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Explosively driven fragmentation simulation of the 90mm Mk8 HESH grenade with LS-DYNA

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This thesis presents the simulation of an explosively driven fragmentation of the *90 mm Mk8 HESH* grenade using the software *LS-DYNA*. The objective is to build an useful model allowing to reduce the number of experimental tests which are expensive. Also the calibration of the *34CrMo4* steel with a new Gurson's based method is developed. From the *34CrMo4* steel was taken a series of specimens with different notch radii (smooth, R=1, 2, 4mm). These experimental tests will give the objectives for the upcoming calibration process.

Two calibrations for two material cards are conducted (piece wise linear plasticity and Gurson's based method) with the software *LS-DYNA*. At the end of these calibrations, both material cards show a good representation of the true physical elasto-plastic behaviour. The Gurson method will show to be more realistic when reproducing the outward failure and matching better the measured failure strains at rupture. Lastly, a regularization curve is identified for both the material cards in order to avoid mesh dependency of the results.

Then, the fragmentation simulations is introduced. In *LS-DYNA* the method used to simulate the detonation is the Particle Blast Method. To simulate the expansion of the steel cylinder or case and avoid the problem of big deformations in Lagrangian solid elements, the Smooth Particle Hydrodynamics elements are introduced. The method used is to replace the solid element when deleted by a SPH element in order to ensure the conservation of energy and mass. The problem with this method is that it doesn't supports the Gurson material card. Therefore the piecewise linear plasticity material is used for fragmentation simulations. As a first step the Goto test consisting in a explosively driven fragmentation of a steel cylinder is simulated. The simulations appears to show a really good correlation in terms of number of fragments and their relative masses with the experimental data. The guarantee of a good visual aspect of the fragmentation of the steel cylinder is achieved by comparing high-speed camera pictures and the simulation at given times of the expansion.

The final objective, the detonation and fragmentation of the *90 mm Mk8 HESH* grenade is simulated. Experimental static detonation tests results were used as objective. The simulations results are satisfying, the grenade shows a qualitatively good detonation and fragmentation behaviour during the whole process. The results are acceptable and encouraging for the future developments of this 90 mm Mk8 HESH grenade fragmentation simulation.

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