

PHOTOGRAMMETRY OF SEQUENTIAL MULTI-BURST EXPLOSIONS

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There are various circumstances in which explosions may occur in sequence. Some examples are a methane followed by dust explosion in a mine; an explosion in a storage area which triggers the detonation of adjacent sources, and a sequence of explosions from multiple munitions. The overall effect of such explosions will depend on whether the multiple blast wave remain separate or overtake and coalesce, and on other structures impacted by first blast are made more vulnerable to subsequent blasts. The use of photogrammetry and other time-of-arrival technique for studying sequential explosions has been limited because of the need to know physical properties of the gas immediately ahead of a shock front entrained in a previous blast wave. To overcome this difficulty two photogrammetric techniques have been combined and used to study the blast waves produced by three 100 kg charges, each detonated at a height of approximately 2.5m. One charge was initiated first. 30 ms later the other two charges were detonated simultaneously, inside the first blast wave. The Mach stem blasts formed over the ground from these two charges combined to form a „cleavage“ Mach stem which moved in the negative phase of the first blast. The refractive images of the shocks from the three charges and of the „cleavage“ Mach stem were photographed using high speed cameras. From the resulting films the velocities of the shocks were determined. The cameras also photographed a linear array of smoke puffs formed along the path of the „cleavage“ Mach stem, in the plane symmetry between the two charges and through the first charge. An analysis of the particle trajectories determined from the movement of the smoke puffs provided a mapping of the physical properties throughout the blast wave from the first charge, and in particular, gave those properties immediately ahead of the „cleavage“ shock so that the time varying properties of that blast could also be determined. The results of these measurements and analysis will be presented.