Research Abstract: Impact Resistance of Sandwich Structures

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Abstract

This abstract outlines the research project on transient (time-dependent) deformations of sandwich structures subjected to impact loads such as those produced by a blast, a hurricane, or a collision of two high-speed moving deformable objects such as automobiles. The structures of interest consist of foam core sheets and fiber-reinforced composite face sheets. The objectives are to develop insights into the failure of these constituent materials and of the structure as a whole, thereby informing the design of impact-resistant protective systems. We hypothesize that the response of a structural element can be represented by linear and nonlinear springs and dashpots connected to each other, and we numerically solve the resulting coupled differential equations using in-house developed and verified software in the Julia programming language. The anticipated benefit of this work is to find the optimum structure configuration: the lay-up of foam layers and their thicknesses will be optimized using publicly available optimization algorithms to maximize, for a given areal mass density (mass per unit area of the impacted surface), the structure's impact resistance as measured by either the deflection of the non-impacted (back) face or the total force transmitted to a rigid substrate perfectly bonded to the back face.

My role in this project will be to contribute to model development, numerical implementation of the spring-dashpot formulations in Julia, and optimization studies to identify optimal lay-up configurations. Expected end-of-semester outcomes include a validated numerical model for at least one impact scenario (e.g., blast or collision), an optimization framework for foam layer ordering and thickness, and a draft manuscript section summarizing the methodology and preliminary results. These outcomes represent working goals toward which I will direct my efforts during the semester.