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Statistical Validation of Individual Fibre Segmentation from Tomograms and Microscopy

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Abstract

Imaging with X-ray computed tomography (CT) enables non-destructive 3D characterisations of the micro-structure inside fibre composites. In this paper we validate the use of X-ray CT coupled with image analysis for characterising unidirectional (UD) fibre composites. We compare X-ray CT at different resolutions to optical microscopy and scanning electron microscopy, where we characterise fibres by their diameters and positions. In addition to comparing individual fibre diameters, we also model their spatial distribution, and compare the obtained model parameters. Our study shows that X-ray CT is a high precision technique for characterising fibre composites and, with our suggested image analysis method for fibre detection, high precision is also obtained at low resolutions. This has great potential, since it allows larger fields of view to be analysed. Besides analysing representative volumes with high precision, we demonstrate that based on our methodology for individual fibre segmentation it is now possible to study complete bundles at the fibre scale and reveal inhomogeneities in the physical sample.

Keywords: Geometrical characterisation A. Polymer-matrix composites (PMCs) A. Glass fibres C. Statistics D. Non-destructive testing

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