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Comparative analysis of X-ray CT images and the results of digital modeling of objects printed on a 3D printer

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Computed tomography (CT) is a widely used method that provides huge opportunities for imaging the internal structure of different samples without disturbing their structures. During a CT scan, X-rays pass through a sample and detectors measure the radiation intensity after their interaction with this sample. The images directly obtained during the X-ray CT scan are two-dimensional projections of a three-dimensional sample through which radiation has passed oriented at different angles to the irradiating beam. In classical tomography, a three-dimensional sample is represented as a series of thin layers with one pixel thickness. During the processing of the received data, it is assumed that the trajectory of the beam is a straight line, and the linear absorption of radiation in the material occurs:
$dI/I = \mu(x,y)dt$
The main mathematic models use inverse Radon transformation for the reconstruction of tomographic images from two-dimensional projections reconstructing the function $\mu(x,y)$. Three-dimensional reconstruction aims to restore the original $\mu(x,y)$ function of the sample under investigation and different mathematical algorithms can be used for that. It is important to use different complex-shaped samples to train and check the applicability of such algorithms. 3D printing allows the creation of complex samples that can be used for obtaining real CT images while models of these objects can be used for computer simulation of the results of CT experiments.
This study reports an ad-hoc algorithm for simulating tomography images of different 3D-printed samples and a comparison of these images to ones obtained in real CT experiments.

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