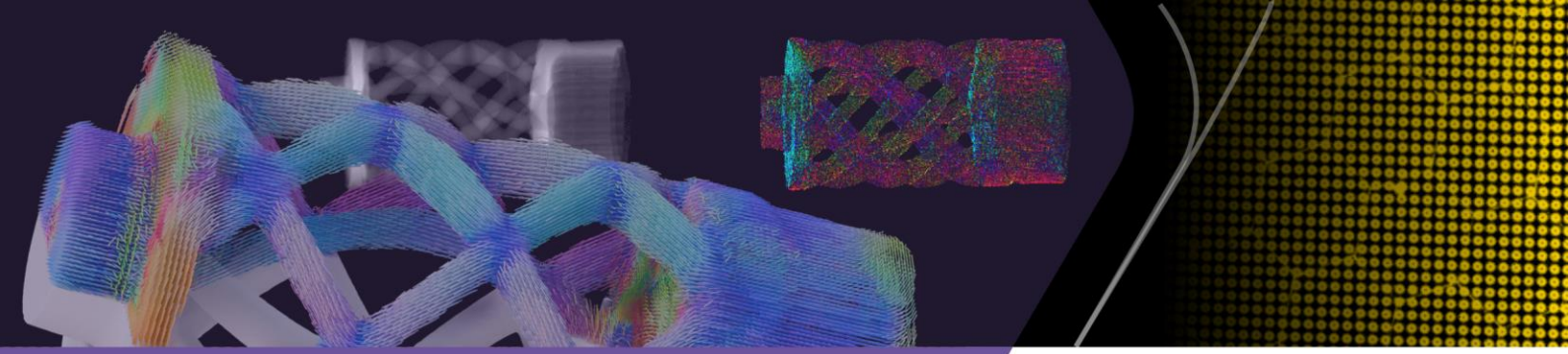

FiberScanner3D *Spotlight*

Pultruded Carbon Fiber Reinforced Profile

Fibers at a Scale

Characterizing carbon fiber reinforced polymer (CFRP) composites is notoriously difficult with X-rays due to the low contrast between carbon fibers and the surrounding polymer matrix. FiberScanner3D overcomes this challenge by employing advanced X-ray optics to indirectly probe fiber structures. This enables accurate measurement of fiber orientation and concentration on a much larger scale than previously possible.

The figure on the right shows a section of a pultruded CFRP profile with an artificially induced fuzzball defect. Using FiberScanner3D reveals the influence of the defect on local fiber orientation and concentration, providing essential input parameters for mechanical modeling and allows fast quality control.

Multimodal Analysis

By analyzing changes in the x-ray scattering signal caused by the sample, parameters such as projected scattering orientation, intensity, and anisotropy can be determined. These measurements are directly related to fiber orientation, density, and alignment.

Multiple images are acquired at different sample rotations and reconstructed using advanced tensor tomography that enables quantitative three-dimensional characterization of fiber parameters.

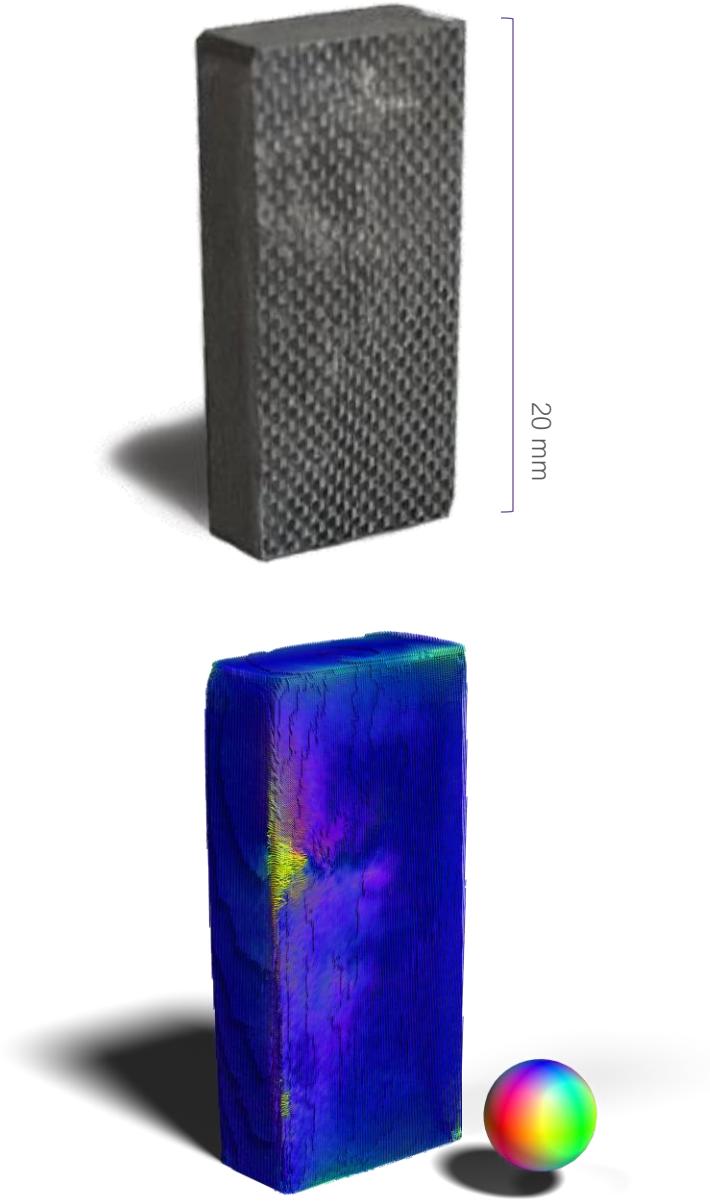

Figure: Pultruded carbon fiber reinforced polymer (CFRP) profile. Top: Picture of the sample mounted for scanning. Bottom: Fiber orientation map with voxels coloured according to their average orientation.

Sample Description

Pultruded carbon fiber reinforced polymer (CFRP) profile with an artificially induced fuzzball.

Dimensions: 10x5x20 mm

Filler: 67% Carbon Fiber

Matrix: Vinyl Ester

xnovotech
a RAITH company

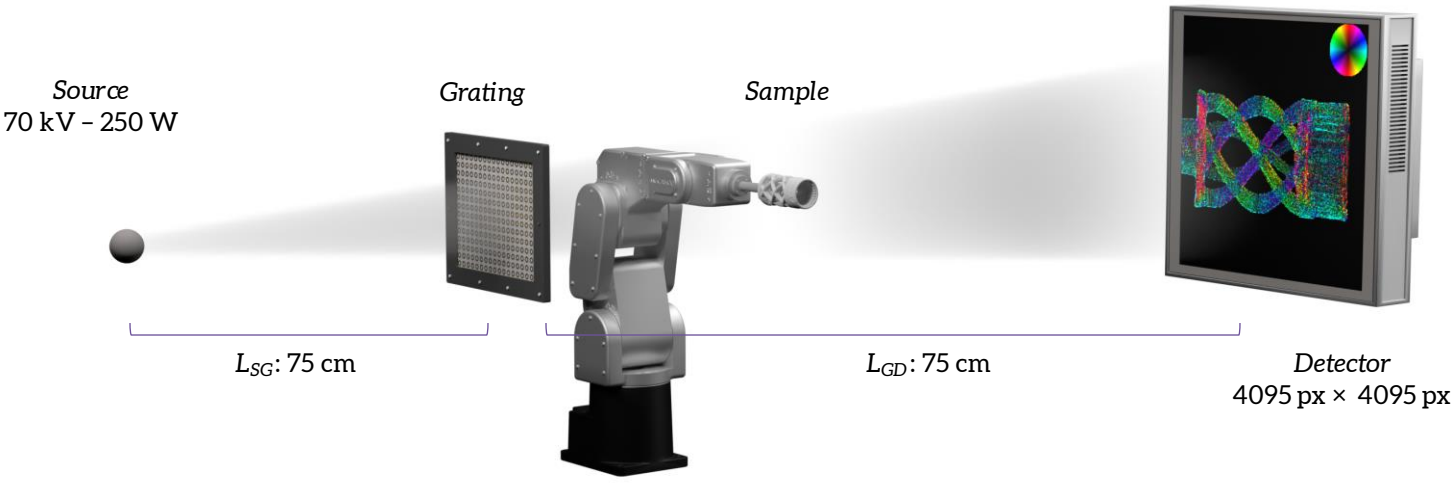

Figure: Schematic illustration of the setup for tensor tomography data acquisition of a carbon fiber reinforced polymer sample. Key acquisition parameters are marked.

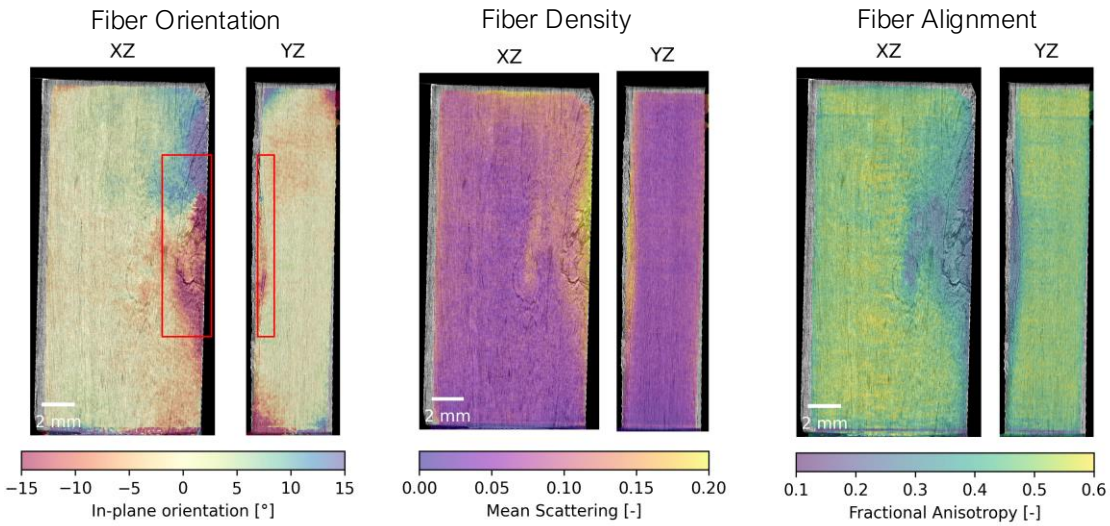

Figure: Example of different modalities in the 3D-analysis. From the scattering signal fiber-orientation, -density and –alignment can be extracted.

Data Acquisition Parameters

System: Exciscope Polaris

- *Voltage*: 70 kV
- *Power*: 250 W
- *Detector*: Large field-of-view flat panel
- *Source – Grating distance*: 75 cm
- *Grating – Detector distance*: 75 cm
- *Exposure*: 15 s / # of frames 4 / binning 1
- *Number of projections*: 721
- *Voxel size*: 86 µm

Collaborators

Sample provided by the Composites Manufacturing and Testing section at DTU Wind

DTU

DTU Wind

Department of Wind and Energy Systems

Xnovo Technology ApS
Galoche Allé 15, 1.
4600 Køge, Denmark
info@xnovotech.com
www.xnovotech.com

xnovotech
a RAITH company