Reconstruction with rigid motion correction technique in CT imaging: a simulation and application study

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Abstract: In four-dimensional computed tomography (4DCT), 3D images of moving samples are reconstructed from a set of 2D projection images. Recent techniques for affine, motion-compensated reconstruction either necessitate a reference acquisition or alternate image reconstruction and motion estimation steps. In these methods, the motion estimation step involves the estimation of a limited set of parameters corresponding to the affine motion, including rigid motion. The majority of these approaches rely on nested iterations, incurring significant computational expenses. Recently, we proposed the Motion-compensated Iterative Reconstruction Technique (MIRT)[2]- an efficient iterative reconstruction scheme that combines image reconstruction and affine motion estimation in a single update step, based on the analytical gradients of the motion towards both the reconstruction and the affine motion parameters. Results from simulation and real experiments show that our method allows accurate reconstruction with rigid motion artefacts compensated. In particular, this method allows accurate reconstruction for a real, non-stationary diamond, showing a novel application of 4DCT.

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[2]A.-T. Nguyen et al., "MIRT: a simultaneous reconstruction and affine motion compensation technique for four dimensional computed tomography (4DCT)", arXiv:2402.04480, *submitted.*