Segmentation of individual fibres in a uni-directional composite from 3D X-ray computed tomography data

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**MOTIVATION**

Wind turbine blades are becoming longer to decrease the cost of energy. They need to stand higher stresses.

**TASK**

We segment individually uni-directional glass and carbon fibres from tomography data to study the fibre orientation and relate it to the compression strength, a key parameter when designing the blade’s load carrying parts.*

* green parts in the blade on the right

**PIPELINE AND CHALLENGES**

- Low quality scans to avoid a long acquisition time.
- Composite materials with high fibre volume fraction.
- Large data sets.

**SEGMENTATION AND TRACKING**

1. Glass Fibre Reinforced Polymer (GFRP)
2. Carbon Fibre Reinforced Polymer (CFRP)

- Voxel Size 1.124 μm
- Voxel Size 0.482 μm

Detected centres in red and reference centres in yellow.

**accuracy**

**1. GFRP**
**2. CFRP**

**ACCU**

**FIBRE ORIENTATION**

1. GFRP
2. CFRP

- ∆ = 4d
- ∆ = 10d
- ∆ = 79d

**COMPRESSION STRENGTH**

\[
\sigma' = \frac{G}{1 + \varphi/\gamma}
\]

(Budiansky et al., 1993)

For a more precise estimate...

...add the spatial distribution

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Individual fibre segmentation from 3D X-ray computed tomography for characterising the fibre orientation in unidirectional composite materials. Emerson et al., under submission.