TWENTY-THIRD INTERNATIONAL CONFERENCE ON COMPOSITE MATERIALS

3D Printed Continuous Fiber Reinforced Composites of Anisotropic Topology Optimized Structures

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Research Background



Experimental Verification



Materials and Methods









Research Background



Experimental Verification



Materials and Methods



1. Research Background

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Wide-Ranging Application of Fiber Reinforced Composites

- High specific strength
- High specific modulus
- Design flexibility, ...





Vehicle Body of the BMW 7 SERIES



Sources: www.airliners.de

1. Research Background



Manufacturing Process of Continuous Fiber Reinforced Composites (CFRCs)





More complex structure can be realized



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1. Research Background



Topology Optimization of CFRCs



Anisotropic property

Path planning

Performance







Research Background



Experimental Verification



Materials and Methods





Multidisciplinary framework to design and produce a topology optimized structure



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Equipment and material



Shaanxi Fibertech Technology Development Co., Ltd.



Topology optimization



Simultaneous optimal designs for both material distribution and fiber orientation



Path Planning



Topology optimized structures can be produced by this continuous printing path



Progressive design of fiber content



Inhomogeneous distributions of fiber content







Research Background



Experimental Verification



Materials and Methods



3. Experimental Verification

3D printed topology optimized structures of two benchmark geometries



3D Printed Continuous Fiber Reinforced Composites of Anisotropic Topology Optimized Structures

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Cantilever beam



Universal testing machine (PLD-5kN, LETRY Corp., China)

123.07 % in structural stiffness increase
52.16 % in peak load increase



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3D Printed Continuous Fiber Reinforced Composites of Anisotropic Topology Optimized Structures

Load (N)

3. Experimental Verification

MBB beam



> 36.27 % in structural stiffness increase 200 ➢ 64.43 % in peak load increase



Peak load: 1406.44 N





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MBB beam with different fiber contents







120*40*10 mm







MBB beam with different fiber contents









Research Background



Experimental Verification



Materials and Methods



4. Summary

• Topology optimization and 3D printing could promote the potential of CFRCs, and even challenge traditional design and manufacturing mechanism relating material and structure scale.



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Thank you for your attention !

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