

X-ray microtomography for 3D imaging of cultural heritage artefacts

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Basic principles and the use of X-ray microtomography for 3D imaging of cultural heritage artefacts will be described. X-ray microtomography (μ CT) combines the principles of X-ray shadow microscopy together with the computed tomography CT. The current technical possibilities allow achieving submicron resolution by the use of μ CT facilities. Primary use of this method can be found particularly in materials research, precision engineering and electronics industry. In all these areas there is a need for non-destructive, high resolution visualization of internal microstructures, measurement of interior dimensions of 3D objects and testing for the presence of internal defects. In the cultural heritage field the X-ray microtomography method can be used for non-destructive visualisation of internal structure of archeological and historical artefacts and for precise 3D imaging of artefacts.

Keywords: X-ray, CT, microtomography, cultural heritage, 3D imaging, non-destructive testing

X-ray radiation is electromagnetic radiation in the wavelength range from 10 nm to 0.01 nm. Waves from the region 10 nm to 0.1 nm are usually classified as soft X-rays and waves from 0.1 nm to 0.01 nm are then classified as hard X-rays. Outstanding feature of X-ray is - similarly to other high-energy waves like the gamma radiation and cosmic rays - the high penetration power through a matter. This property of X-ray radiation can be effectively used for non-destructive visualisation of internal structures of objects, detection of defects, cracks, inclusions in materials and other applications.

X-ray microtomography measurement is composed of two phases – acquisition of projections and volume reconstruction. During the first phase – acquisition of projections the object under test is step by step turned around the rotational axis at a small defined angle. After each elementary rotation, so called X-ray projection is recorded. When all necessary projections are obtained, the second phase starts: volume image reconstruction. It is a set of mathematical operations that are in general called inverse Radon transform, when from the group of measured projections the cross-sections and 3D image of X-ray absorption in object are reconstructed.

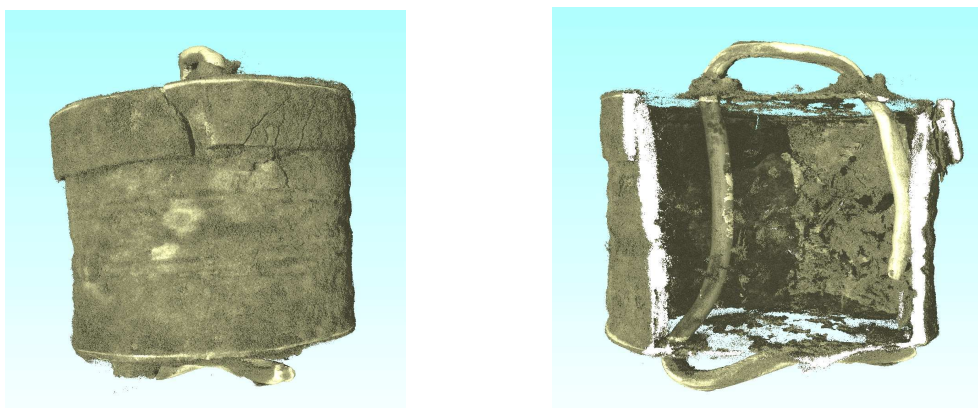


Fig. 1 3D visualisation of an archeological artefact by X-ray microtomography – view of outside and inside

Presented results were achieved using X-ray microtomograph GE Phoenix|X-ray Nanotom 180 with tungsten target. For rendering, filtering and visualisation of 3D data the software VG StudioMAX 2.1 was exploited.