Multi-resolution X-ray tomography for multi-purpose use in cultural heritage

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Nanowood is the latest multi-resolution X-ray tomography setup developed at UGCT, the Ghent University Centre for X-ray Tomography. It consists of an 8-axis motorized stage combined with two X-ray tubes and two X-ray detectors, specifically designed to obtain very high resolution scans as well as scans of larger objects. The system offers a large range of operation freedom, all combined in versatile acquisition routines (standard or fast scanning, tilling, helix, etc). It has a generic in-house developed CT scanner control software platform (Dierick et *al.* 2010) that allows full control of the scanner hardware. Reconstruction of the scans is performed with Octopus, a tomography reconstruction package for parallel and cone-beam geometry (Vlassenbroeck et al. 2007). The latest developments include GPU-based helix reconstruction and phase-contrast filtering using dedicated algorithms such as MBA (Modified Bronnikov Algorithm, Boone *et al.* (2009)) and BAC (Bronnikov Aided Correction, De Witte *et al.* (2010)). Thanks to the flexibility of Nanowood, this state-of-the-art scanner can be deployed in many different fields of research with an interest in non-destructive visualization of the internal structure of objects in a high-throughput chain, but the scanner at the Laboratory of Wood Technology is dedicated to wood research sensu lato. The multi-purpose usability of this scanner is demonstrated with scans of ethnographical statues from the Democratic Republic of Congo (DRC), tomographical microscopy for wood anatomical identification of wooden objects, the study of corrosion preserved wood from an archaeological site in Flanders and the detailed study of wood decay (Figure 1), all important issues in a cultural heritage context.

These examples pinpoint at the possibilities of the modular and flexible set-up of Nanowood, allowing scanning with a resolution of 0.2 mm for samples of 37 cm in diameter and a maximal length of approximately 20-30 cm down to approximately 400nm for objects that have about the size of a splinter. The improvements of scanner hard- and software compared to a few years ago are of such a magnitude that resolution, scanning and reconstruction speed, resulting image quality and image processing performance are meeting the highest standards. Furthermore, the ongoing interaction within UGCT between wood scientists and X-ray physicists enables an optimal use, refinement and continuous updating of the equipment and accompanying software for scanner control, reconstruction, data analysis and visualization.

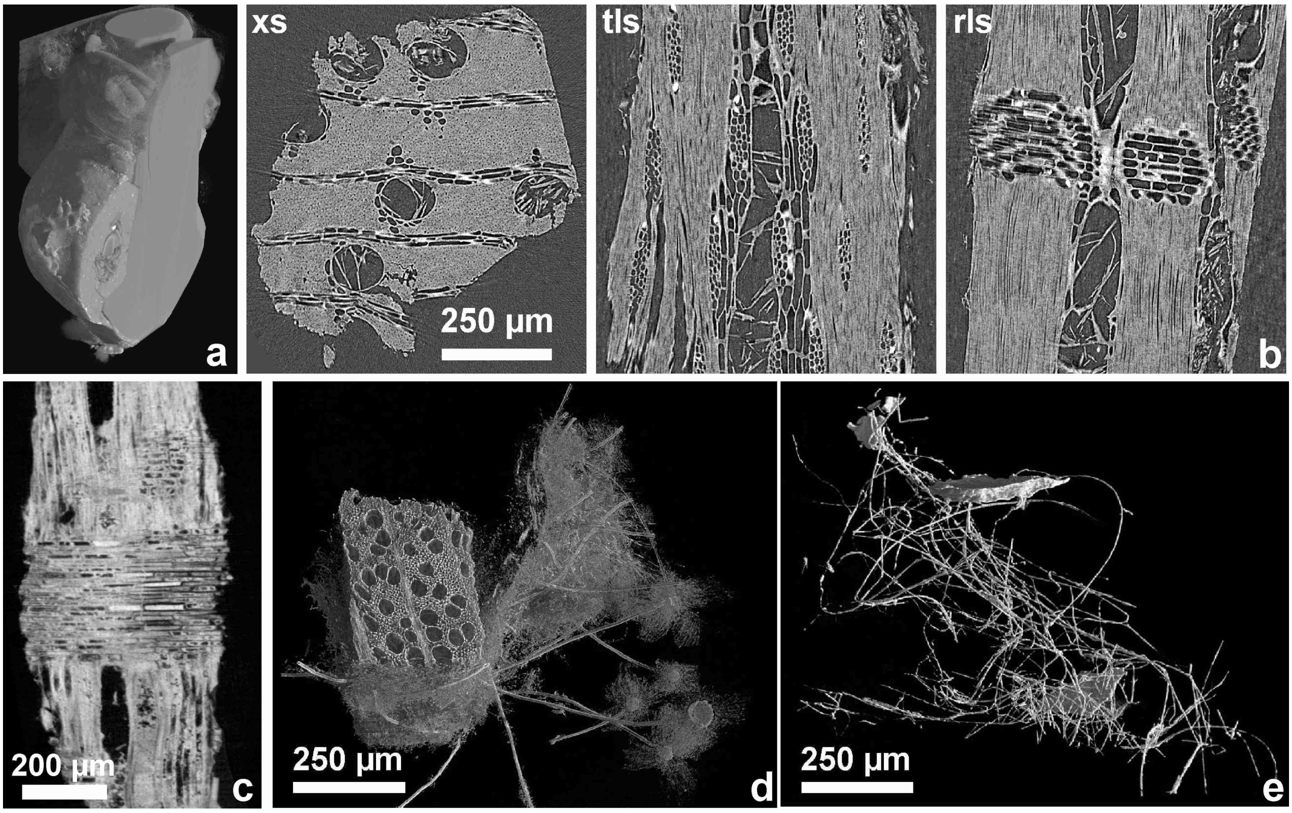

Figure 1. (a) 3D rendering of an ethnographical statue from DRC; (b) transversal (xs), tangential (tls) and radial (rls) view on Ipé (*Tabebuia* spp.); (c) radial section through a piece of corrosion preserved wood; (d) fungal growth on beech and (e) fungal hyphae.

References

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