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Deformable Curves for Outlining Objects Directly From Projections

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Processing of X-ray tomographic projection data usually starts by computing a reconstructed 2D or 3D image, often followed by an image segmentation step. Each of these steps introduces errors and artefacts, which is especially pronounced when data is noisy or incomplete. This has motivated the development of methods that combine the reconstruction and the segmentation step. When the object under study consists of a number of domains with approximately homogeneous absorption coefficients, the segmentation may be obtained by evolving the curve in the reconstruction domain.

We developed an efficient algorithm that computes a segmented reconstruction directly from X-ray projection data [1]. Our algorithm uses a parametric curve to define the segmentation. Unlike similar approaches, which are based on level-sets, our method avoids a pixel or voxel grid; hence the number of unknowns is reduced to the point-set outlining the curve, and the attenuation coefficients of the segments. Through systematic tests on synthetic data, as illustrated in Fig. 1, we demonstrated a high robustness to the noise, and an excellent performance under a small number of projections. Recently we tested our method on the real tomography data, yielding promising results shown in Fig. 2.

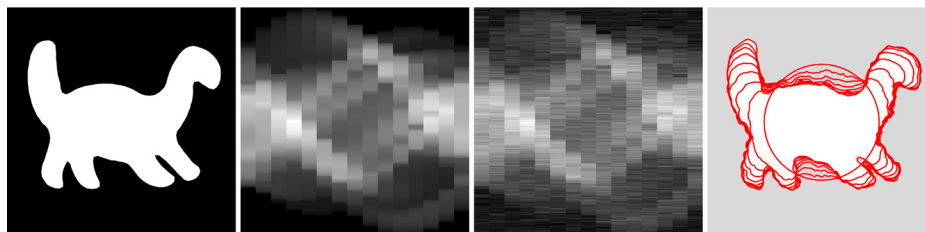


Figure 1: A synthetic test object, ground truth sinogram consisting of 15 projection angles and 200 detector pixels, a sinogram corrupted by Gaussian noise (noise level 0.1), and an illustration of a curve evolution obtained when reconstructing the noisy sinogram.

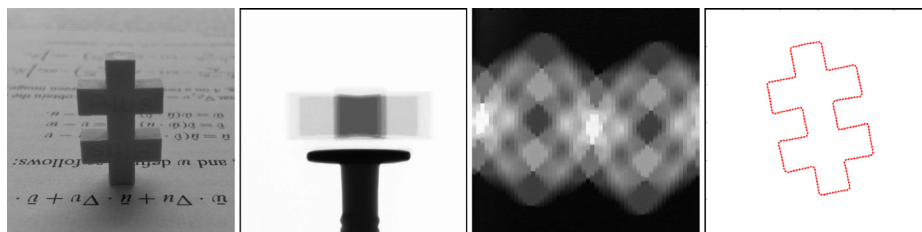


Figure 2: A photograph of a small plastic object, a single image from a sequence of the X-ray projections, a sinogram corresponding to a one slice through the object and a reconstructed object outline represented by 200 points.

[1] V.A. Dahl, A.B. Dahl and P.C. Hansen. "Computing segmentations directly from X-ray projection data via parametric deformable curves." *Measurement Science and Technology* 29.1 (2017): 014003.