INVESTIGTIONS ON FLUID DYNAMIC INSTABILITIES AND PRESSURE FLUCTUATIONS IN THE NEAR FIELD OF DETONATIONS

A. Klomfass, T. Kisters

Fraunhofer Ernst-Mach-Institut, Eckerstr.4, 79104 Freiburg i.Br., Germany

During the initial development of a blast wave the Rayleigh-Taylor and Richtmyer-Meshkov instabilities act on the interface between air and detonation gases. These instabilities let an initially smooth interface evolve into an irregularly rough shape, resembling that of a cauliflower. In a numerical investigation by the author, [1], it was found that in conjunction with the instability of the fluid interface significant fluctuations of the static and total pressure fields occur in the near field of the detonation of a spherical TNT charge. These fluctuations may render a large uncertainty to the determination of the blast loads acting on an object in the near field.

In the current paper we present spatially three dimensional, high-resolution simulations together with results from scaled and real size experiments. The investigated configurations are detonations of spherical TNT charges at distances between 0.2 $m/kg^{1/3}$ and 0.4 $m/kg^{1/3}$ above ground and between 0.5 $m/kg^{1/3}$ to 1.5 $m/kg^{1/3}$ to a planar vertical surface. These configurations have been chosen due to their relevance to IED attacks on military vehicles. As in [1], the numerical simulations are conducted on stretching Cartesian grids which are continuously adapted to the expanding blast front. This technique guarantees an adequate spatial resolution throughout the entire blast evolution. The evaluations of the simulations and the experiments reveal the statistical fluctuations of peak pressures and positive impulses in both the free field and on the loaded planar surface in the near field of the detonations. In addition, we identify those zones, where the superposition of incident and reflected waves and the refraction of waves on the fluid interface lead to particularly large spatial variations of the pressure and impulse distributions.

References

[1] A. Klomfass: “Numerical Investigtion of fluiddynamic instabilities and pressure fluctuations in the near field of a detonation”. Proceedings of MABS 20.