AbstractID: 6936 Title: Exact image reconstruction in reverse helical cone-beam CT for radiation therapy

Purpose: To propose an exact image reconstruction algorithm based on Pack-Noo formula for a reverse helical cone-beam CT (CBCT) which is potentially a useful scanning geometry for image-acquisition in image-guided radiation therapy.
Method and Materials: Last year, we proposed a novel scanning geometry named reverse helical trajectory for a CBCT imager mounted on a linear accelerator (LINAC) treatment system, and applied a chord-based backprojection filtration (BPF) algorithm for exact image reconstruction. It was shown that there is a middle gap in the reconstructed image which is due to lack of chords passing through the gap. The gap was removed when we used an additional long line segment connecting the end points of the revere helices. However, larger patient dose and longer scan time due to additional line scan were pointed out as drawbacks of the proposed method. In this work, we applied Pack-Noo formula, which does not depend on the existence of chords for reconstructing the exact image, to propose an exact image reconstruction algorithm for a reverse helical trajectory. Cone-beam data requirement for the proposed algorithm was exploited to address the concept of reduced cone-beam scan. A numerical study using 3D Shepp-Logan phantom was performed.
Results: We showed the proposed algorithm can reconstruct the image without any gap in the middle from the cone-beam data acquired by a reverse helical scan. Additional line scan, which is necessary for chord-based BPF algorithms to remove the middle gap, is not needed for exact image reconstruction with the proposed algorithm.
Conclusion: A new algorithm based on Pack-Noo formula for exact image reconstruction in reverse helical cone-beam CT was proposed. Without any additional line scan which is necessary for chord-based BPF algorithms to reconstruct the complete image, the proposed algorithm successfully reconstructed the image.