

# The influence of impact damage on the damping behavior of constrained layer damping laminates

Alexander Jackstadt, Luise Kärger, Kay A. Weidenmann

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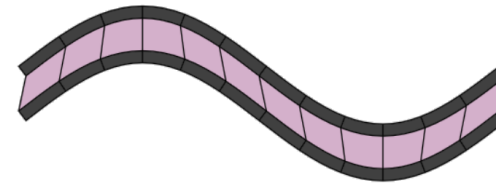
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# Introduction

## Motivation

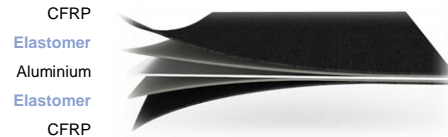
- Lightweight components prone to vibrations due to...
  - High stiffness
  - Low mass
  - Low thickness
  
- Noise vibration harshness (NVH) is a growing issue in the development of most structures and machinery
  
- Can hybridization influence damping?

## Constrained-layer damping (CLD)



constraining layer: stiff material  
 constrained layer: highly compliant, viscoelastic material

- Intrinsic damping mechanism
  
- High transverse shear deformations allow for effective dissipation in viscoelastic damping layers



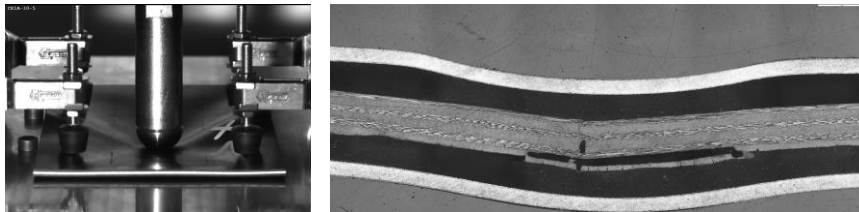
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*How does low-velocity impact damage influence CLD?*

# Methodology

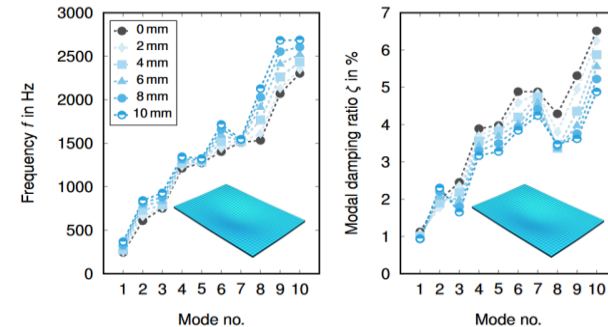
## Experimental

- Low-velocity impact tests according to ASTM 7136
- Impact energies: 5 J, 10 J, 20 J
- Observed damage modes:
  - Delaminations
  - Intra-ply damage in CFRP layers
  - Permanent deformation

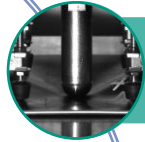


## Numerical

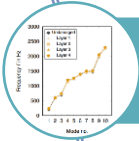
- Modal analysis of pre-damaged laminates considering intra-ply failure, delaminations and permanent deformation
- Example: Depth of permanent deformation



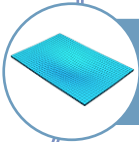
# Conclusions



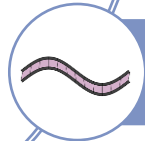
Low-velocity impact results in delaminations, intra-ply damage to CFRP layers and permanent deformation



Natural frequencies and modal damping ratios largely unaffected by delaminations and intra-ply damage



Permanent deformation is the leading cause of change in natural frequencies and modal damping ratios



CLD is a highly damage-tolerant intrinsic damping mechanism for lightweight design

# Thank you for your attention!

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## Contact

**Alexander Jackstadt, M.Sc.**

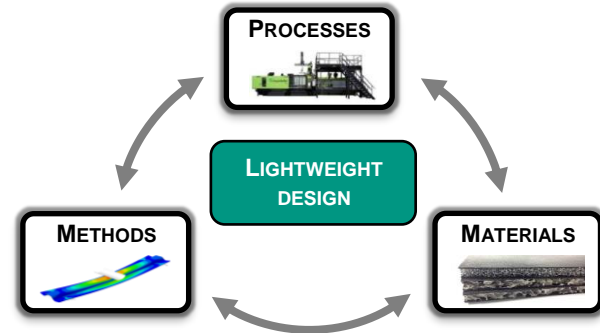
[alexander.jackstadt@kit.edu](mailto:alexander.jackstadt@kit.edu)

+ 49 721 608-45365



**KIT** | Karlsruhe Institute of Technology  
Institute of Vehicle System Technology – Lightweight Technology  
Rintheimer Querallee 2 | Bld. 70.04  
76131 Karlsruhe

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