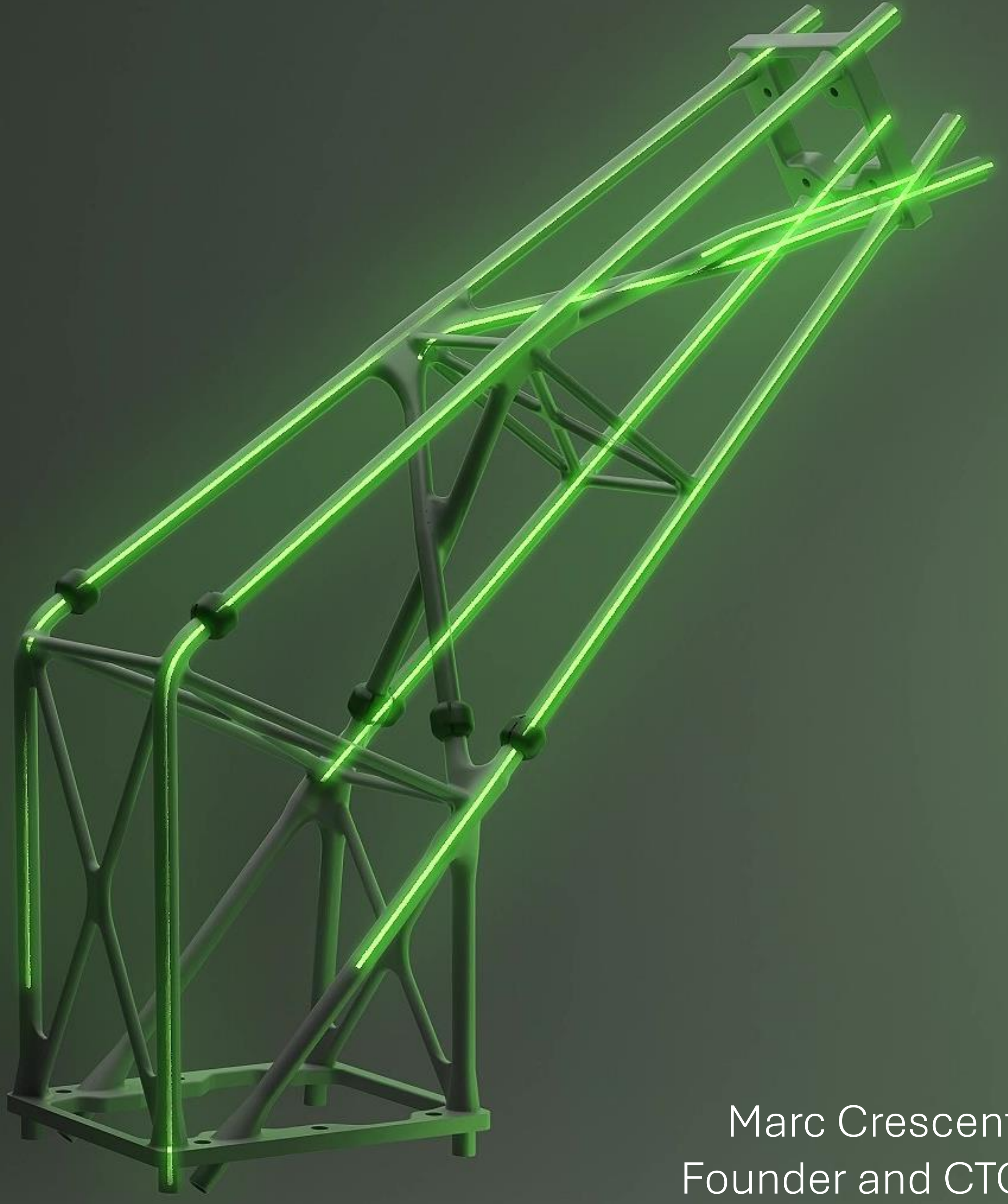
REINFORCE3D

CFIP Technology

Improving the mechanical and lightweighting performance of 3D printed products by injecting continuous fibers



Marc Crescenti
Founder and CTO

Continuous Fibre Injection Process

The Continuous Fibre Injection Process (CFIP) is a new composite manufacturing technology for reinforcing parts with continuous fibres such as carbon fibres.

It is based on injecting the continuous fibres simultaneously with liquid resin inside tubular cavities in the part.

It also enables to integrally joint different parts by providing fibre continuity from end to end.

Continuous Fibre Injection Process

CFIP, a new manufacturing concept

How continuous fibres were processed?

Placed upon a surface

Infusion, RTM, Autoclave, AFP, Filament winding, 3D Printing...

Shell-like structures

CFIP, a new manufacturing concept

How continuous fibres were processed?

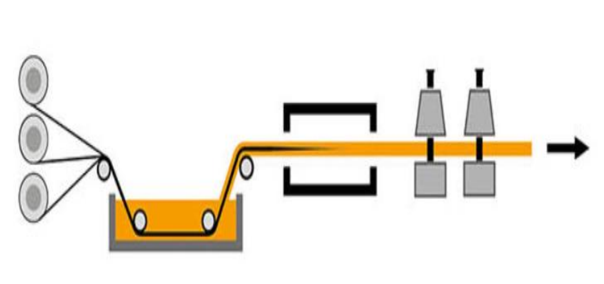
Placed upon a surface

Infusion, RTM, Autoclave, AFP, Filament winding, 3D Printing...

Shell-like structures

Pulled through a mould

Pultrusion



Profiles

CFIP, a new manufacturing concept

Now...

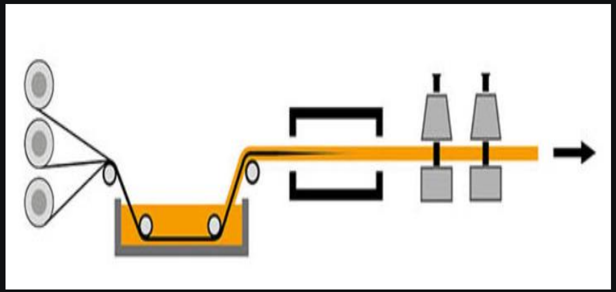
Placed upon a surface

Infusion, RTM, Autoclave, AFP, Filament winding, 3D Printing...

Shell-like structures

Pulled through a mould

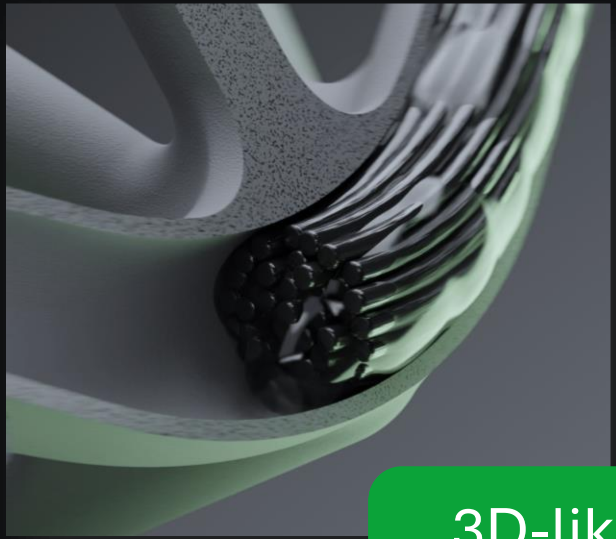
Pultrusion



Profiles

Injected inside cavities

CFIP



3D-like structures

Key Principles

In order to enable the process automation, CFIP only acts from the tubular cavity inlet.

3 key principles enable the process:

- Simultaneous injection with pressurized resin:
    - Lubrication of the tubular cavity
    - Drag forces on the continuous fibres
- Push force is applied on the fibres

TECHNOLOGY
PATENTED
TECHNOLOGY

Manufacturing Technologies

CFIP can be used for any manufacturing technology, including traditional and 3D printing

3D Printing + CFIP = Fibres in all directions

REINFORCE3D

Manufacturing Technologies

CFIP can be used for any manufacturing technology, including traditional and 3D printing

3D Printing (FFF) + CFIP = Fibres in all directions + PEEK

Manufacturing Technologies

CFIP can be used for any manufacturing technology, including traditional and 3D printing

3D Printing (SLS, MJF) + CFIP = Fibres in all directions + High building rates

Manufacturing Technologies

CFIP can be used for any manufacturing technology, including traditional and 3D printing

3D Printing (SLM) + CFIP = Fibres in all directions + Metallic materials

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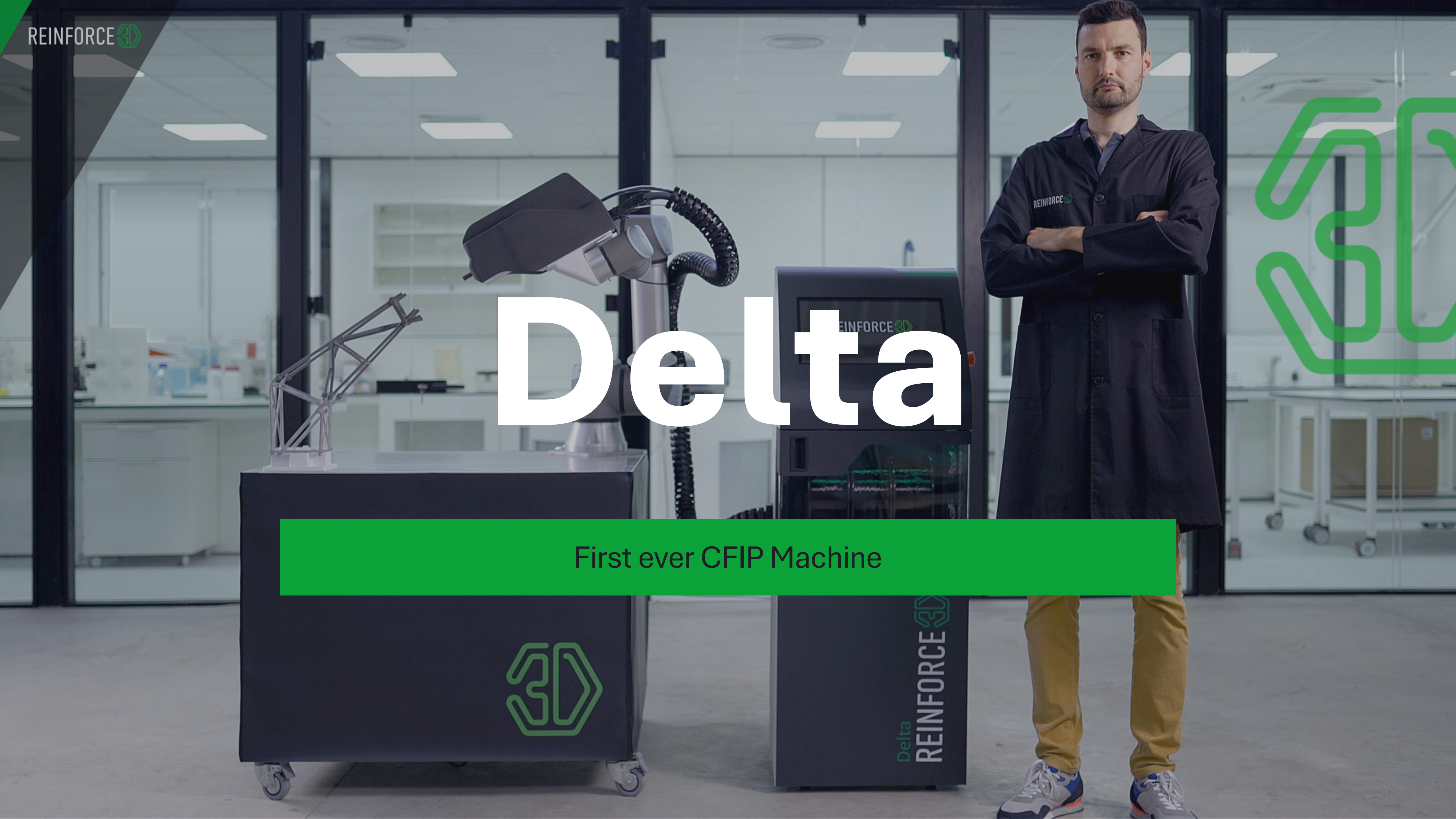
Delta

First ever CFIP Machine

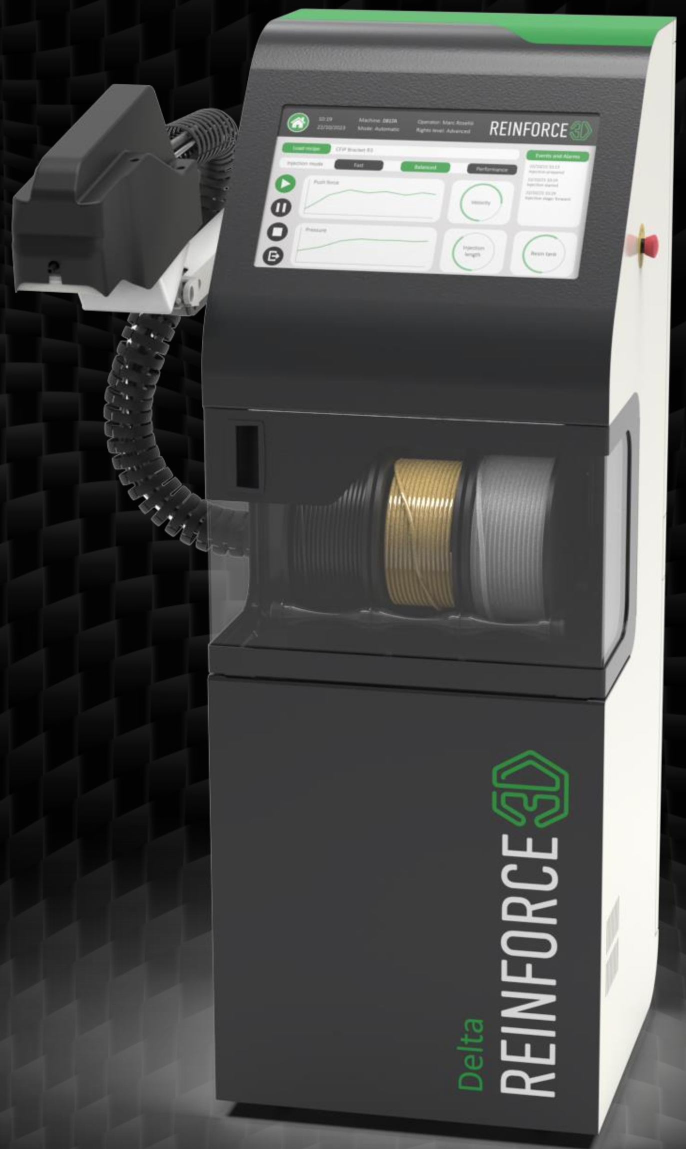


DELTA

First ever CFIP machine

The first ever commercial machine able to perform the Continuous Fibre Injection Process (CFIP) automatically, enabling the manufacturing of highly complex and optimized parts with ultra-high-performance materials at industrial scale. With our patented CFIP technology at its core, the machine is a dedicated solution for reinforcing parts with continuous fibres down to the last detail.

- Fibre types: carbon, glass, aramid, others
- Compatible with thermoset, thermoplastic and bio-sourced resins
- Injector easily adaptable to different cavity diameters
- Intuitive Human Machine Interface
- Industrial grade components
- Accurate resin flow and pressure control
- Easy coupling to different parts' geometry, size and materials
- Suitable for a robot arm to maximize automation



REINFORCE3D

Reinforce3D Products & Solutions

Delta Machine

Fully automated and controlled process with industrial-grade components

Supplies

- Fibres
- Resins
- Injector

Services

- Consultancy
- Manufacturing

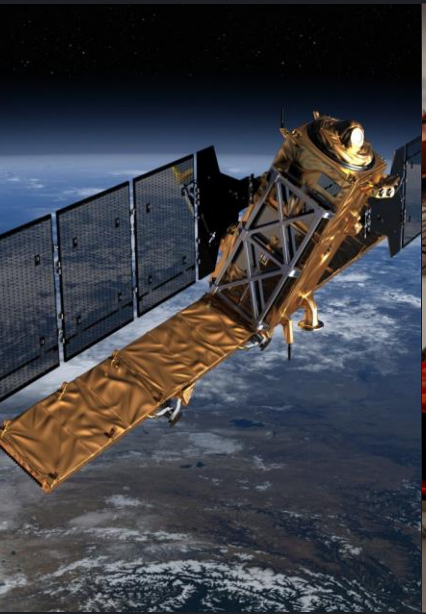
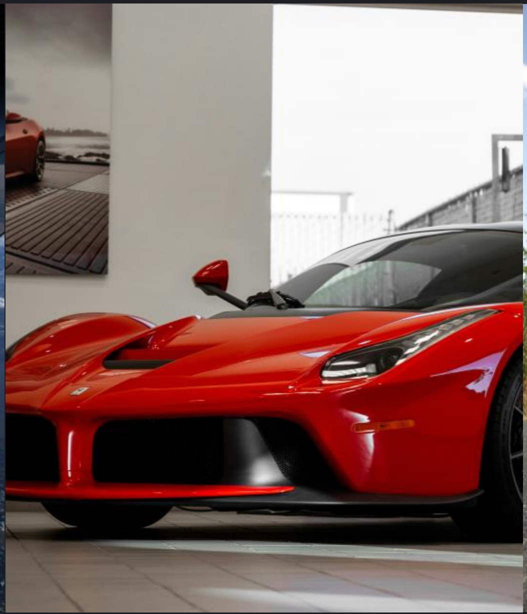
Software

Design, simulation and validation support softwares

Who is our **customer**?

Applications that require Lightweighting and Strength

Innovative Companies | Component manufactures



AIRBUS GROUP

Navantia

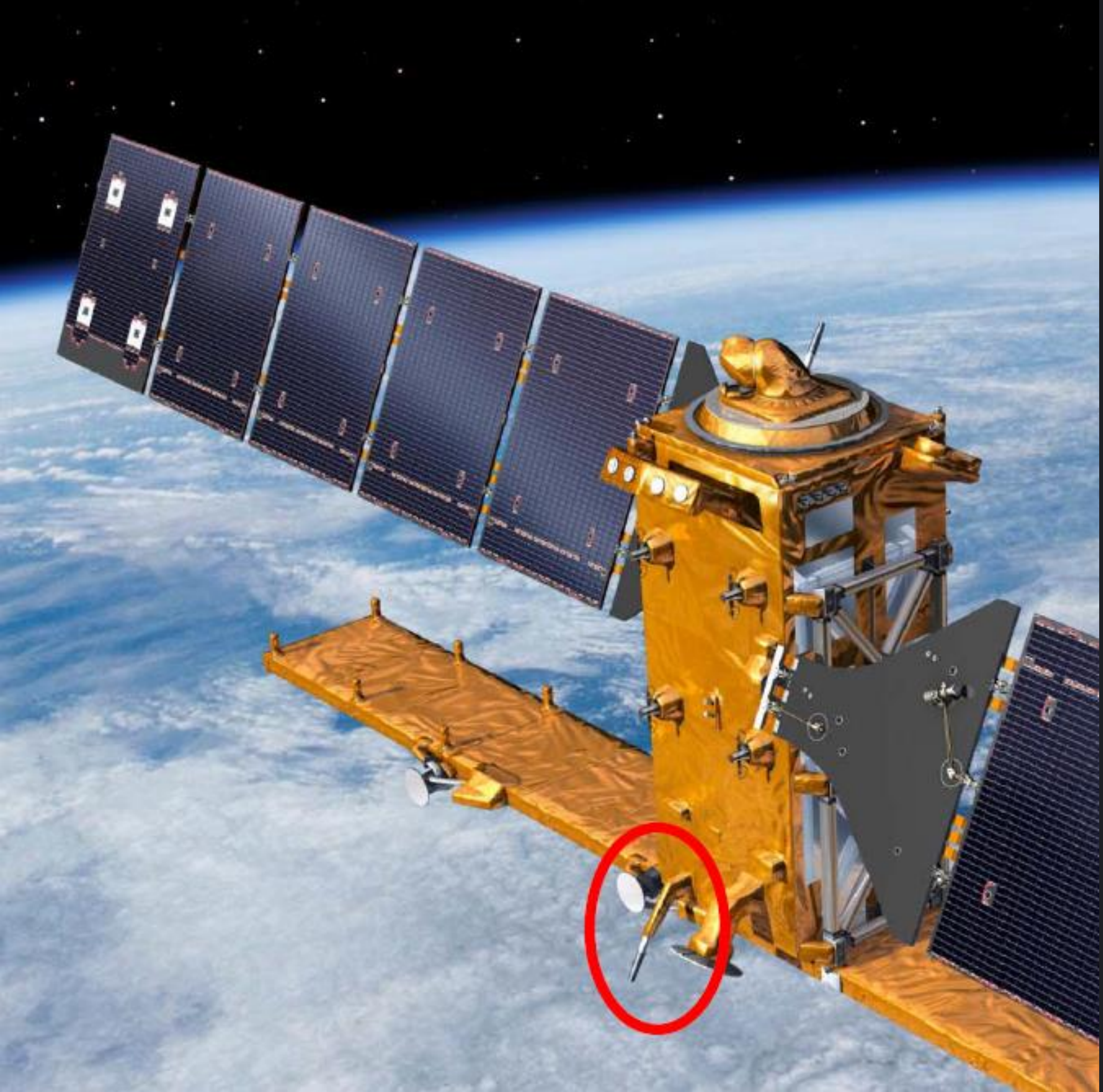
SEAT

materialise innovators you can count on

DALBELLO

hp

asics

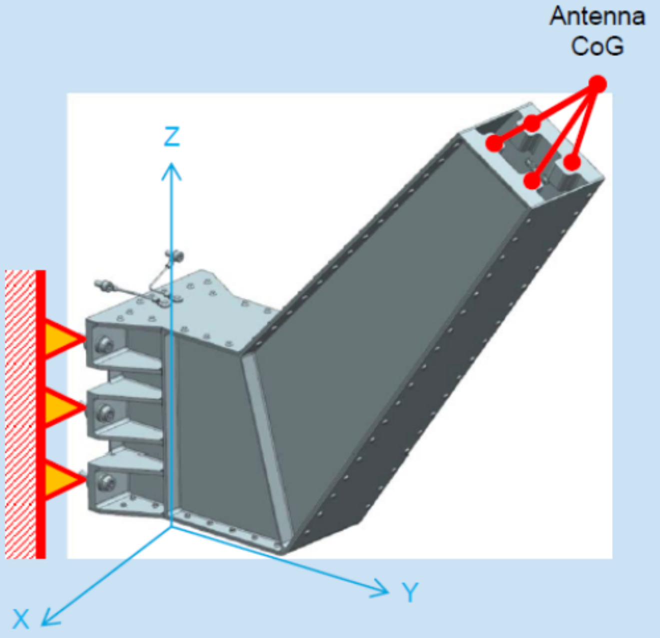


Satellite Structure

REINFORCE3D

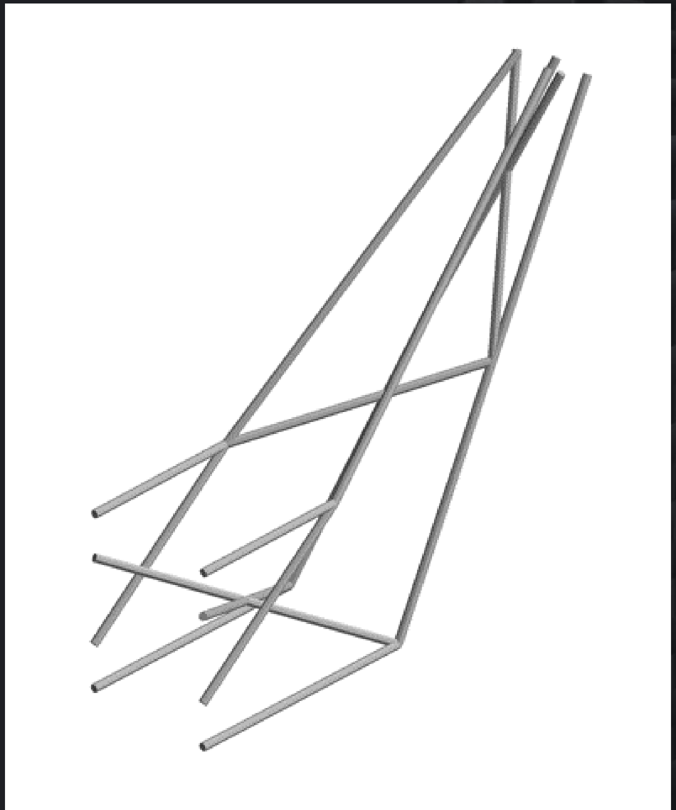
Satellite antenna support

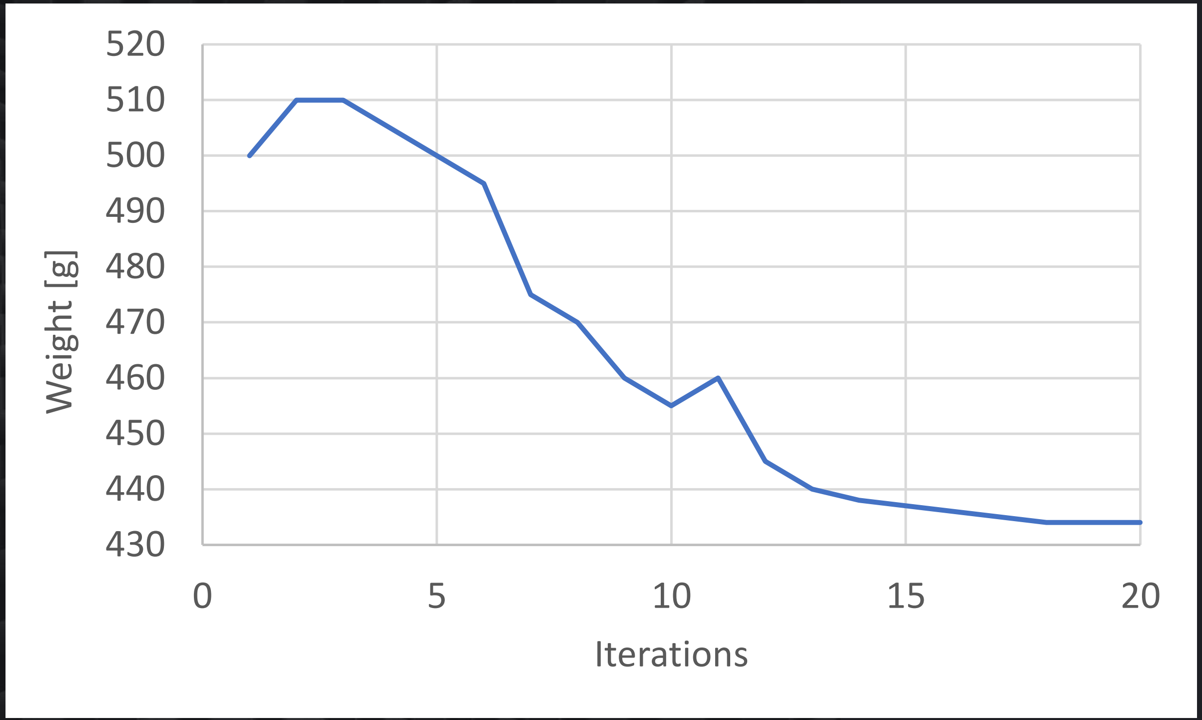
Specifications > Design and optimization > Manufacturing and CFIP > Testing > Benchmark

Original Design	Specification
	▪ Eigenfrequency > 70Hz ▪ Boundary condition Hard Mounted ▪ Dimensions 385 x 345 x 115 mm3 ▪ Static Load (QL) 20g (X,Y) / 25g (Z) ▪ S-Band Antenna 0.783kg ▪ CoG Position X = 436.2mm, Y = -1091.8mm, Z = 3330.6mm

Satellite antenna support

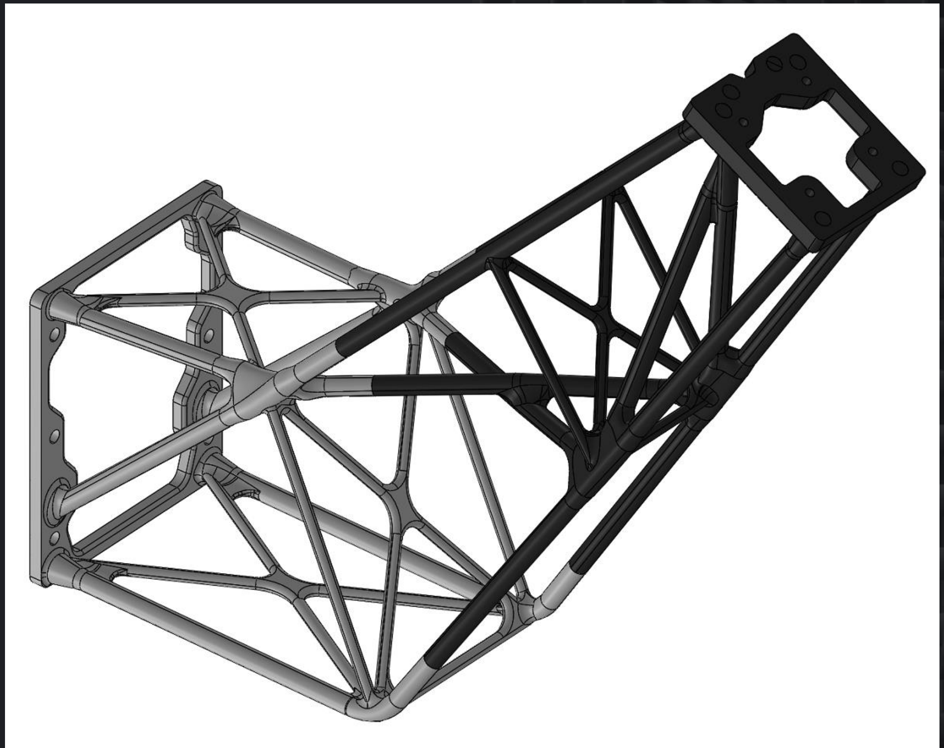
Specifications → **Design and optimization** → Manufacturing and CFIP → Testing → Benchmark

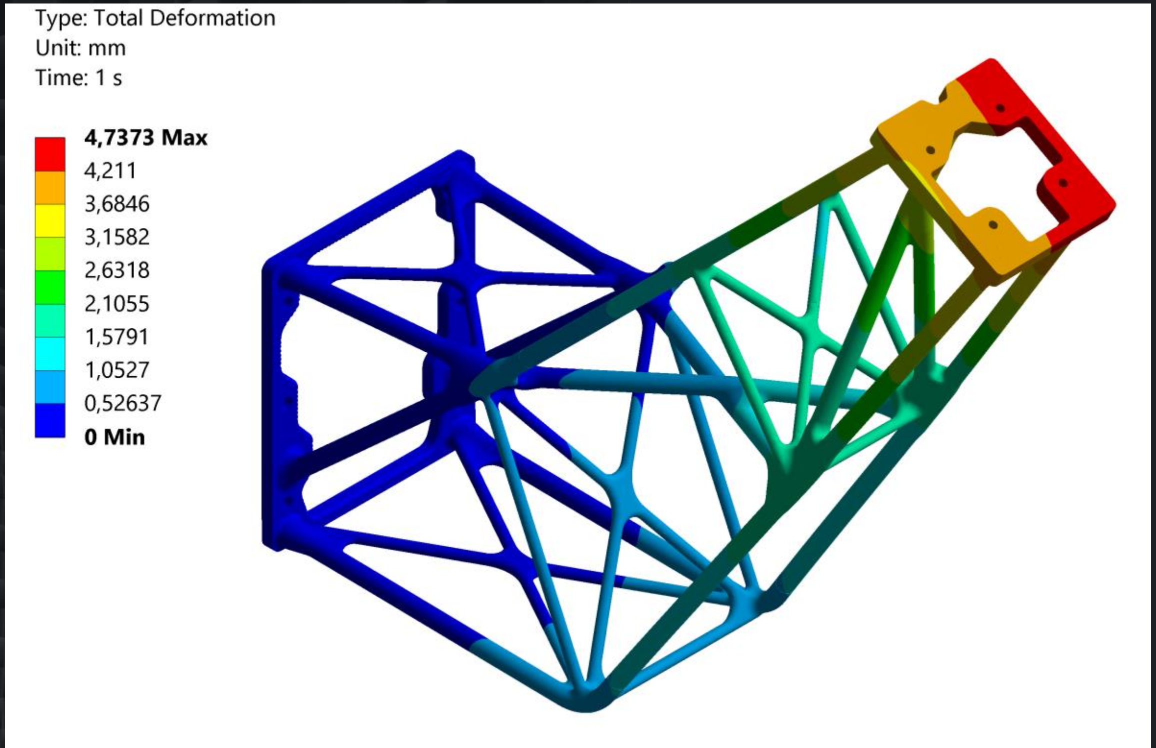




Satellite antenna support

Specifications → **Design and optimization** → Manufacturing and CFIP → Testing → Benchmark





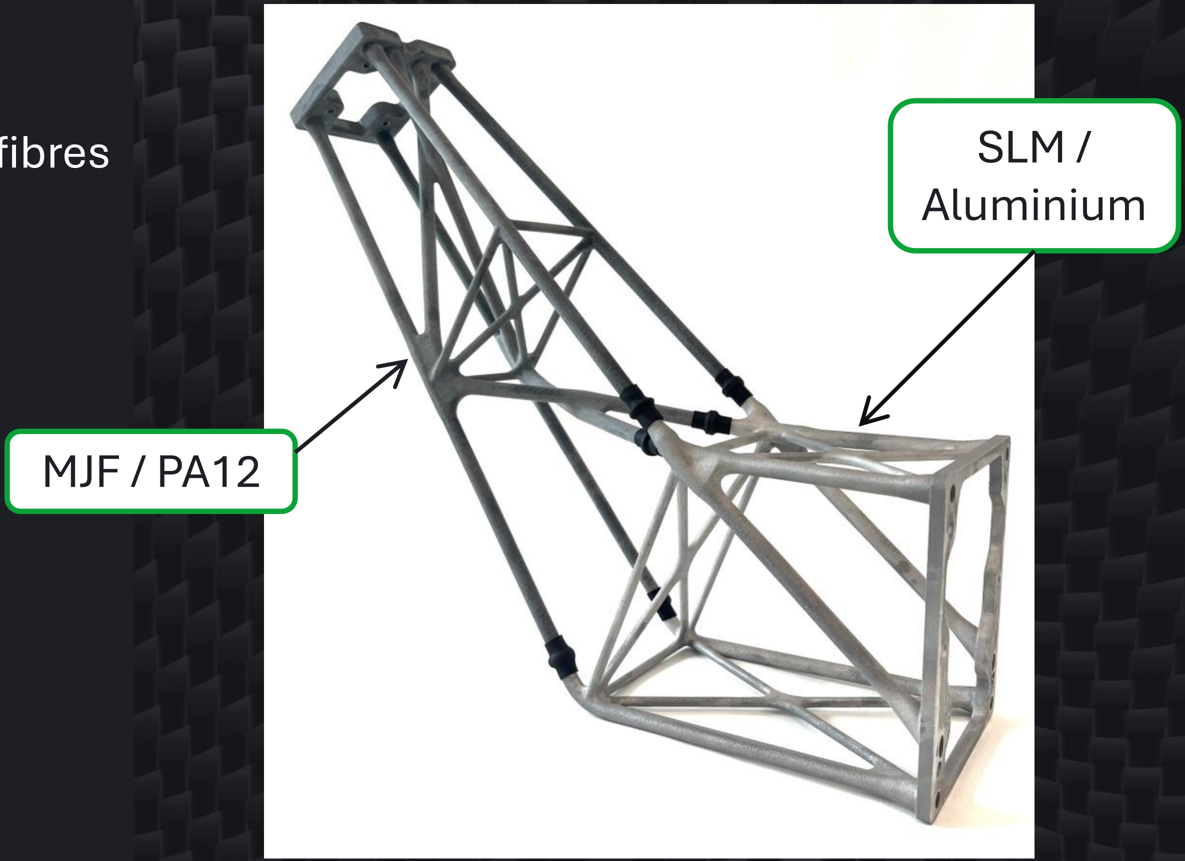
REINFORCE3D

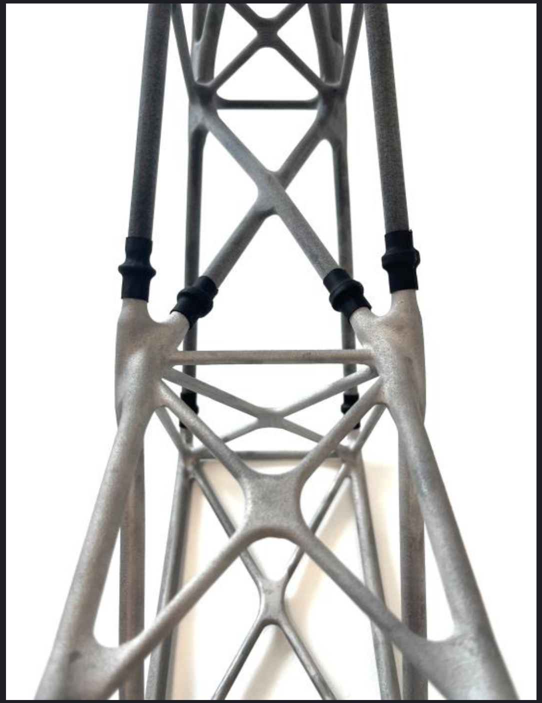
Satellite antenna support

Specifications › Design and optimization › **Manufacturing and CFIP** › Testing › Benchmark

CFIP materials:

- Continuous Carbon fibres
- Epoxy

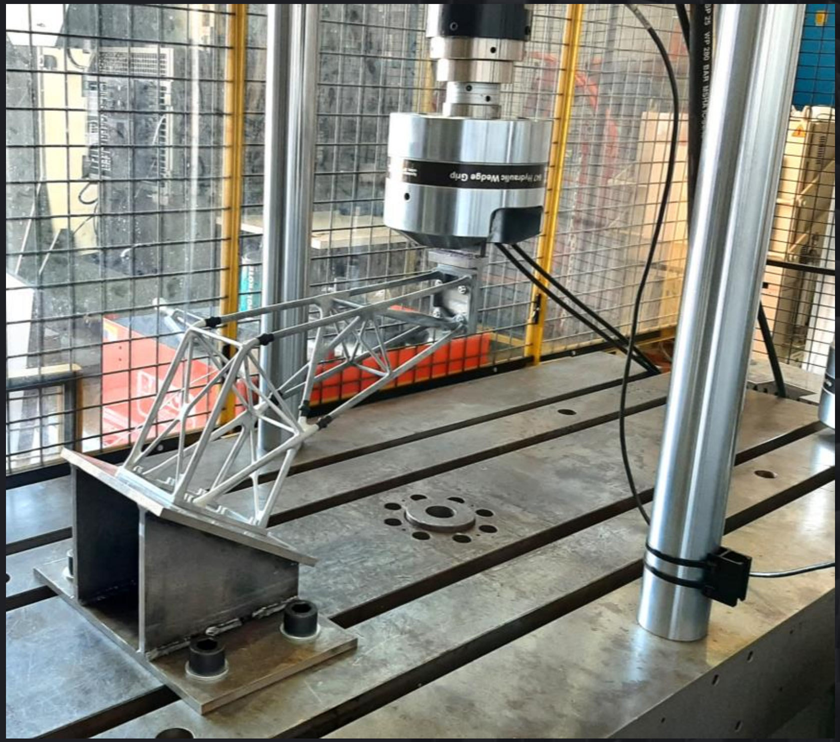


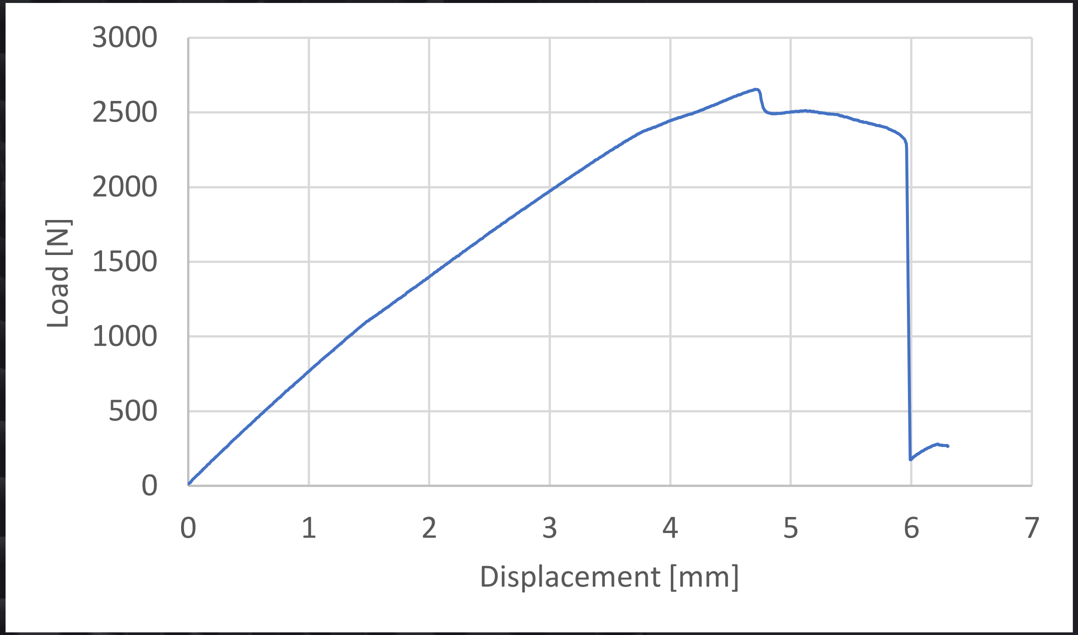


Satellite antenna support

REINFORCE3D

Specifications → Design and optimization → Manufacturing and CFIP → **Testing** → Benchmark

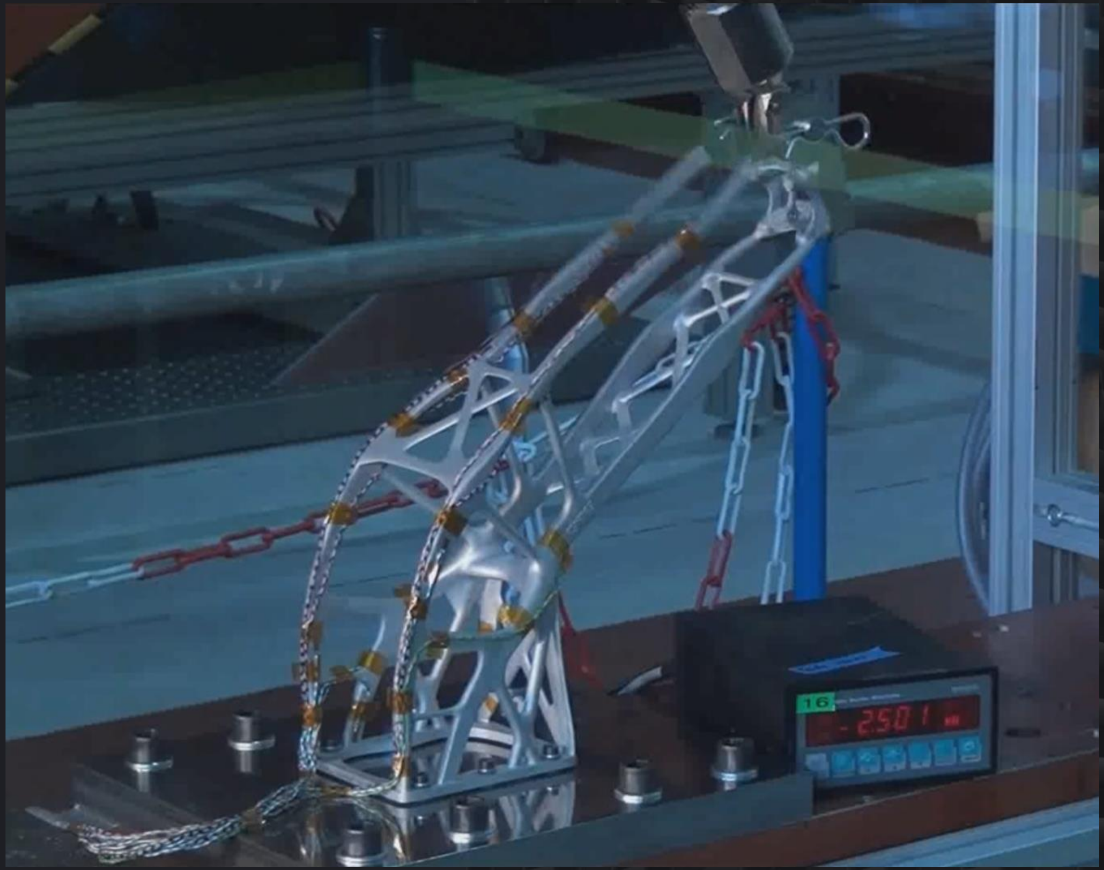


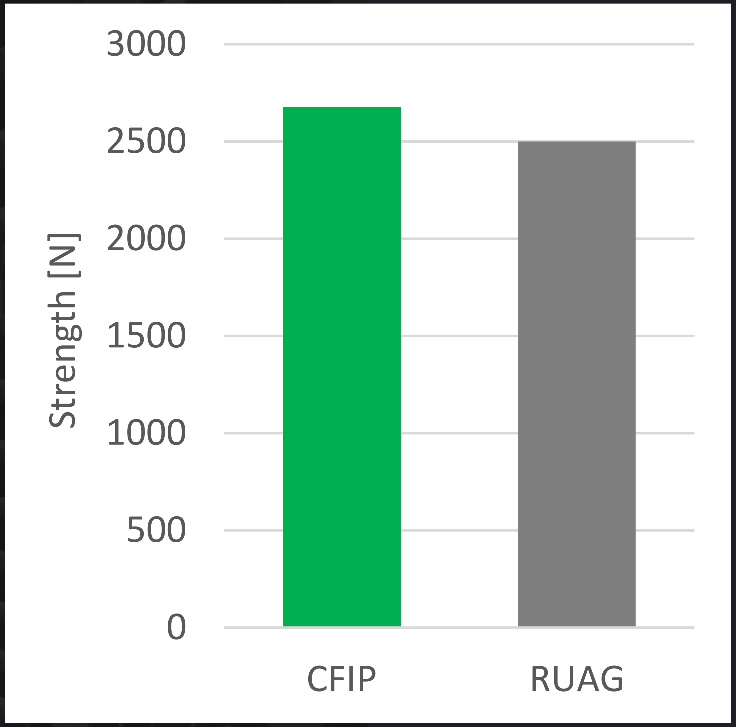


Satellite antenna support

REINFORCE3D

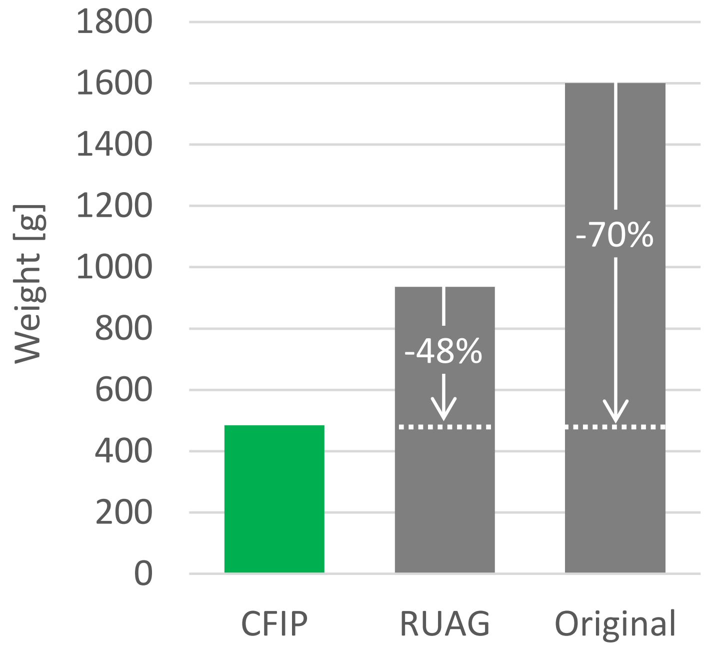
Specifications → Design and optimization → Manufacturing and CFIP → Testing → **Benchmark**

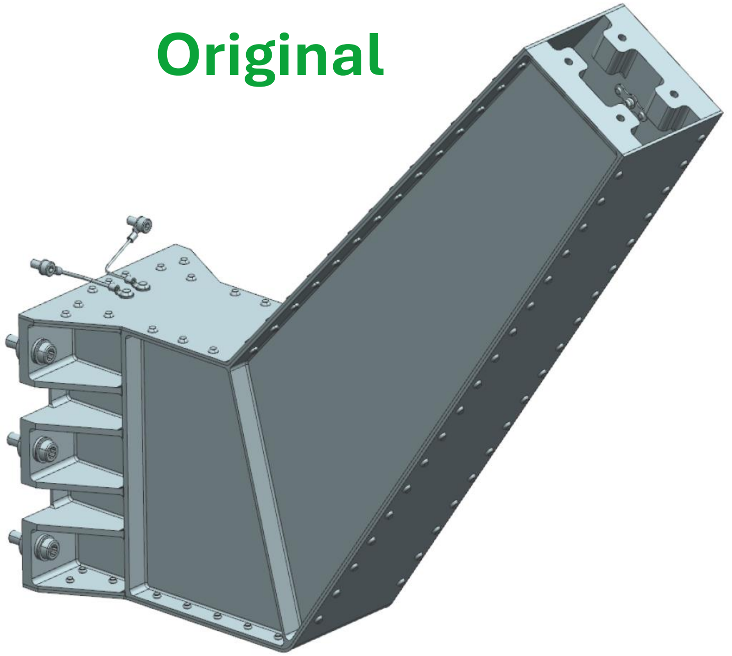




Satellite antenna support

Specifications → Design and optimization → Manufacturing and CFIP → Testing → **Benchmark**

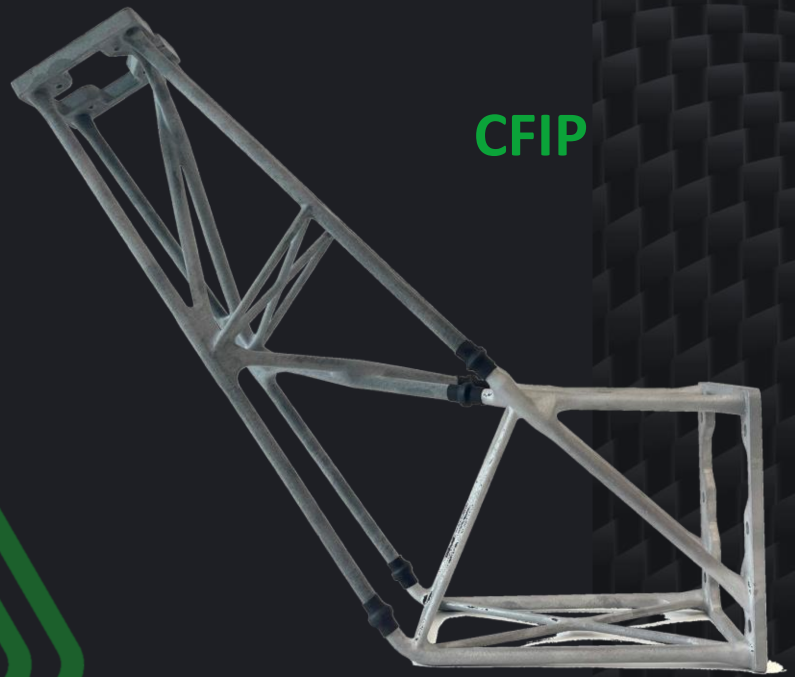




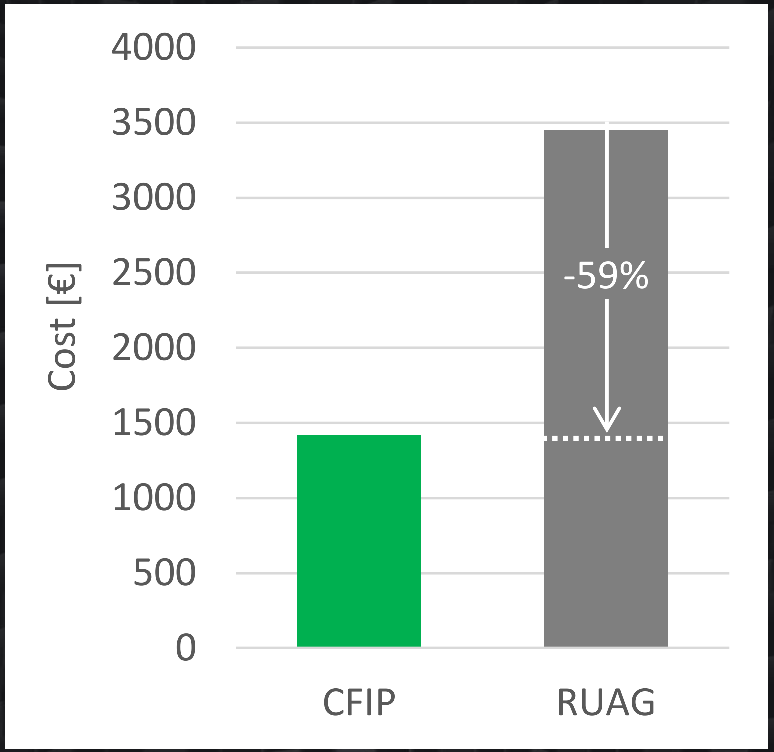
REINFORCE3D

Satellite antenna support

Specifications › Design and optimization › Manufacturing and CFIP › Testing › **Benchmark**



CFIP



Aircraft Bracket

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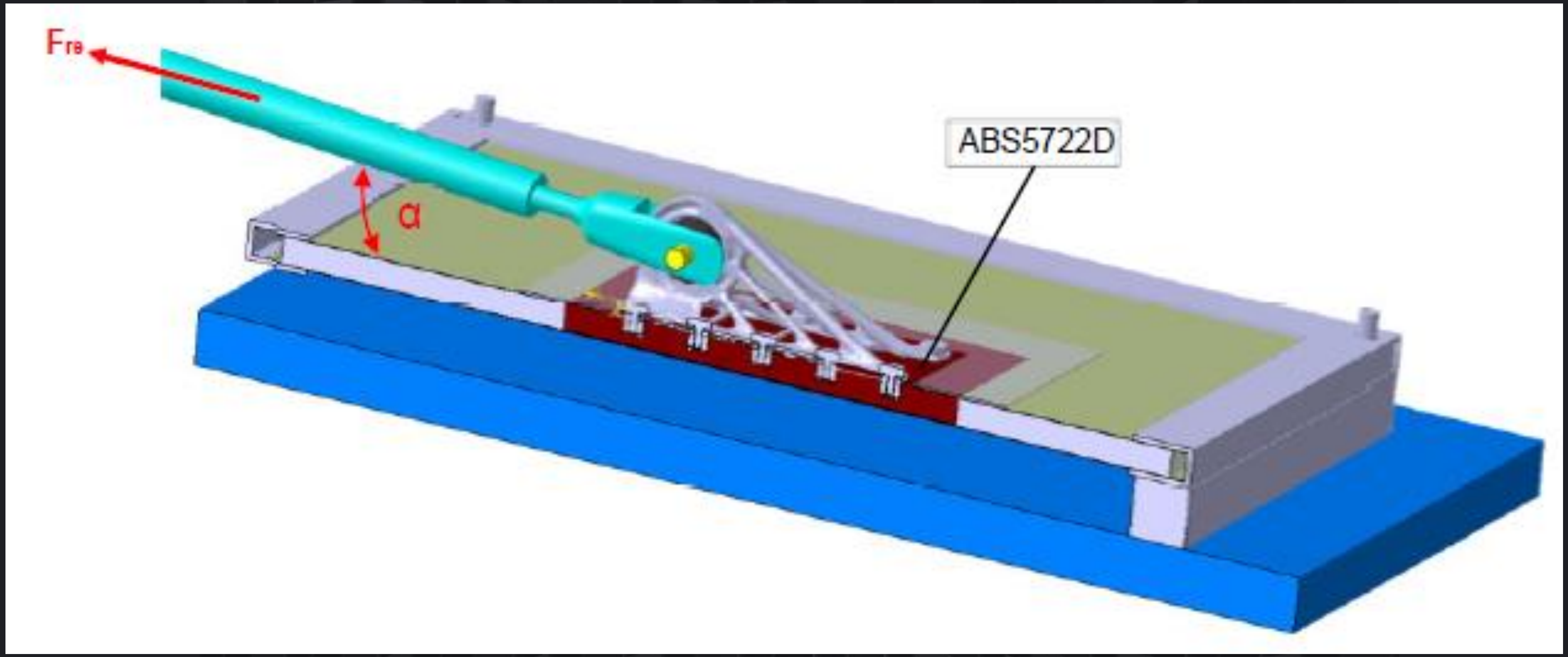
Specifications

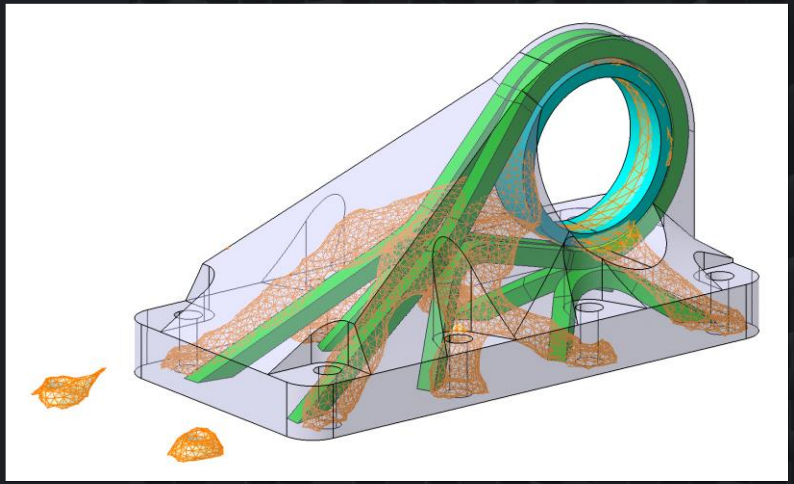
Two load cases

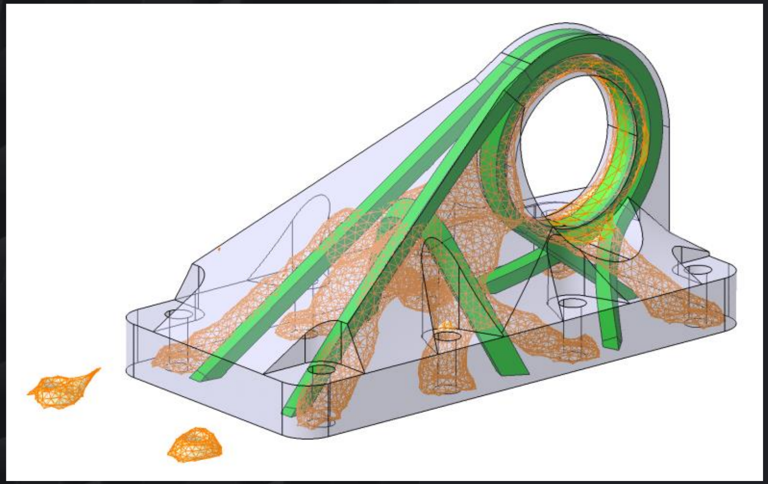
Maximum shear load per screw constraint

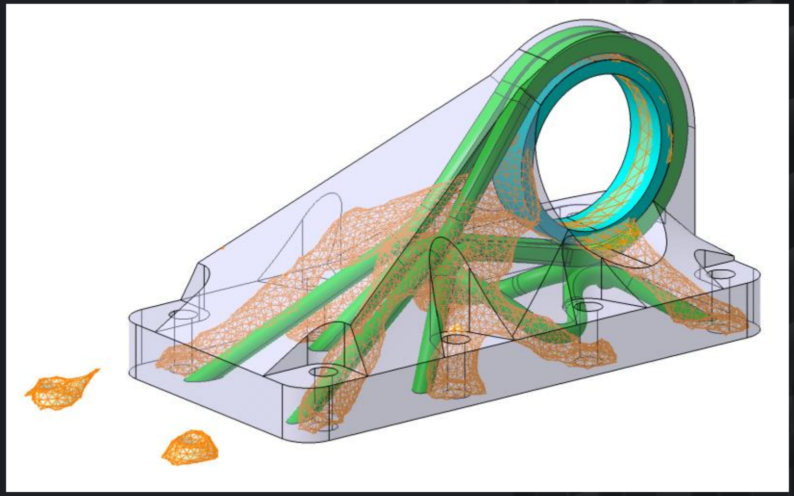
Objective: minimize the weight while keeping the structural integrity

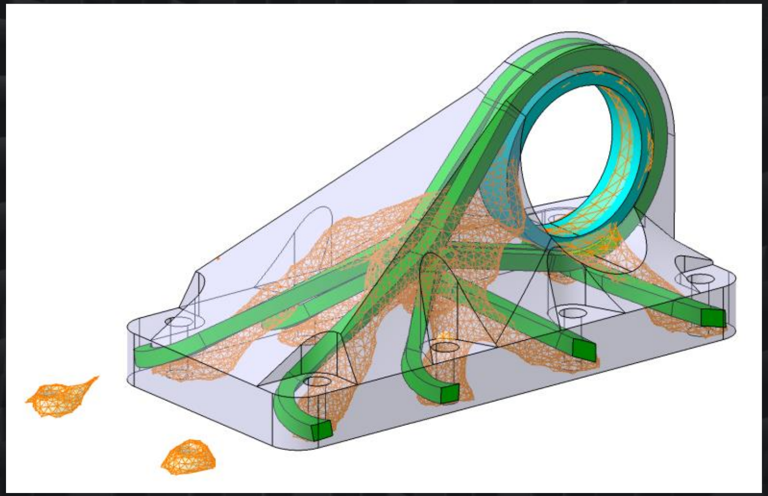


Design of fibre trajectories

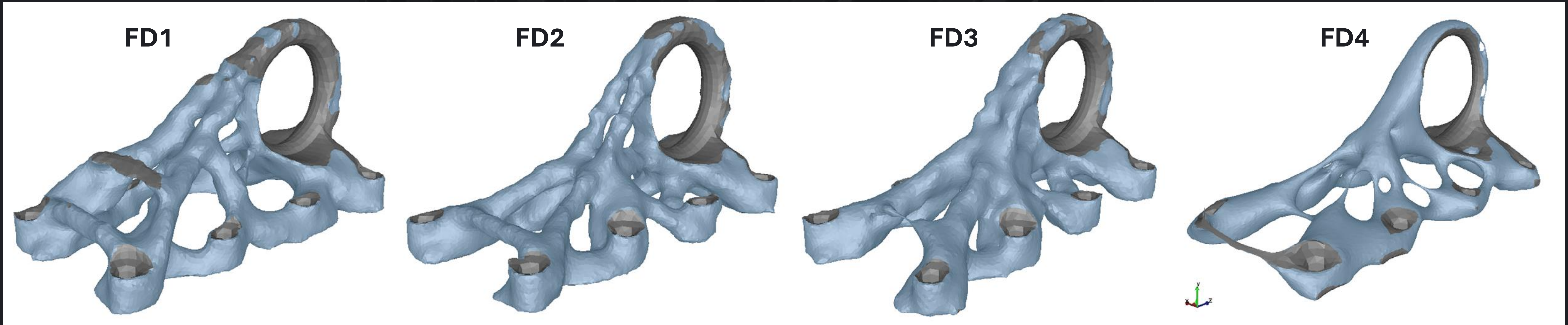

FD1

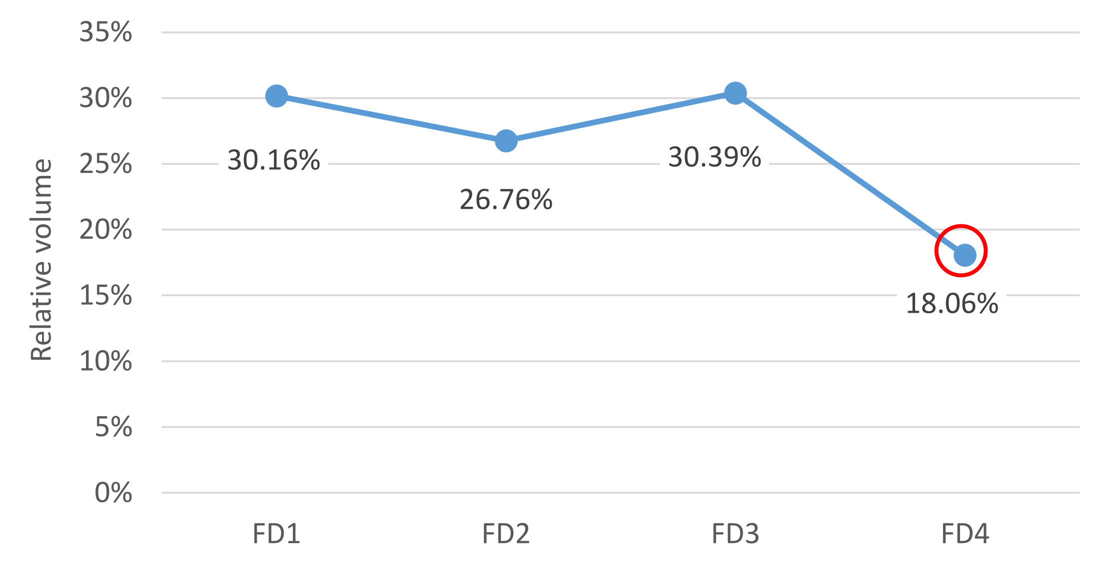

FD2

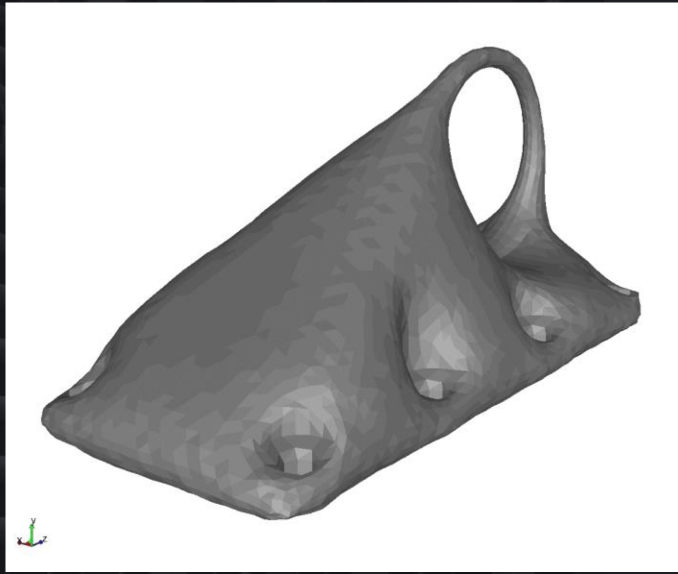

FD3


FD4

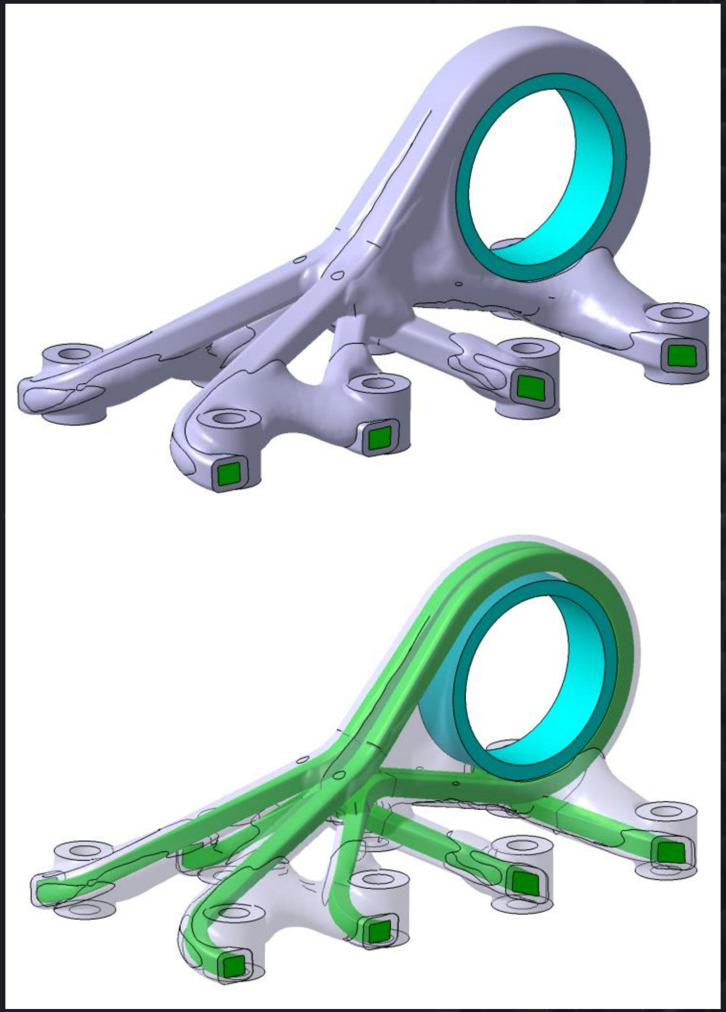
Lightweighting performance

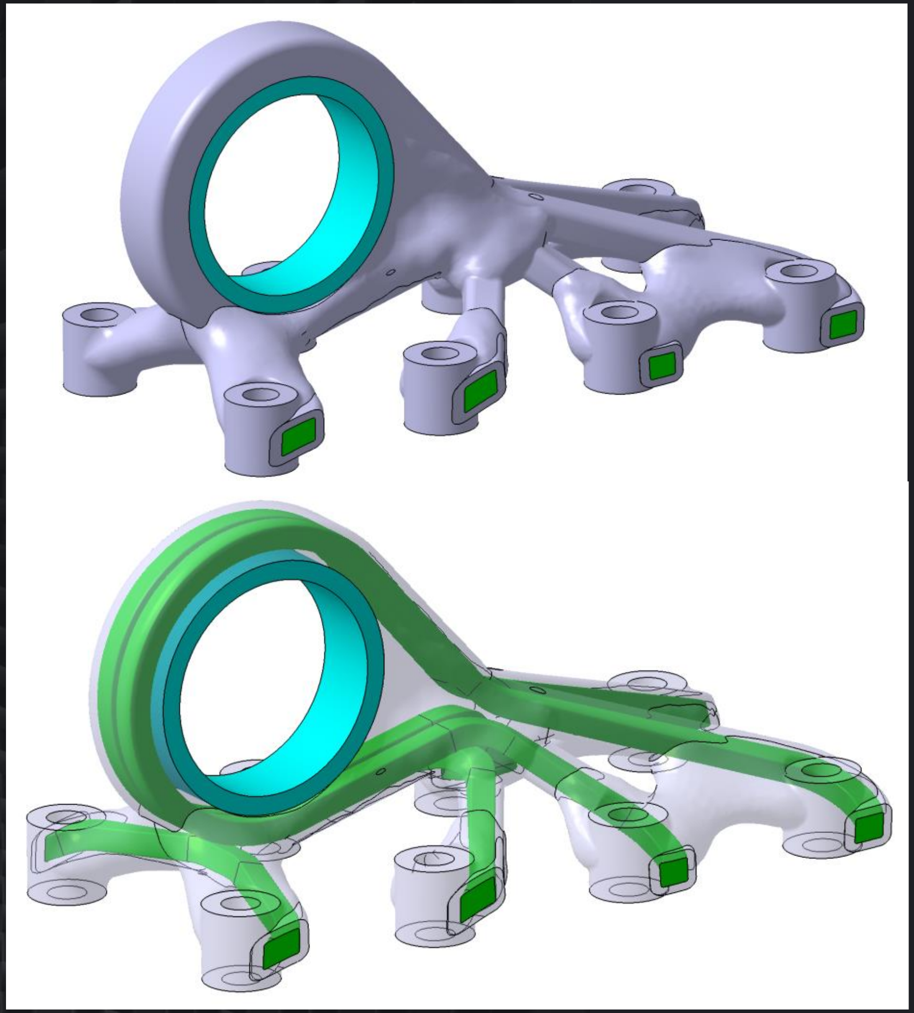




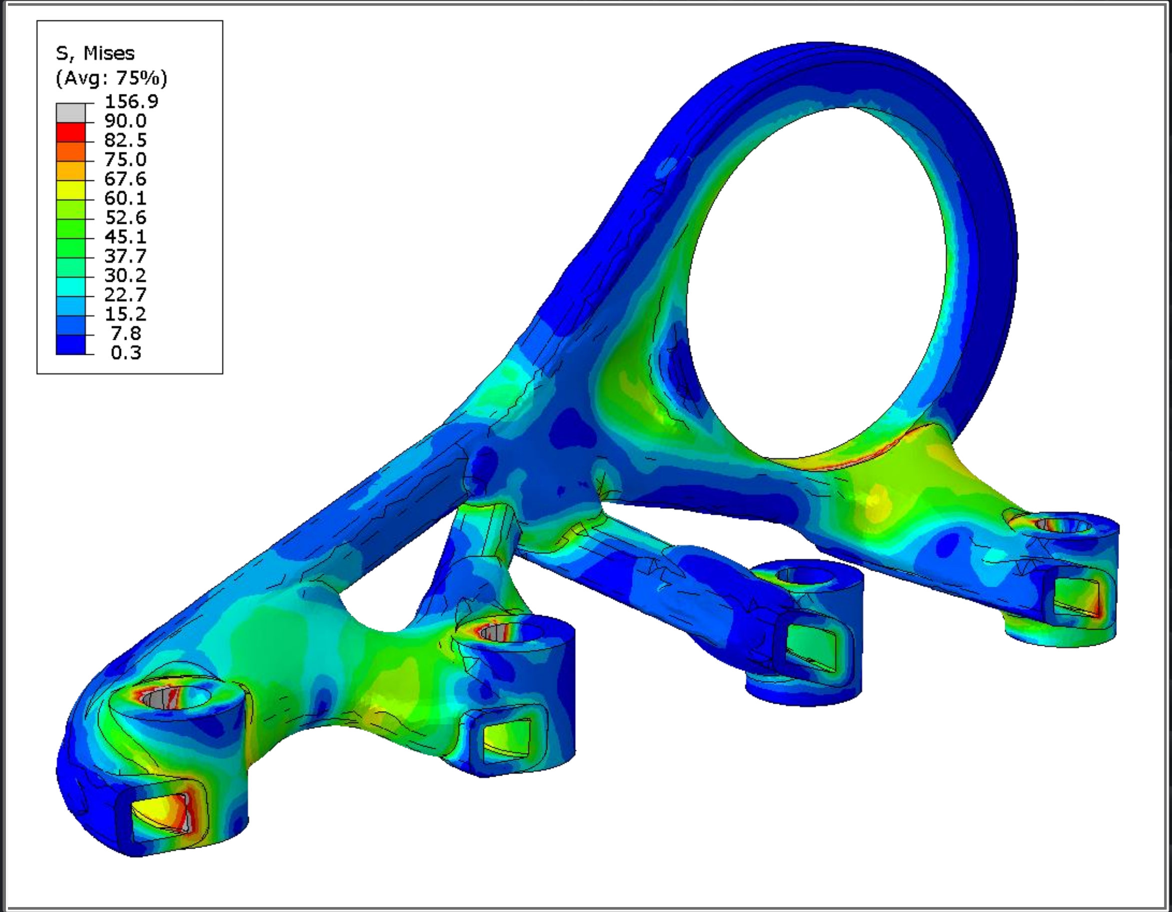


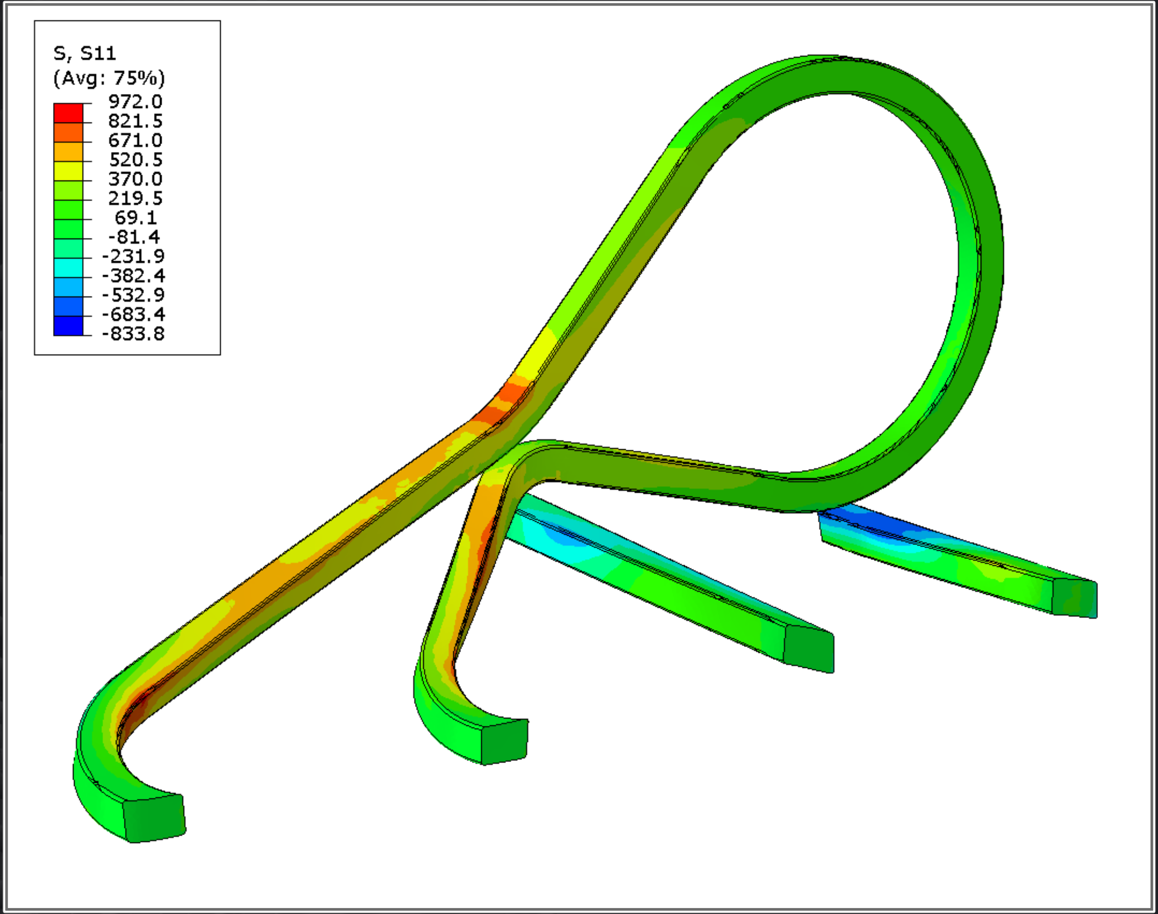
Detail Design





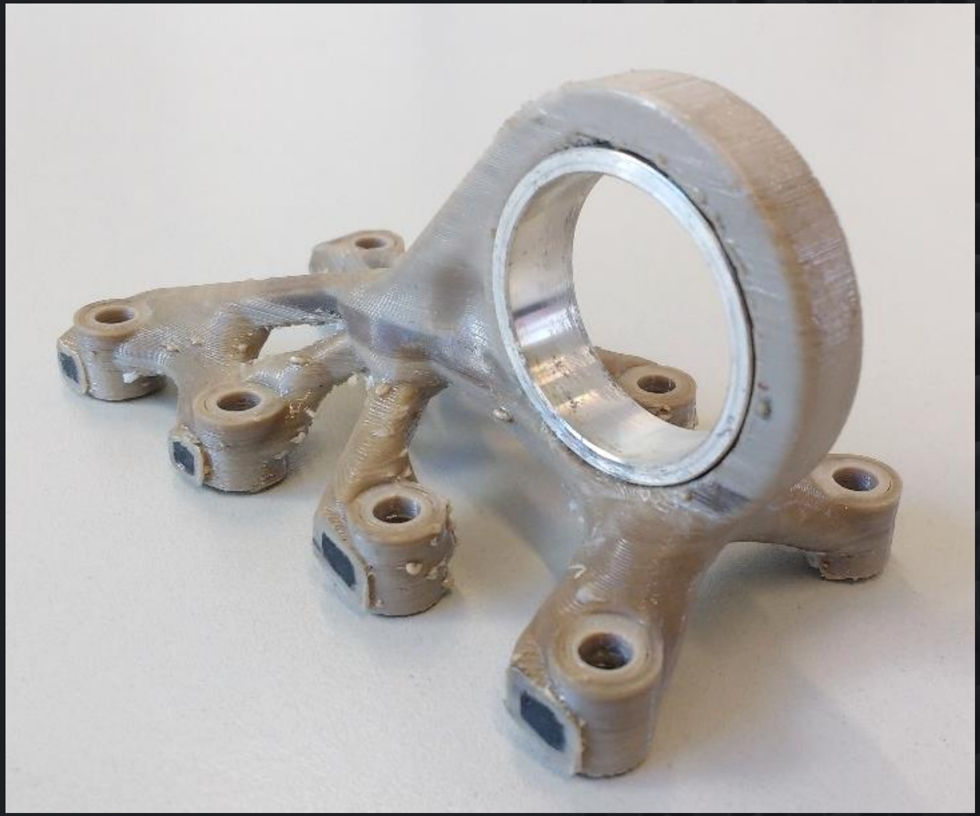
FEM Validation



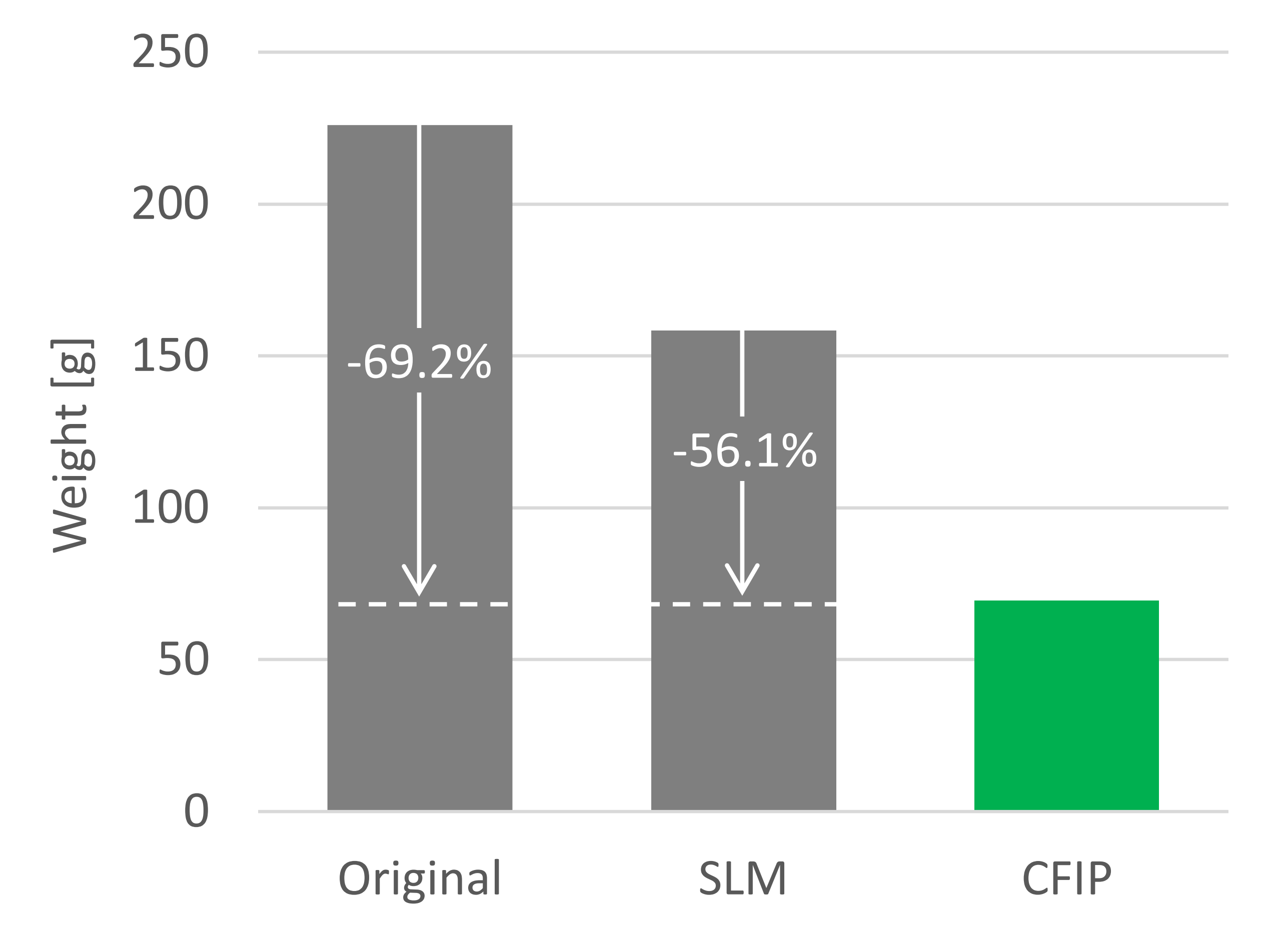


Final Prototype

- AM: PEEK (FFF)
- Fibres: HS Carbon
- Resin: Epoxy



Benchmark



Thanks!

Revolutionizing the carbon fibre reinforcement

Marc Crescenti
Founder and CTO
marc.crescenti@reinforce3d.com

REINFORCE3D