AbstractID: 5625 Title: Computation-efficient cone beam image reconstruction for image-guided radiation therapy applications using 3D weighted filtered backprojection (CB-FBP) algorithm

Purpose: To extend the 3D weighted cone beam filtered backprojection (CB-FBP) algorithm for diagnostic CT imaging to image-guided radiation therapy (IGRT) applications.

Method and Materials: 3D isotropic spatial resolution is one of the most attracting features of state-of-the-art volumetric CT for diagnostics imaging. However, in IGRT treatment planning, the CT image slice thickness is usually larger than what is determined by detector row width (namely thin image). A straightforward way to generate thicker image is the combination of weighted adjacent thin images in image domain, which is computationally expensive because each thin image has to go through a computation expensive 3D backprojection. Another way is to carry out cross-row filtering in projection domain, which may cause shading/glaring artifacts and uneven slice thickness as isotropic 3D geometry is distorted. To optimize both image quality (IQ) and computational efficiency, a virtual reconstruction plane (RP) based algorithm is proposed and implemented. By using the 3D weighted CB-FBP algorithm, a thick image is still a weighted combination of adjacent thin images, but the combination is implemented in projection domain using virtual RPs. To maintain the IQ of thick image, the 3D weighted CB-FBP algorithm is applied by tracking re-sampled projection data. The tracking process is to improve computational efficiency further by making use of the projection data corresponding to involved virtual RPs only, while the re-sampling process is to improve IQ by increasing the in-plane sampling-rate in virtual RPs.

Results: By using a helical body phantom, spatial resolution phantom and 20 cm water phantom, the performance of the proposed algorithm, such as suppression of artifacts, uniformity of slice thickness and noise characteristics, are experimentally evaluated and verified.

Conclusion: The experimental evaluation shows the proposed algorithm is indeed an optimized image reconstruction solution for IGRT applications in terms of both image quality and computational efficiency.