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THE COMPARISON OF IMPACT RESISTANCE PERFORMANCE OF HYPERVELOCITY IMPACT ON ALUMINUM AND GLARE BY NUMERICAL SIMULATION

Abstract

Orbital debris is an ever-growing threat for spacecraft longevity. Structural solutions to protect spacecraft systems may be improved by the use of advances in composite materials. Therefore, fiber metal laminate (FML) panels subjected to hypervelocity impact loading are investigated by numerical simulation. The impact model uses Abaqus/Explicit for finite element calculation. A smoothed particle hydrodynamic (SPH) method is defined as a subroutine to simulate the dispersion and expansion of fragments and in order to avoid large mesh distortions. The baseline impact model uses aluminum as the referential target material and the simulation results agree well with the experimental data, which have already been published. Additionally, glass laminate aluminum reinforced epoxy (GLARE) is modeled as target material impacted by both aluminum and stainless steel projectiles, respectively, at a velocity of 5.5 km/s. The numerical simulation results show the debonding between the aluminum sheets and individual composite layers at each time increment. The model also indicates good agreement of the damage of the target plates, in the form of the breakage of fibers and the petalling of the aluminum sheet in the vicinity of the penetrated hole on both the front and back sides, as compared with the visually inspected experimental test plates. The validated model is then used to simulate hypervelocity impact on GLARE with variable impact angle obliquities and impact energies, in order to predict how these parameters contribute to the damage during impact. By comparing the aluminum and GLARE simulation results under the same impact conditions, the impact resistance performance and suitability of these materials as structural solutions are evaluated.