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Article · January 2009

DOI: 10.1115/IMECE2009-12428

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Space frames are usually used to enhance structural strength of the vehicle while reducing its overall weight. These frames are comprised of beams connected together at joints. Recently, space frames are being incorporated in military vehicles. Space frames in this case are however subjected to different types of loading than what is encountered in civilian vehicles such as, projectile and land mine attacks.

In this paper, the space frame is composed of hollow square cross-section bars and angle sections. It is enclosed by uniform-thickness armor, except at the turret. The vehicle is subjected to high impact load that simulates a projectile hit. The optimization variables are the dimensions of the space frame members and joints cross section in addition to the thickness of the armor. The finite element model is parameterized to allow integrating it within the optimization program. The objectives of the optimization are to minimize the overall mass of the vehicle and the shocks at identified critical locations of the inner space frame. The optimization process is subjected to stress constraint to ensure the overall structural integrity of the vehicle. This problem is solved using the Successive Heuristic Quadratic Approximation (SHQA). This algorithm combines successive quadratic approximation with an adaptive random search within varying search space. The entire optimization process is carried out within MATLAB environment.

By comparing the mass and shock results it is found that shock is reduced as the mass of the vehicle decreases. This is expected as lower mass indicate more plastic deformation and energy absorption by the vehicle resulting in shock reduction. This trend however does not monotonically continue as results show that reducing the mass beyond further point results in increase of shocks. Sensitivity analysis of the results versus the variables is conducted. It is found that the cross-sectional dimensions of the square members are the most dominant. Analysis of the results indicates a set of dimensions of these members where shock values are consistent. The results of this work can be used to design a military vehicle with the goal of ensuring safety of electronic equipment and occupants under various threat types.

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