AbstractID: 7722 Title: Suppression of artifact in axial cone beam reconstruction via ray-wise 3D weighting and anisotropic adaptive filtering

Purpose: To identify the root causes of artifacts in axial cone beam reconstruction, propose and evaluate the solutions of suppressing artifacts for image quality optimization.

Method and Materials: With increasing cone angle in volumetric CT, suppression of artifacts in axial cone beam reconstruction becomes more challenging. In the past, data insufficiency and longitudinal truncation were identified as the major causes of the artifacts. In this study, insufficient longitudinal sampling is identified as the third major cause. Based on a detailed artifact analysis, it has been experimentally verified that, (a) the artifacts caused by data insufficiency is quite acceptable at small cone angle up to 4.23°, and barely acceptable at moderate cone angle equal to 8.46°; (b) the artifacts caused by longitudinal truncation can be efficiently reduced by ray-wise 3D weighting. A straightforward way to reduce the artifacts caused by insufficient longitudinal sampling is to increase detector's longitudinal sampling rate, but such a way degrades noise characteristics and dose efficiency. An anisotropic adaptive filtering approach is proposed to suppress the artifact caused by insufficient longitudinal sampling. An oblique wire phantom, humanoid head phantom, modified Defrise phantom and helical body phantom, are employed to analyze artifacts and evaluate the efficacy of the proposed solutions.

Results: Experimental evaluation based on the phantom study shows that, the artifacts caused by longitudinal truncation and insufficient longitudinal sampling in axial cone beam reconstruction can be substantially suppressed by ray-wise 3D weighting and anisotropic adaptive filtering, especially while the image plane is approaching the detector's longitudinal boundaries.

Conclusion: It has been evaluated and verified that the combination of ray-wise 3D weighting and anisotropic adaptive filtering can significantly improve the image quality of axial cone beam reconstruction at cone angle up to 4.23°. Moreover, it is expected that such a combination can work well at larger cone angles.