ID contributo: **6** Tipo: **Presentazione orale**

On the Design of Automotive Energy Absorbers using Natural Fiber and Hybrid Composites

giovedì 4 settembre 2025 13:15 (15 minuti)

In recent years, the increasing adoption of natural fiber-reinforced composites for sustainability has impacted many industrial sectors, including the automotive industry. However, achieving the required structural performance presents challenges when relying solely on natural fiber composites due to their lower mechanical properties, reduced durability, and limited compatibility with high-performance polymer matrices compared to synthetic counterparts. Hybridization, which combines natural fibers with synthetic reinforcements, is a viable solution to enhance mechanical performance while maintaining environmental benefits. This study examines the crashworthiness of flax/epoxy, carbon/epoxy, and inter-ply hybrid carbon-flax/epoxy composites under impact. The goal is to explore the design process of an energy absorber component for automotive applications by incorporating flax fibers, using experiments and finite element analysis to predict material behavior under crushing, and optimizing the design. Energy absorption capability is assessed through crashworthiness evaluation, focusing on the role of natural fibers and component geometry in enhancing crushing performance, from simple to curved structures, extending to structural automotive applications. A preliminary testing campaign characterizes the mechanical properties of the composites and defines material models for numerical analysis. The impact behavior of composite structures is then assessed both experimentally and numerically. The design process involves material characterization, evaluation of geometric influences on crushing behavior, finite element analysis, optimization, and validation of numerical simulations. An iterative modeling approach ensures the development of an accurate predictive tool to support and streamline the development of complex energy absorber structures. Material cards are set in LS-DYNA software using mechanical characterization parameters and an optimization procedure based on simple geometries under impact. Experimental and simulation results are compared to validate the accuracy of numerical models in predicting the behavior and failure modes of composites, from simple standard structures to advanced impact attenuators under crushing loads. Findings demonstrate the potential of hybrid composites to enhance energy absorption efficiency and integrate natural reinforcements into automotive applications.

Autore principale: CAPRETTI, Monica (Università di Camerino)

Coautore: Prof. BORIA, Simonetta (Università di Camerino); CASTORANI, Vincenzo (HP Composites SpA)

Relatore: CAPRETTI, Monica (Università di Camerino)

Classifica Sessioni: Automotive

Classificazione della track: Automotive