NEW EXPERIMENTAL DATA ON BLAST INTERACTION WITH INSTRUMENTED STRUCTURES

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ABSTRACT

The aims of this study are to understand the behavior of the air blast around rigid structures close in shape to a thorax and to analyze the response of the same targets, but deformable, in terms of pressure, impulse and kinematic parameters caused by different air blast profiles. The exposed structures are hollow rectangular parallelepipeds (RPP) and cylinders, composed of Dural® or elastomer of polyurethane material. The chosen scenarios are the detonation of 300g of C-4 at three different heights of burst, so that the structures are in the simple reflection regime, the Mach stem regime, and the transitional one.

Each structure was instrumented with pressure transducers at different locations, in addition to one accelerometer for the deformable targets. Four hundred fifteen reproducible pressure profiles and accelerations were collected, which could then be used for numerical validation. Moreover, a high-speed camera recording at 20,000 fps was installed to record the shockwave propagation and interaction with the simplified torso surrogates, allowing to see some physical phenomena at play.

From the rigid structures, it was shown that the received impulse at different location is influenced by rarefaction waves created at the surrogates' edges. Moreover, the impulses received on the RPP, which offers more surface to the blast, are higher than the ones received on the cylinder. Indeed, the increase in impulse is around 20% in front, 39% on the side, and 17% on the rear, with no significant variations according to the regimes.

From the deformable surrogates, it was shown that the peak of acceleration is influenced by the pressure-time history despite similar maximum impulses, which is not the case for the peaks of velocity and displacement. It is inferred from this that the peak of acceleration, sometimes used to evaluate protective systems, seems not so good a metric that expected to quantify the changes in lung injury by wearing protective clothing. However, the maximum of velocity and displacement seems to be good candidate parameters for thoracic injury criteria definition.