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SIFTING MAZ CALCULATIONS FOR HIGHER ORDER BLAST EFFECTS

C.K.B. Lee

Weidlinger Associates Inc.
Los Altos, California
USA

We present results from a set of numerical calculations using the MAZ code. Unlike many modern hydrocodes that can only yield a higher order solution, MAZ offers both a low order solution and a high order solution depending on the input. Our physical problem is to determine the pressure and impulse signatures on the ground surface from the explosion of a 2 x1x1 box of TNT. The bottom of this box is several feet above the ground surface. We performed a set of quarter space calculations taking advantage of the symmetry. In each calculation we recorded the peak pressure and maximum impulse (to 2 ms). We follow the traditional method of plotting the peak pressure and the maximum impulse as a function of distance from GZ in the direction of the long axis of the box. The resulting peak pressure and maximum impulse distributions on the ground along the length of the box varied drastically according to the coarseness of the initial grid, the input CFL number, and the input maximum level of adaptivity. When the initial grid is coarse, and the CFL number is close to 0.15, the resulting peak pressure and maximum impulse on the ground have the shape of a bell-curve centered at GZ. This behavior agrees with the traditional understanding of the decay of explosive effects from the explosion point. Because the modern desktop computers allow us to further fine-zone the problem, we continued the calculations to much finer zones to see if this behavior persists. As we refine the grid, we found that the maximum allowable CFL number for the TVD scheme in MAZ begins to increase. The highest possible CFL number for our runs in this geometry is ~ 0.5. Meanwhile, the peak pressure plot begins to show a highly anomalous peak ~ 1.8 ft from GZ. The magnitude of this peak is almost twice the peak pressure at GZ. This anomalous behavior triggered a more detailed fine-zoned study. It was concluded that the coarse-zoned results that agreed with traditional understanding belong to a class of low-order solutions typical of the hydrocode results from the 1970s. The results of the fine-zoned high CFL set with the anomalous peak are believed to be the more accurate result. Sifting the calculations in more detail reveals that the anomalous peak is a result of a compressibility effect on the explosive. In this box geometry, the low order solution failed to describe the detailed compression of the explosive immediately behind the shock/detonation front. Although the overall yield in both solutions is the same, the compressibility effect that produced the anomalous pressure peak on the ground in the higher order solution was not predicted by the low order solution. The road to higher order weapons effects is rough and a good fraction of the conventional understanding derived from low-order hydrocode results can be severe roadblocks.