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Measurement of the X-ray computed tomography instrument geometry by minimization of reprojection errors—implementation on simulated data

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Highlights

- In this research article, we measure the CT instrument geometry from simulated radiographic acquisitions of a novel reference object. The reference object consists of 49 radiographically opaque spheres arranged in a particular pattern. The CT instrument geometry is determined by way of least-squares minimization of reprojection errors, that is the deviation between observed sphere center projection and modelled sphere center projections. In this article, we describe the image analysis step, i.e. the extraction of sphere center projections from the acquired radiographs, the tracking of spheres along all radiographs, and the processing of sphere center overlaps. Once the observed data set is acquired, the minimization step is described. The performance of the described geometrical measurement procedure is tested on 10 radiographic datasets, each generated with randomly varied misalignments of the simulated CT instrument. Rotary stage error motions are included in the simulation to approximate expected sources of error in experimental CT systems.