Graduate Student Research Seminar

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AI-Driven Feature-Based Design of Car Hoods using Attributed Feature Graphs (AFGs)

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3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

Feature-based modeling (FBM) has long been a cornerstone of CAD design, enabling the creation of complex geometries through parametric relationships. However, traditional parametric optimization methods often struggle to capture the intricacies of feature-based designs, limiting their effectiveness in exploring innovative structural patterns. This research introduces an AI-driven approach that leverages Attributed Feature Graphs (AFGs) to represent key design features—such as ribs, middle ribs, pockets, and hinges—as graph nodes, with their spatial and functional relationships forming edges.

To enable efficient design exploration, we employ a Graph Neural Network (GNN) that learns from existing hood frame designs and generates new variations that meet structural and performance requirements. By integrating graph-based learning, this method facilitates rapid ideation while ensuring adherence to manufacturing constraints. Our study develops a framework for converting CAD models into AFG representations and applies machine learning techniques for design completion and generation.

The proposed methodology enhances the conceptual design phase by providing AI-assisted guidance in generating structurally sound and manufacturable hood frame designs. By streamlining the exploration process, it also helps reduce design cycle time, allowing engineers to iterate faster and make informed decisions earlier in development. This paves the way for data-driven optimization in automotive engineering, enabling more efficient and innovative design exploration. Expected outcomes include insights into the effectiveness of AFGs in CAD-based feature representation and the potential of GNNs for advancing engineering design automation.

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