Title

AI-Based Parameterization of Full Vehicle Models Considering Manufacturing Effects on Crash Simulations

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Abstract

Crash simulations are essential in virtual vehicle development, enabling early-stage validation and optimization of safety performance. However, conventional modeling often neglects the influence of prior manufacturing processes such as deep drawing, which can significantly affect material behavior during crash events. This work presents a novel AI-driven framework that enables the data-based parameterization of full vehicle crash models while accounting for manufacturing-induced effects.

The core of the approach is the integration of key features from the forming process – specifically, local variations in sheet thickness and plastic strains – into crash simulations. Machine learning models are trained in a combination of low-fidelity and high-fidelity forming simulation data. These models capture the complex relationships between forming conditions and resulting material properties, allowing for spatially resolved predictions across the entire vehicle structure.

The integration of these AI-predicted properties leads to a significant increase in the physical accuracy of crash simulations. As a result, vehicle developers gain more reliable insights into structural crash behavior, contributing to improved occupant safety and reduced development costs. The approach effectively bridges the gap between forming and crash simulation domains, offering a scalable solution for future digital engineering workflows.