Hybrid Modeling of Composite Laminates for Structural-Scale Armor Models

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Abstract

This presentation focuses on the development of a multi-scale hybrid finite element model for composite laminates used as a front and backing layer of a protection system in land armor vehicles. Laminated composites are widely used for impact resistance, energy absorption, stiffness, and structural integrity. A unidirectional carbon fiber reinforced polymer composite laminate is simulated using the MAT_ENHANCED_COMPOSITE_DAMAGE material model in the LS-Dyna® finite element software. The composite model consists of a sub-scaled volume around the impact zone of the protective armor layer, with the remaining areas being a macro-scale homogenous component. The calibrated material model is integrated with other materials to form a structural-scale model that also includes alumina hexagonal tiles and a steel plate which are bonded to the composite layers using a polyurethane adhesive interlayer. Once integrated, this system-scale model is simulated under high-velocity long rod impacts and calibrated with experiments. Overall, this work will give insights towards understanding the influence of the composite layers on the protection system performance and damage propagation through the different layers of the model, which will help in designing improved systems.

This work is a part of an Alliance Project in collaboration with the Defense Research and Development Canada, General Dynamics Land Systems, and NP Aerospace through NSERC CRD-DND project DNDPJ 531130-18.