# Fidelity and Accuracy of the 3D Reconstructed Morphology of Elementary Flax Fiber Using Optical Projection and X-ray Micro-tomography: a Comparative Study

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Plant fibers are experiencing renewed interest for the last twenty years. For growing range of high-performance applications, it is essential to consider their intricate and variable morphology at the elementary fiber scale throughout their entire life cycle. Currently, to achieve that morphological characterization, there is no fast, non-destructive, cost-effective method that also makes no assumptions about the geometry of the fiber's cross-section. Optical Projection Tomography (OPT) is a promising method. The aim of this study is to assess the fidelity and accuracy of 3D reconstructions from optical tomography projections of two flax fibers. These are compared with the benchmark method, reconstruction generated from X-ray tomography projections. Both OPT and X-ray tomography, with voxel size of 0.244 µm and 0.430 µm respectively, are applied to the same single flax fiber, resulting in two 3D reconstructions of the morphology of the same fiber. At the same positions along the length of the fiber, comparisons are made between the two methods in terms of contour shape, cross-sectional area and the major and minor axes of ellipses fitted to the obtained contours.
Considering the time and cost associated with obtaining projections, i.e. 7 hours for X-ray tomography for a 7 mm long fiber, OPT provides consistent information on fiber morphology in terms of shape and dimensions (Figure 1) at a lower time cost, i.e. 1.5 hours to obtain projections for a fiber of the same length. This advantage paves the way for more systematic characterization of plant fibers, given their wide variability.

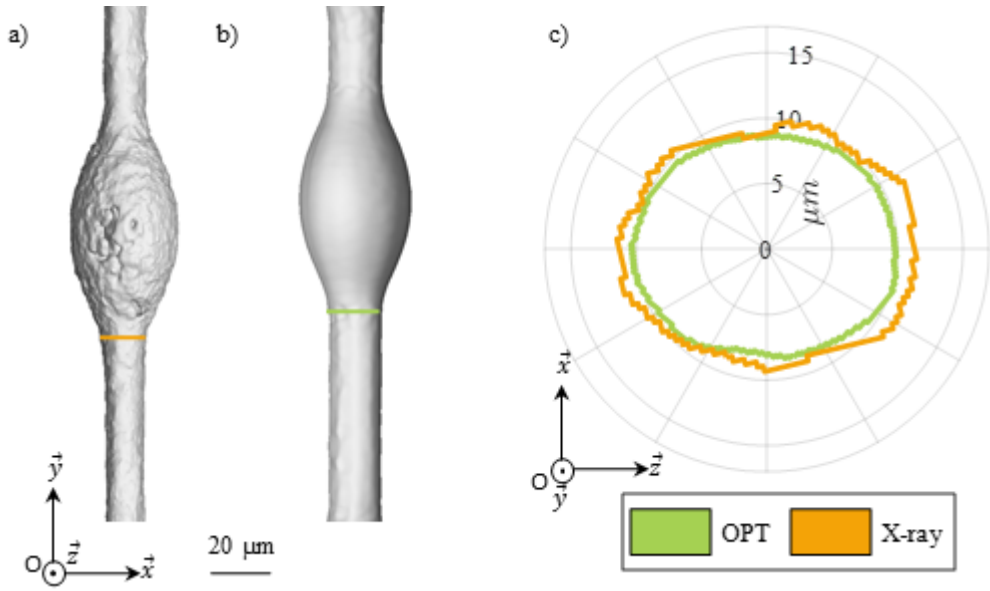


Figure 1: At the same position along the same flax fiber, near a glue droplet, (a) X-ray reconstruction (b) OPT reconstruction, with the position of a comparison slice, and (c) the outer shapes of the slice obtained with both methods