University of BRISTOL
Bristol Composites Institute (ACCIS)

A smart wing

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Bristol Composites Institute Postgraduate Research 2021

bristol.ac.uk/composites

accis
ADVANCED COMPOSITES COLLABORATION FOR INNOVATION & SCIENCE

UKRI Engineering and Physical Sciences Research Council

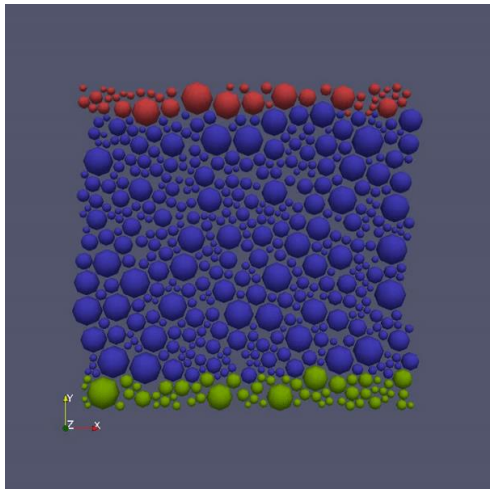
University of BRISTOL
EPSRC Centre for Doctoral Training in Advanced Composites for Innovation and Science

CONACYT

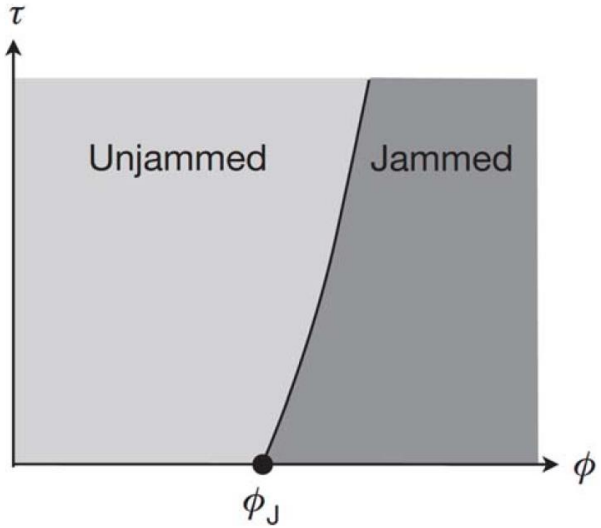
Warsaw University of Technology

SABRE

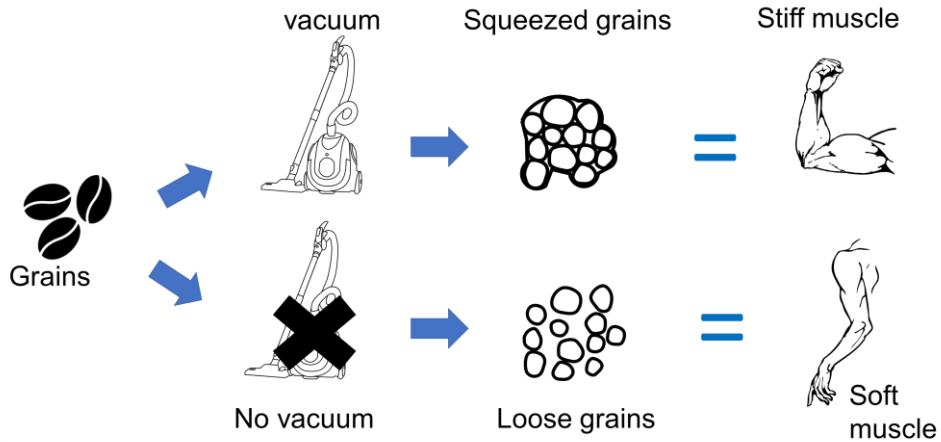
Vacuum-packed particles **(jamming)**



[4] Video: George Lesica

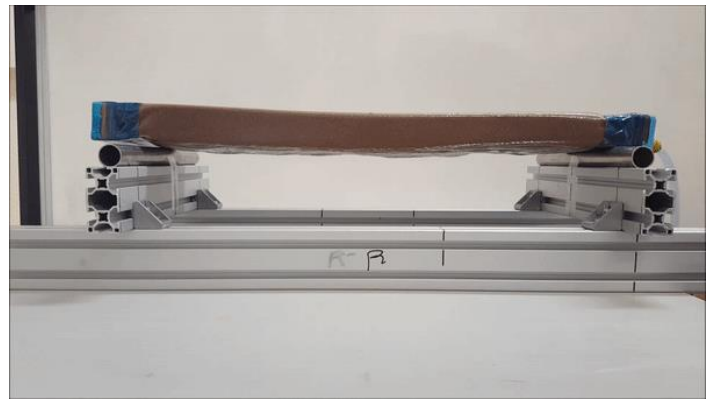


[5] Image: D. Bi, Brandeis university



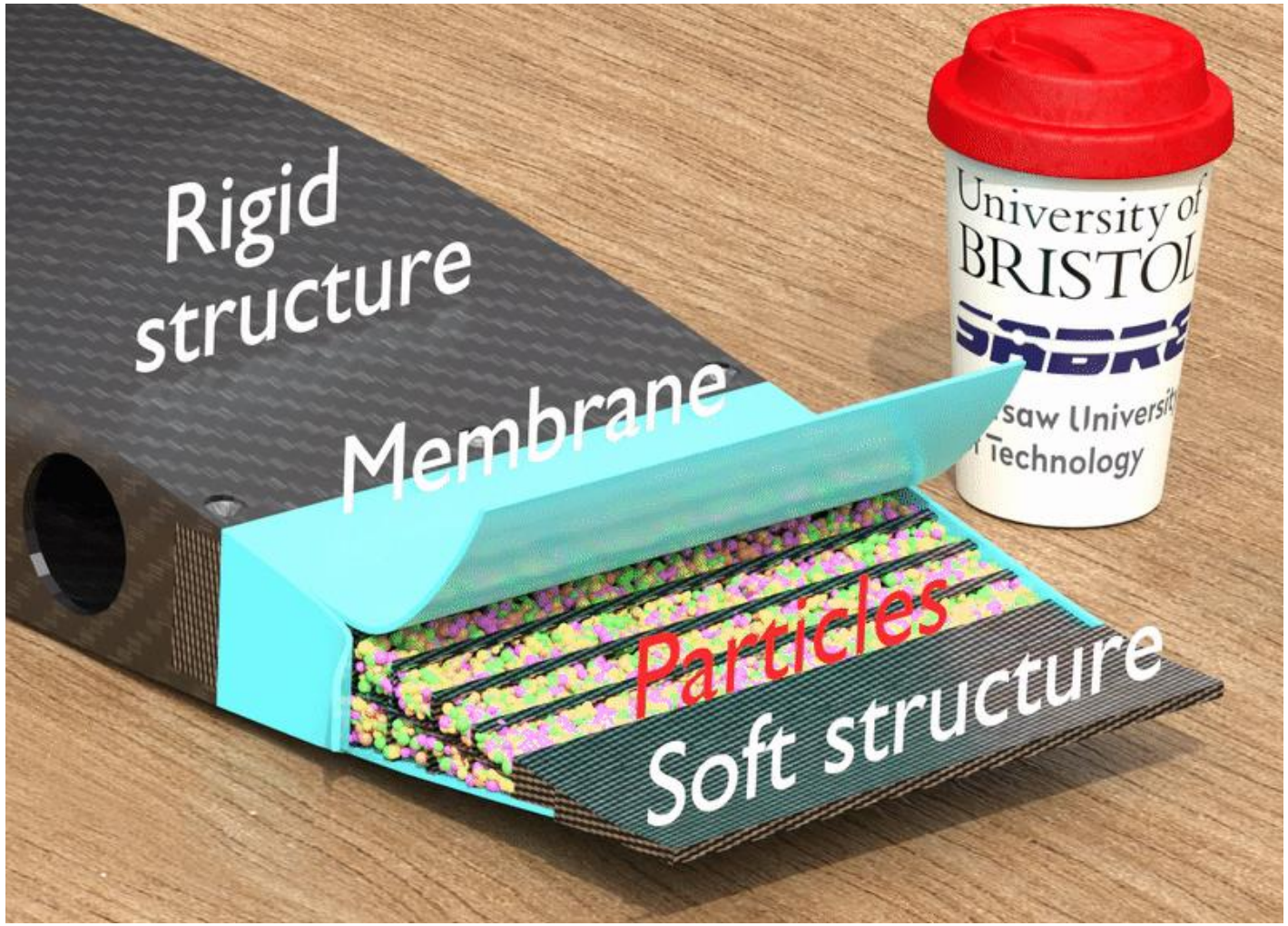
- Liquid-like: Less contact among particles.
- Solid-like: More contact among particles.

$$\phi = \frac{N_p V_p}{V_s}$$



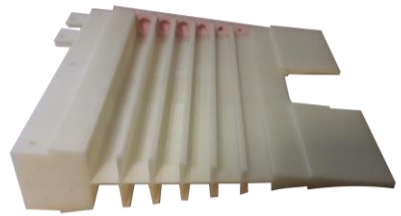
[4] George Lesica. Granular material undergoing shear stress. https://www.youtube.com/watch?v=lp4EsXx9ldE
[5] Dapeng Bi, Jie Zhang, et al. Jamming by shear. Nature, 480(7377):355–358, 2011.

Switchable Stiffness FishBAC **SwitchBAC**

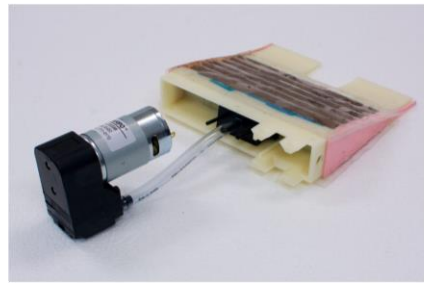


Demonstrator (3D printing wing with flexible trailing edge)

Silicone end-tabs

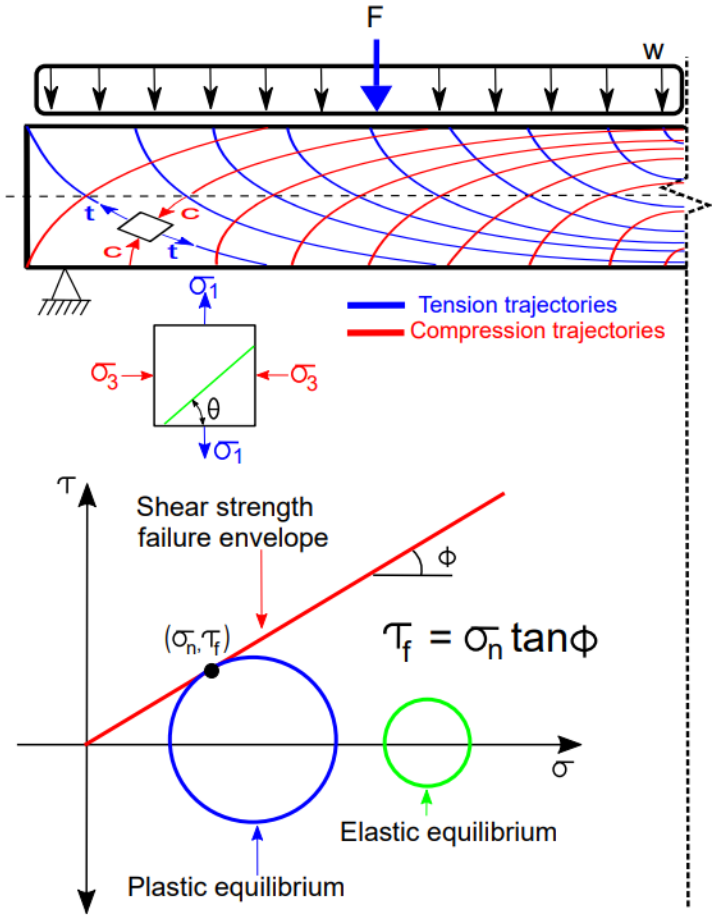


trailing edge with end-tab

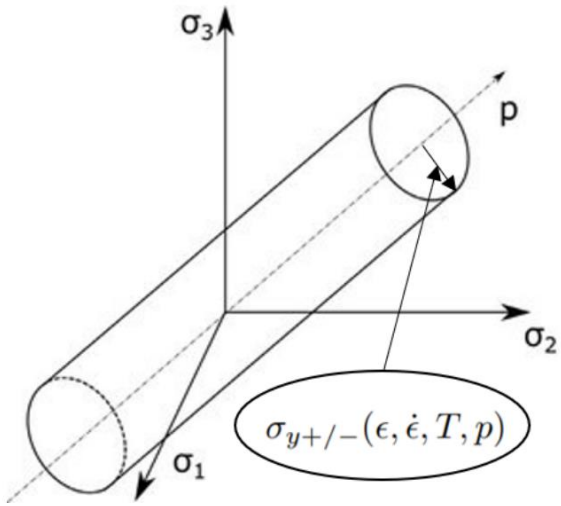


SwitchBAC with vacuum pump

Flexural models



Beam model based on Mohr-Coulomb Failure criterion



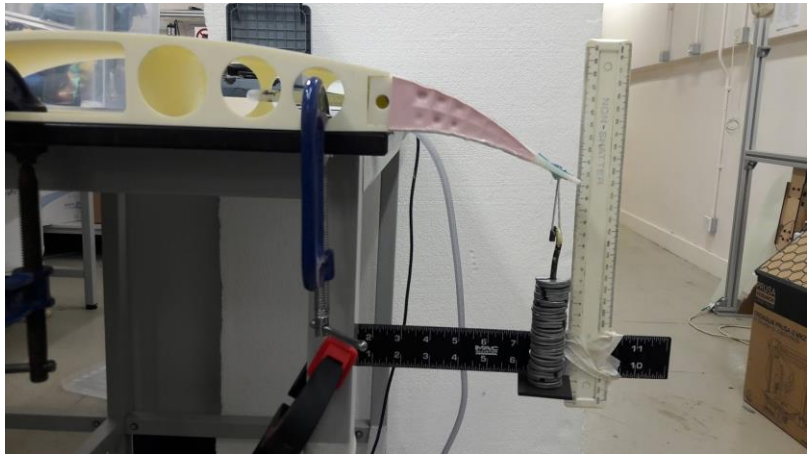
$$\phi = \frac{1}{2} s_{ij} s_{ij} - \frac{\sigma_{y+/-}(\epsilon, \dot{\epsilon}, T, p)^2}{3} \leq 0$$

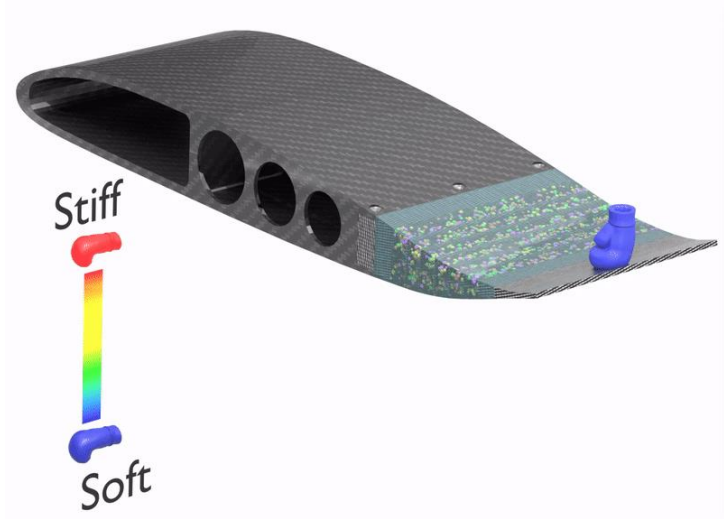
$$\sigma_{y+/-}(\epsilon, \dot{\epsilon}, T, p) = \begin{cases} \sigma_{y+}(\epsilon, \dot{\epsilon}, T, p) & \text{if } I_\sigma > 0 \\ \sigma_{y-}(\epsilon, \dot{\epsilon}, T, p) & \text{if } I_\sigma < 0 \end{cases}$$

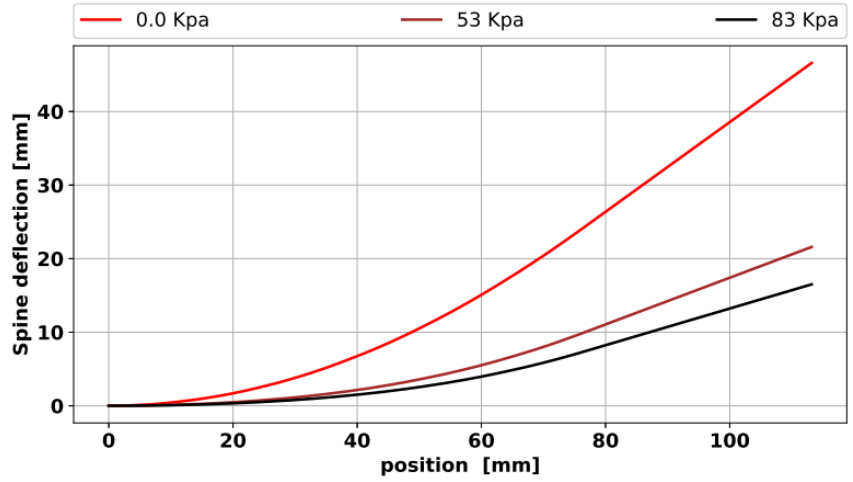
Plasticity model based on Von Mises yield criterion

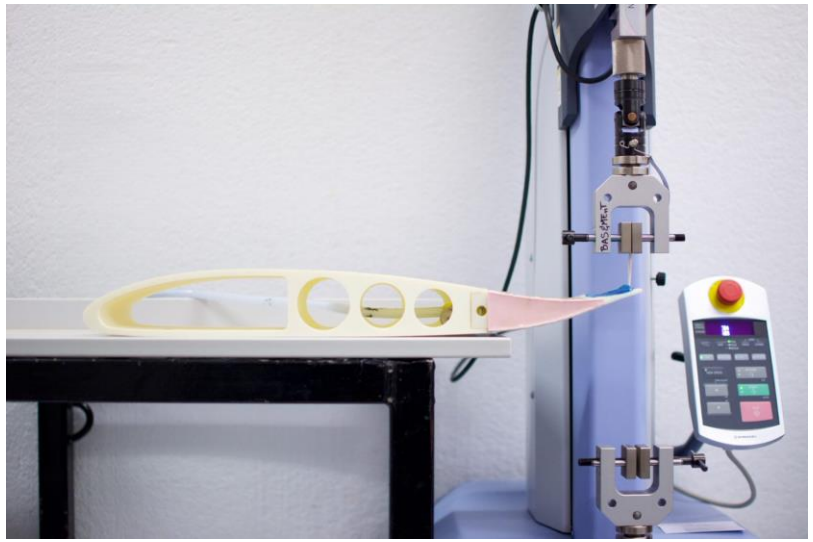
- Plasticity model: **2 hours** for case (six 2.6GHz and 64GB)
- Beam model: **30 seconds** for case (single 2 GHz and 8GB)

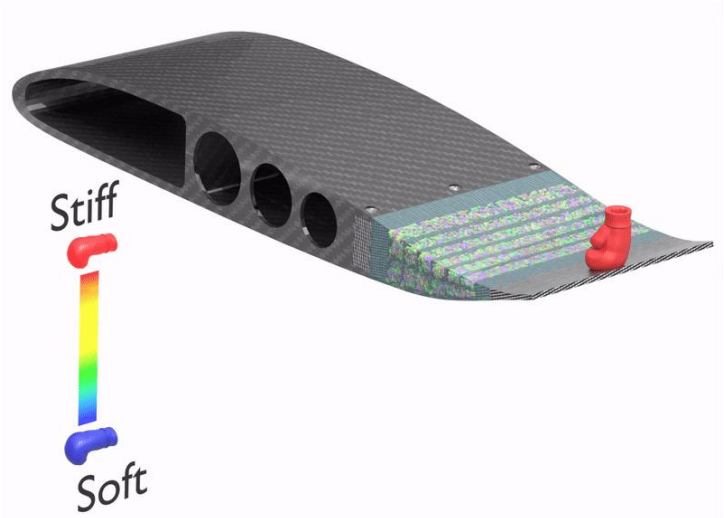
Spine deflection

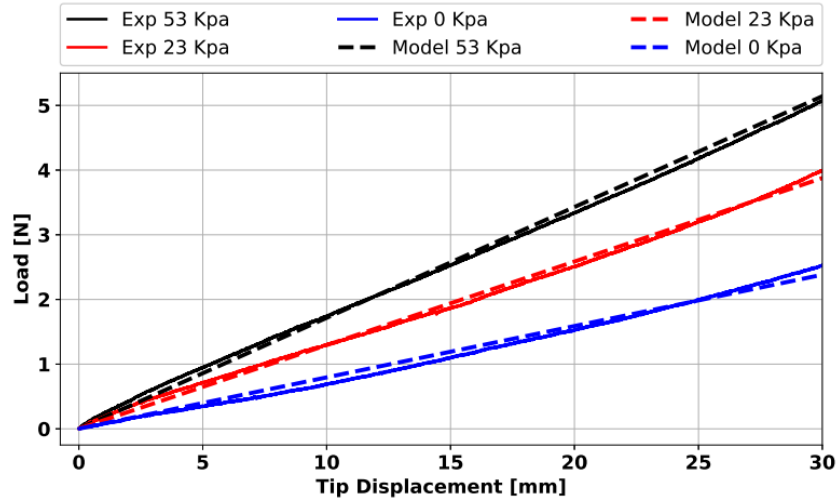




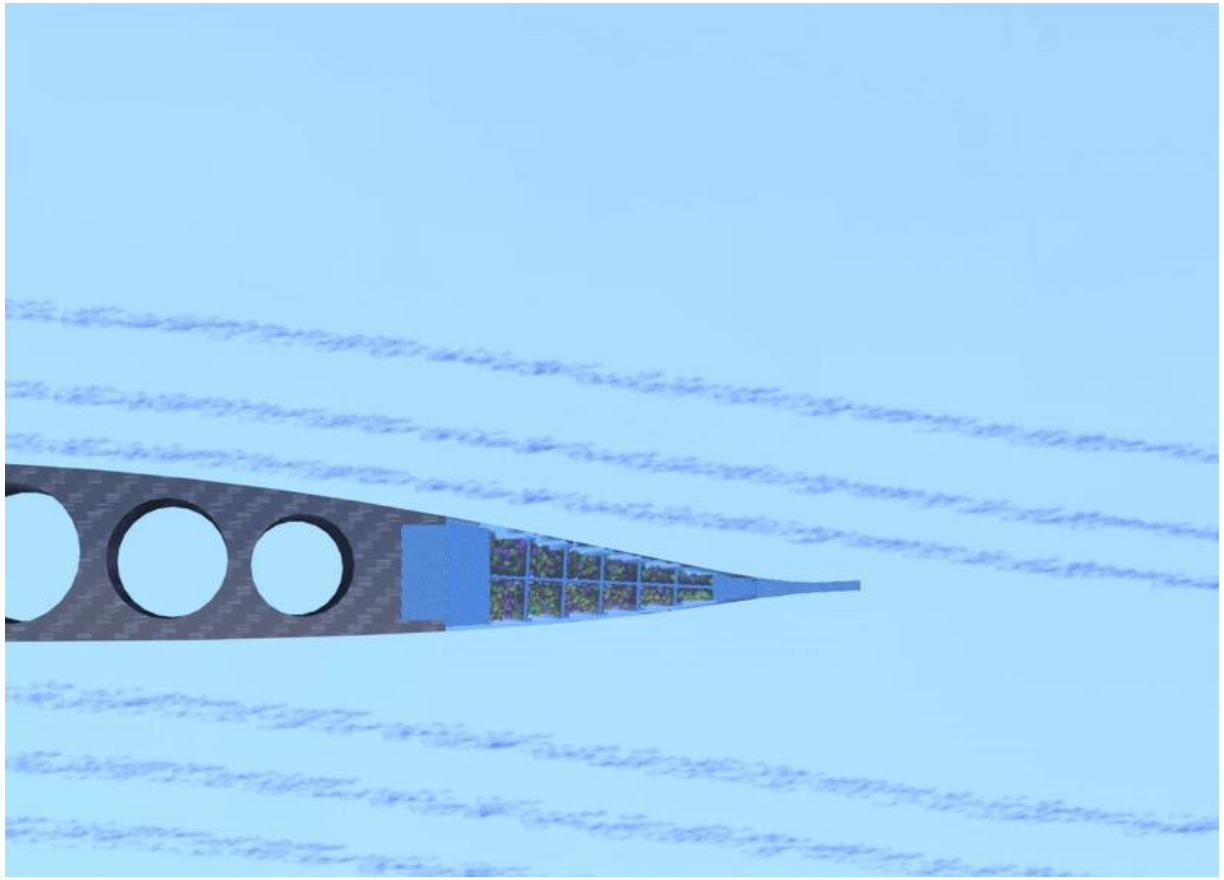


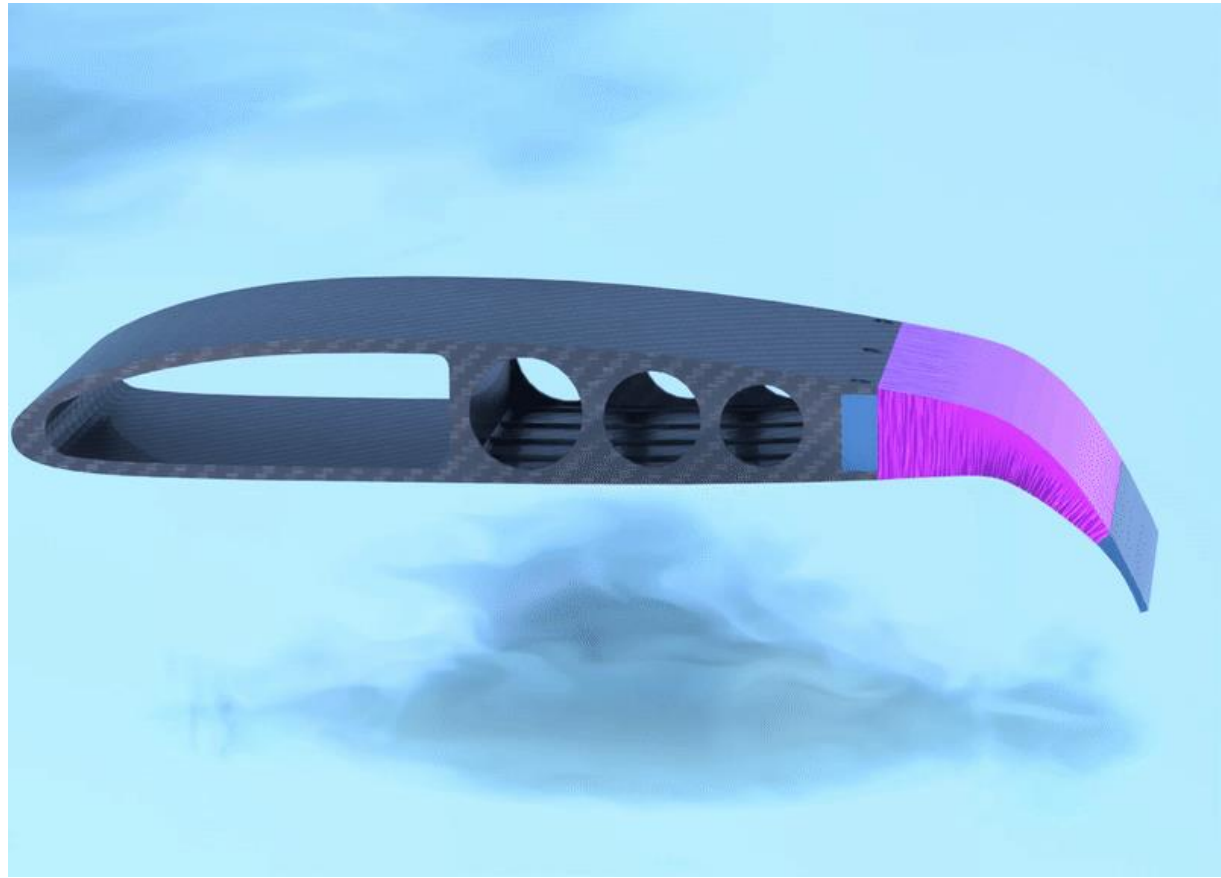






Fluid-Structure interaction





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We thank you!

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