinement levels) to shocks and other high-density gradient flow processes, and to coarsen the mesh once these gradients cease to exist at the given location. Shown here are the adapted mesh distribution after 800 time steps and a superposition of the mesh and the pressure contours at this time showing the adaptation capabilities of the new scheme. The Gouraurd-shaded pressure contour plots at
0,800, 1600 and 2900 time steps, demonstrate the existence of several shock wave diffraction processes around the tank's decks, turret, wheels, cannon and the hull. Expanded discussion of these processes will be given in the full paper.