BLAST-INDUCED MOTION: DIFFERENT HYDRODYNAMICS DOMINATES FOR SHORT-DURATION BLAST

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Continuing from exploratory experimental research reported at the previous MABS-24, computational studies have confirmed there is a dramatic shift of behavior in the blast-induced motion of spheres as the sphere size approaches the same order-of-magnitude as the blast wavelength which is a common circumstance for IED attacks against vehicles and personnel. The previous MABS paper described the preliminary and unexpected result that subsequent to a relatively low ‘kick-off’ velocity imparted by the diffraction of the shock front, spheres were actually decelerated in the afterflow when the sphere diameter was even 1/20th that of the blast wavelength. The unusual behavior is due to the combined effect of the initial shock-front diffraction and the gradients in the freestream flow leaving vortices embedded in the afterbody region of the spheres. This observation of what is effectively a ‘negative’ drag coefficient is in fact opposite to what for smaller spheres and dust particles exposed to the typical step-function shockwave of standard shock tubes for which greatly enhanced drag is reported. The current results have implications for problems such as blast-induced traumatic brain injury (bTBI) where many studies had concluded that severe acceleration from blast was the likely biomechanical cause for the injury.