TRANSIENT RESPONSE OF PROJECTILE IN GUN-LAUNCH SIMULATION USING CRUSHABLE AL HONEYCOMB MITIGATOR

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This paper describes the usefulness of Lagrangian and Aribitrary Lagrangian/Eulerian (ALE) methods in simulating the dynamics of a generic artillery component subjected to launch simulation in an air gun test. An air gun launch simulation model requires simulating the impact mitigation environment in which the kinetic energy of a projectile is absorbed by crushing aluminum (Al) honeycomb-mitigator. Issues related to the effectiveness of these methods in simulating a high degree of distortion of Al honeycomb mitigator using the commonly used material models - metallic honeycomb and crushable foam - are discussed. Both computational methods lead to the same prediction for the deceleration of the test projectile and are able to simulate its transient behavior.

Two material formulations are used for simulating the Al honeycomb mitigator behavior using the Lagrangian method. These included, a honeycomb- and crushable foam-material models. The honeycomb material model simulates an anisotropic crushable behavior of a fully uncoupled system. The crushable foam material model on the other hand simulates an isotropic crushable behavior of a coupled system. This isotropic foam model crushes one-dimensionally with a Poisson's ratio that is essentially zero. Most of the Al honeycomb material in the air gun simulation is crushed axially. Therefore, the crushable foam model is considered to be appropriate for simulating crushing behavior of an Al mitigator in the air gun test. Only the crushable foam material model is used in the ALE method. The effectiveness of these two material models along with the applicability of Lagrangian and ALE methods are discussed in this paper.

Both material models lead to reasonable predictions and are able to simulate the behavior of the mitigator. In the simulation, a stress scale factor is used to include the high strain rate effect in the material models because of the unavailability of high strain rate dependent experimental data. Good agreement between the test results and simulation is achieved using the presented models and the methods employed.