

AbstractID: 5364 Title: Cone-beam CT for radiation therapy with reverse helical trajectory

Purpose: To propose and study a novel scanning trajectory, named reverse helical trajectory, for a cone-beam CT (CBCT) imager mounted on a linear accelerator (LINAC) treatment system by applying an exact 3D backprojection filtration (BPF) algorithm.

Method and Materials: A numerical study using 3D Shepp-Logan phantom was performed. We applied the PI-line-based BPF algorithm to reconstruct exact 3D image from data acquired numerically for a reverse helical trajectory. It was revealed that there is a middle gap in the reconstructed image which is due to lack of PI-lines passing through the gap. Application of a chord-based BPF algorithm showed a reduction in the middle gap. Two kinds of line plus reverse helical trajectories were proposed and tested to reduce the middle gap further. One of them is a reverse helical trajectory with a short line segment between two helices separated apart. The other one is a reverse helical trajectory with a long line segment connecting the end points of the reverse helices.

Results: The middle gap in the reconstructed image was reduced by employing a chord-based BPF algorithm. The gap was reduced further when we modified the scanning trajectory by inserting a line segment between two helices. The gap was removed completely when we used a reverse helical trajectory with a long line segment connecting the end points of the reverse helices.

Conclusion: A novel scanning geometry for a LINAC-mounted CBCT imager was proposed, and a preliminary numerical study was performed. The middle gap in the reconstructed image obtained by PI-line-based BPF algorithm was effectively eliminated by using a chord-based BPF algorithm with a line plus reverse helical trajectory.