

1.9.18. ENHANCED SPATIAL RESOLUTION USING ITERATIVE FOCAL SMEARING IN COMPUTED TOMOGRAPHY

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Computed tomography reconstructions of projected data usually assume an ideal point-like focal spot. However, in practice, the actual finite focus size leads to blurred projections, unavoidably. The elements (voxels) of the reconstruction matrix are smeared differently as a function of their individual position relative to source and detector (fig. 1b and c). Neglecting the focal smearing generates considerably blurred reconstructions (fig. 1e). Previous attempts were based on directly deconvoluting blurred projections from a constant kernel, which yields better results but still exhibits artefacts (fig. 1f).

Iterative algorithms can be adopted to take into account focal smearing as a function of position. However, this requires detailed prior knowledge of quantitative smear functions.

The DIRECTT (Direct Iterative Reconstruction of Computed Tomography Trajectories, [1]) algorithm is a promising candidate to meet these requirements. It has been demonstrated elsewhere [2] that DIRECTT copes with limited data sets such as limited view and region-of-interest data by tracing single sinoidal-like trajectories in Radon space, which are selected from the set of all possible trajectories by appropriate criteria. Currently, position-dependent smearing is used in the projection part of iterations. At the example of model reconstructions we demonstrate the gain of spatial resolution by iterative variable desmearing according to the DIRECTT algorithm (fig. 1g) in comparison to the standard filtered back-projection.

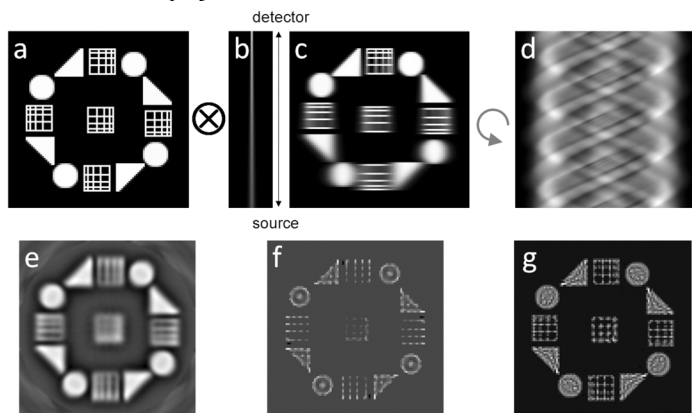


Fig. 1. Stages of numerical modelling of blurred projections (top) and reconstructions results (bottom):

- (a) – 101 × 101 pixel model; (b) – variable smear kernel as function of position;
- (c) – linear convolution of a and b vs. vertical position; (d) – sonogram;
- (e) – filtered back-projection of (d); (f) DIRECTT reconstruction after 20 iterations using an average smear kernel; (g) – same as f using b as variable smear kernel

References:

1. Lange A., Hentschel M.P. Patent DE 103 07 331, 05.03.2009.
2. Lange A., Hentschel M.P., Kupsch A. Computertomographische Rekonstruktion mit DIRECTT, MP Materials Testing. 50(5). – 2008. – P. 272 – 277.