Numerical and Experimental Evaluation of Natural Fragmentation of Explosively Driven Cylinders Rings

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Abstract

In focus of this research is the mechanism where the shrapnel occurs by natural fragmentation of an explosive confinement, such as pipe bombs. When Improvised Explosive Devices (IED) are discovered by armed forces, it is difficult to determine their lethality. In some cases found IEDs are rebuilt at institutes such as ISL for threat characterizations, in order to quantify the magnitude of potential damage. Well-validated numerical models can play an important role in the design of these experiments. To better understand the mechanisms of the fragmentation under blast, and to develop a numerical model for predicting the damage of IEDs, a validation example was designed. Experiments were conducted for different height to wall thickness ratios and the recovered fragments were investigated statistically. The experimental results have already been compared to numerical results obtained with the academic SPH-Code MCM of Brunel University. The commercial, explicit multiphysics code LS-DYNA has SPH-capabilities for fluid and solids. It is used by a large number of defence companies. While the MCM code uses a modification of the Johnson-Cook model to account for the material hardening, LS-DYNA uses the standard Johnson-Cook material model. Further, LS-DYNA utilizes the Johnson-Cook damage model whilst a Lemaitre damage model is implemented in MCM. Thus, the two numerical codes contain different material and fracture models. This paper evaluates the accuracy of LS-DYNA and MCM with regards to the statistical and qualitative fragment prediction for the application of explosively driven cylinder rings.

Keywords: Blast, Natural Fragmentation, LSDYNA, MCM, Explosive Cylinder Rings, XRay

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