Characterising and Modelling Microstructural Organisation in Unidirectional Composites

Integrating Descriptor-Based Inputs into a Novel 3D Microstructure Generator

MSc thesis at TUDelft | Aerospace Structures and Materials | PAAM group

| Materials Science and Engineering | Mechanics of Materials Computing group

Published: March 2026

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Are you curious about how complex fibre patterns can be recreated digitally? This project gives you the chance to contribute to the development of PAAM's **novel 3D microstructure generator**. You'll help connect real 3D microstructural data captured through X-ray Computed Tomographt to a generative model that builds realistic fibre architectures.

Who we are

Within the Processing of Advanced Architectured Materials (PAAM) group at TU Delft, we investigate how microstructural architecture influences processing, performance, and variability in composite materials. You will contribute to the development of next-generation tools for characterising and modelling fibre trajectories, defects, and morphological features relevant for aerospace-grade materials. The project is co-supervised by the Mechanics of Materials Computing group at the Dept. of Materials Science and Engineering at TU Delft.

Your potential topic

PAAM is building a generator that creates fibre architectures based on collective motion rules. The next step is to translate unidirectional microstructure descriptor information (tortuosity, spacing distributions, bundling behaviour, etc.) into rules that the generator can use. This project focuses on formulating those links and validating the synthetic microstructures against real X-ray CT data.

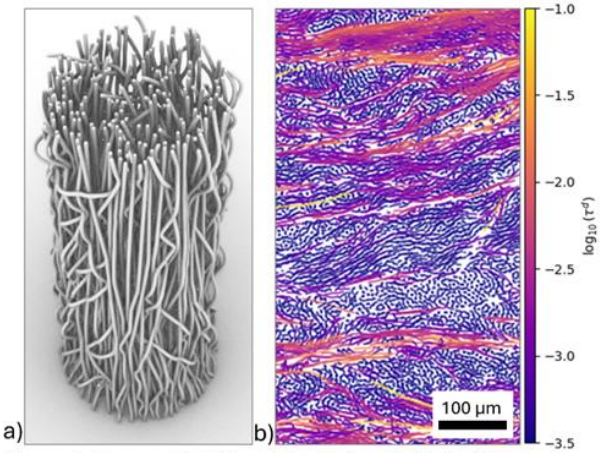

Figure 1 a) generated fibre trajectories; b) Projection on the transversal plane of the 3D fibre trajectories reconstructed from X-ray Computed tomography data.

Your potential tasks could include:

- Studying the current generator logic and generative growth rules
- Translating descriptor sets into parameter constraints or probabilistic rules
- Generating synthetic microstructures with controlled variability
- Developing comparison and validation metrics against Xray-CT-derived architectures
- Proposing improvements that enhance physical realism and feature representativeness

We are looking for you
You are a motivated MSc student in Aerospace Engineering, Mechanical Engineering, Materials Science, Computational Science or a related field. Interest in computational methods, machine learning, and familiarity with Python is required. No prior experience with X-ray CT data is needed.

What we offer
You will work as part of the PAAM group within TUDelft's Faculty of Aerospace Engineering. Guidance in X-ray CT processing, descriptor development, and data analysis will be provided. You will also get the opportunity to contribute to research publications or conference presentations.

The topic is part of ongoing ASM research projects and is directly linked to a Postdoc project at TU Delft, ensuring close academic supervision and integration into the PAAM research group of Prof. Clemens Dransfeld (paam-lab.org), and Dr. Sid Kumar (mech-mat.com).

Next steps
If this opportunity has sparked your curiosity, please contact Silvia via email or LinkedIn. We look forward to hearing from you.