HIGH VELOCITY IMPACTS SIMULATIONS WITH SPH METHODS IN LS-DYNA

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ABSTRACT

Several high velocity impacts (HVI) can be simulated using the SPH method in LS-DYNA. Space debris, whose quantity is on the rise, now pose a major threat to satellites. Effective impact models enable both the development of more efficient protections and the prediction of the damage that an individual HVI will cause to structures.

This paper aims to provide advice and words of caution on how to best model such impacts but also presents an example of a user implemented EOS in a SPH model.

Usually, in the simulation of an HVI on a plate, both projectile and target are modeled using SPH parts. Commonly, the target model uses a tied transition from the SPH impact zone to the lagrangian parts which represent the undamaged area. This method reduces the number of elements in the model and the calculation time.

The advantages and limits of the SPH method are presented first. The influence of the SPH/LAG transition on the quality of results is then discussed. Third, the influence of several SPH parameters on numerical results is mentioned. The number of particles used through the target thickness is of special interest, having a profound effect on the rear face cloud occurring after a perforation.

Space debris can collide with satellites structures at velocities exceeding 10 km/s. In these conditions, commonly used EOS, such as the Gruneisen, for example, can not represent the material behavior during the expansion phase. The contribution of a user implemented EOS are presented for a HVI on an aluminium plate. The results are compared with experimental data to define optimized configurations as a function of impact velocity.