Abstract ID: 15124   Title: Enhancement of Four-Dimensional Cone-Beam Computed Tomography by Compressed Sensing with Bregman Iteration

Purpose: In four-dimensional (4D) cone-beam computed tomography (CBCT), there is a spatio-temporal tradeoff. The aim of this study is to develop a Bregman iteration based formalism for high quality 4D CBCT image reconstruction from low-dose projections.

Methods: The 4D CBCT problem is first divided into multiple 3D CBCT subproblems by grouping the projection images corresponding to the phases. To maximally utilize the information from the under-sampled projection data, a compressed sensing method is employed for solving each subproblem. We formulate an unconstrained lasso (least absolute shrinkage and selection operator) problem based on least-square criterion regularized by total-variation. The least-square criterion reflects the inconsistency between the measured and the estimated line integrals. Furthermore, the unconstrained lasso problem is updated and solved repeatedly by Bregman iterations.

Results: The performance of the proposed algorithm is demonstrated through a series of phantom experiments, and the results are compared to those of conventional filtered back-projection (FBP). The simulation studies have shown that artifact suppressed images can be obtained with as small as 41 projections per phase, which is adequate for clinical 4D CBCT reconstruction without slowing down the gantry rotation. With such small number of projections, the conventional FBP failed to yield meaningful 4D CBCT images.

Conclusions: The proposed method significantly reduces the radiation dose and scanning time to achieve the high quality images compared to the conventional 4D CBCT imaging based on FBP technique.