Design of energy absorbing lightweight structures for improved vehicle crashworthiness
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Motivation
- The use of vehicle lightweight structure raise safety concerns
- Structures depict Euler buckling under oblique impact
- Current design methods do not allow controlling deformation mode in structures with geometric imperfections

Objectives
- Maximize energy absorption of lightweight vehicle structures
- Design structures for progressive folding under oblique impact
- Control and restrict deformation to near-to-impact end in structures with geometric imperfections

Results

Methodology
- Problem Formulation
  - Objective: Maximum energy absorption
  - Define: Design Domain
  - Boundary Conditions
  - Loading Conditions
  - Material properties
  - Mass constraint
- Optimization
- Testing

Conclusions and Future Work
- Energy absorption maximization in lightweight structures
  - Dynamic, non-linear HCA structural optimization allows non-intuitive lightweight energy absorbing structures to levels no achievable with traditional static, elastic material methods
  - Extrusion manufacturing constraints improve manufacturability but decrease performance
  - Future work includes rapid prototyping with optimized G-code generation and testing
- Progressive folding and near-to-impact deformation
  - Shape optimization of compliant tubular structures avoid Euler buckling under oblique impact
  - Structures depict progressive folding near-to-impact end
  - Future work includes tailoring material properties, microstructure, and localized treatment

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