The art of the iterative XCT image reconstruction

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Abstract:

Cone beam computed tomography (CBCT) enables a volumetric image reconstruction from a set of 2D projection data. The image reconstruction problem is very large-scale inverse problem. Traditional, single step method such linear back projection in CBCT's case the FDK method is used. Although very fast, the single step methods cannot provide sufficient image quality with limited projection and limited angle data. They are not very good at dealing with noisy projection data that could come from fast data collection for example. We have implemented a wide range of algebraic iterative algorithms, or so-called algebraic reconstruction techniques (ART). Originally ART algorithms are based on Kaczmarz method; but the name ART originates from important paper form Gordon, Bender and Herman. The performance of various ART type algorithms such as SIRT, SART and OS-SART, and high order methods such as conjugate gradients (CG) and several total variational based methods is studied based on a range of image quality measures. The major limitations of the iterative methods are their computational time. We discuss the implementation of these algorithm in multi-CPU computing in our group and later on in multi-GPU platform leading to an open software toolbox TIGRE a collaborative project between University of Bath and CERN.