AbstractID: 3849 Title: Reconstruction of gated megavoltage cone beam CT data sets with missing projections: filtered backprojection vs. expectation maximization

Purpose: To assess and compare the merits of analytic and iterative algorithms for reconstructions of 3D images from gated megavoltage (MV) projection data that are non-uniformly sampled in projection angle.

Method and Materials: 2D projection images are acquired in a full fan cone beam geometry using the 6MV beam from a Varian 2100 EX accelerator and a prototype Varian 4030HE electronic portal imager. Because a respiratory gating system is used to confine radiation delivery to a predetermined part of the respiratory cycle, the projection image sets containing angular gaps of varying length. This non-uniform angular sampling of the projection data can be expected to result in image artifacts when an analytic reconstruction algorithm is employed. We compare two different methods, a filtered backprojection (FBP) algorithm and the expectation maximization (EM) method, for reconstructing 3D images of phantoms and patients from gated cone-beam MV projection data. Several data sets are considered that contain different sized gaps in the angular sampling of the cone-beam projections. The quality of the reconstructions is assessed by calculating contrast to noise ratios (CNRs) of inserts in an electron density phantom and by observer preference.

Results: The CNRs are consistently higher in the images reconstructed by use of EM algorithm. This can be attributed to the lower noise and artifact levels in the images. The computational burden of the EM algorithm is large, but it may be reduced considerably by use of the ordered subsets expectation maximization (OS-EM) version of the algorithm.

Conclusion: The EM reconstruction algorithm produced 3D images with reduced artifact levels and higher CNRs than those in images produced by the FBP algorithm. Iterative reconstruction methods can significantly improve image quality in gated MV CT applications, but is not suitable for immediate clinical use without implementation on high-performance computers or dedicated hardware.