Visualising the exterior and interior of art objects through combining CT scans and surface scans

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Introduction

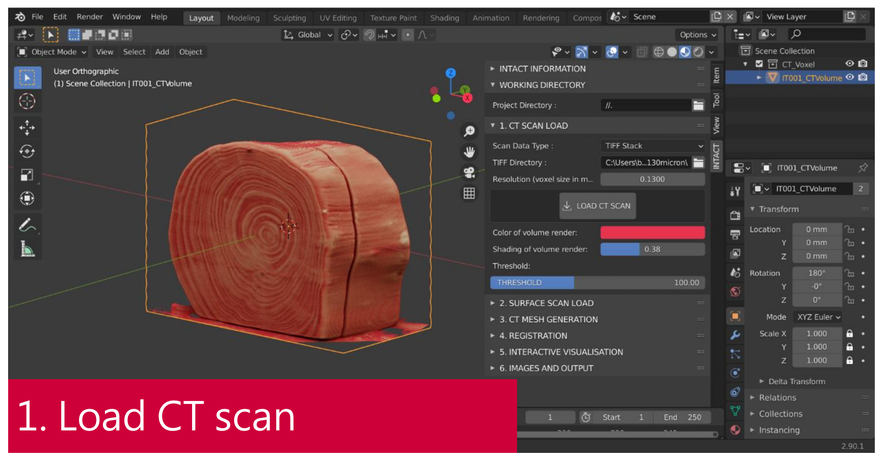
X-ray imaging techniques are becoming increasingly popular to study cultural heritage objects. One of these techniques is X-ray Computed Tomography (CT), an imaging technique based on X-ray absorption, which provides a 3D reconstruction of the interior of the object. The visualisations of these 3D reconstructions are often focused mainly on stacks of 2D slices and the features within these slices. For museum professionals 3D visualisation of CT scans is highly important, as the location of the 2D slices within the object is easier to understand. Researchers have experience investigating objects on the outside, but the interior features of art objects are usually inaccessible. Overlaying the CT visualisations with a structured light surface scan that reflects the real colour and texture of the outer surface therefore takes the impact of visualisations to a higher level. There are several software solutions for 3D visualisations, but there is yet no standard method tailored to cultural heritage.

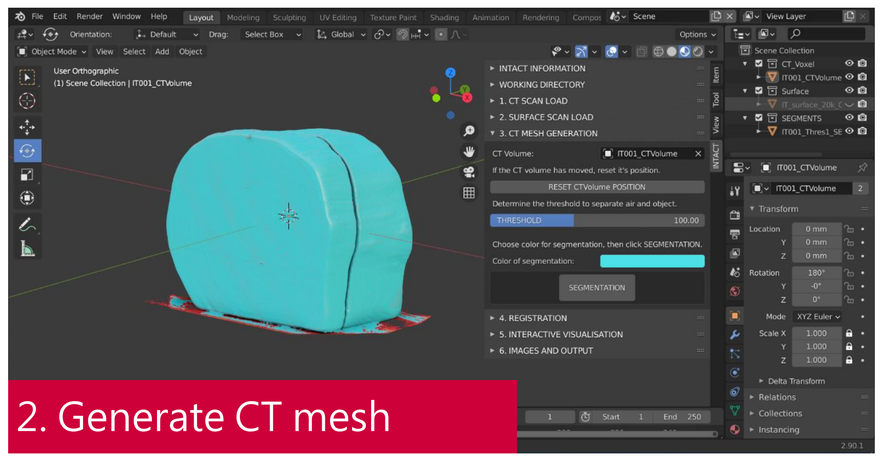
Case study

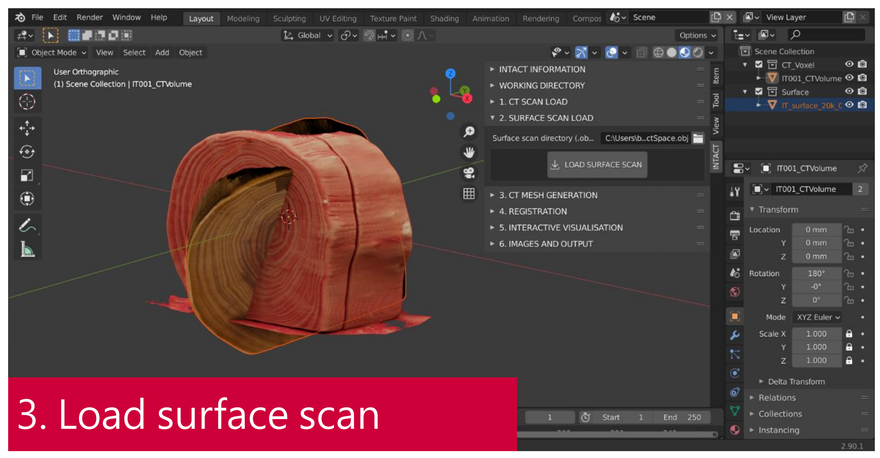
Below we present a case study from the Rijksmuseum: 'Bottle in the shape of a shoe' (BK-KOG-1382, on loan from the KOG), made of wood and leather. Figures a-c present a detail, showing an eye and blowholes in the red rectangle in a) surface scan, b) CT scan, c) CT and surface scan overlay. The volumetric representation of the CT data (in yellow) clearly reveals two circular features that had previously gone unnoticed. In subfigure d) the volumetric representation of CT data is cut through, to visualise the stitch along the back of the tail (blue arrow) as well as multiple pieces of leather converging in the insole (red arrow). In e) the 3D surface scan is sliced through, showing the corresponding CT slice, revealing the hollow spaces inside the object (blue arrows) and tree rings in the heel (red arrow).

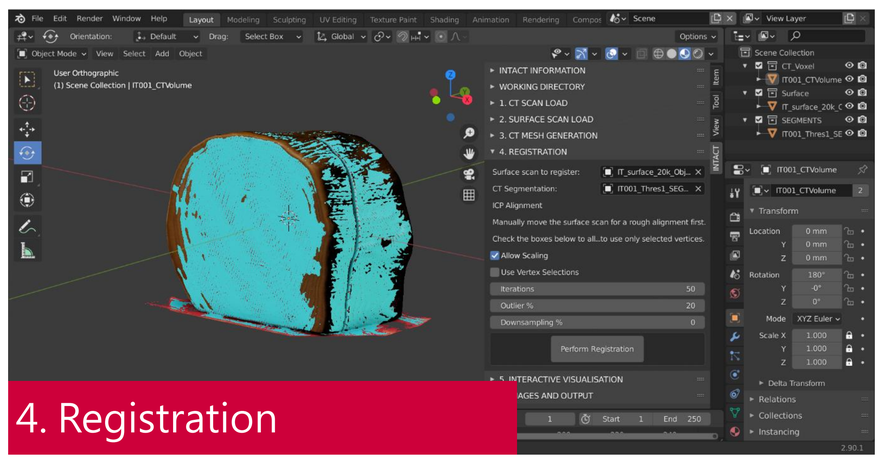
Workflow

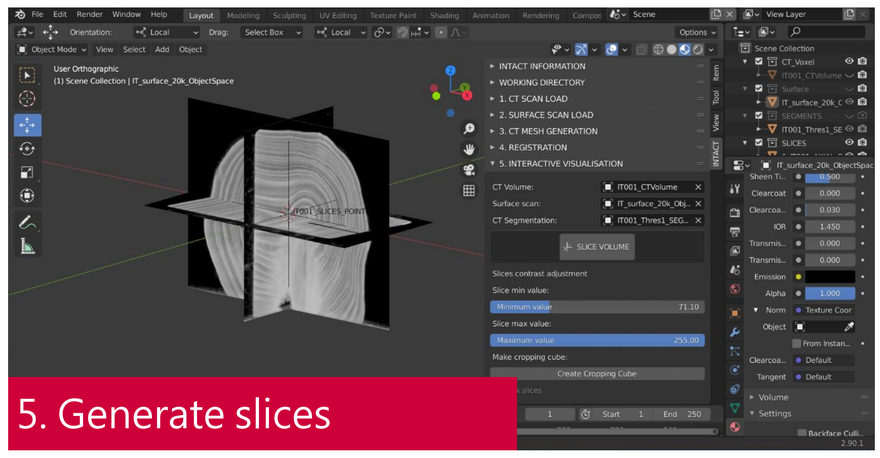
Using the open access software *Blender*, we provide the first step towards interactive visualisation of multiple 3D imaging techniques. We illustrate the full computational workflow once the CT and surface scan data has been acquired. The CT data is loaded (1). From the CT a mesh is generated based on a chosen threshold (2). Then the surface scan is loaded (3) and registered to the CT mesh (4), such that the features on the surface line up exactly with the corresponding features in the CT scan. Orthogonal slices through the CT volume are created (5), and clipping boxes that slice open both the surface scan and the CT scan and show the corresponding slice on the box's surface are created. Lastly, an interactive environment is created for inspecting the data simultaneously (6).

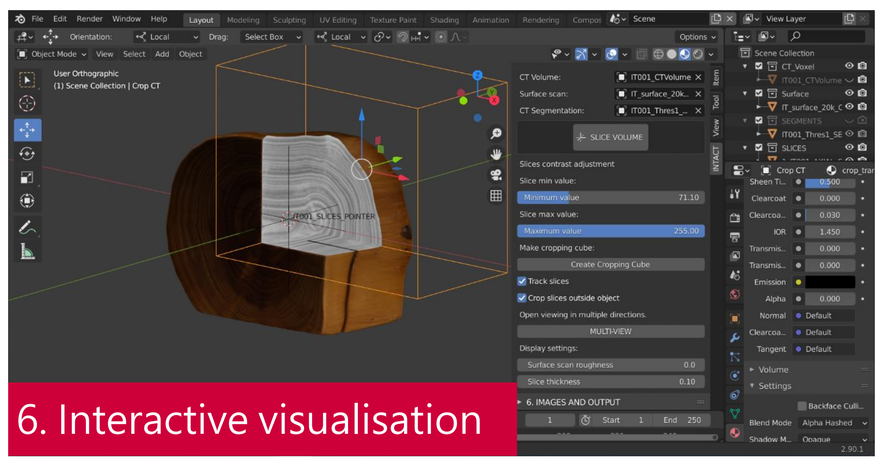












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