AbstractID: 9173 Title: On-board four-dimensional digital tomosynthesis (4D-DTS): optimization of respiratory motion dependent acquisition and reconstruction parameters

Purpose: Amplitude and period of respiratory motion vary among patients. For four-dimensional digital tomosynthesis (4D-DTS), the frequency of projection acquisition and the phase window must be optimized based on respiratory motion. The purpose of this study was to demonstrate optimization of these parameters.
Methods & Materials: Experiments were performed to demonstrate optimization of projection acquisition frequency and phase window based on respiratory motion characteristics. Projection images of a CIRS Dynamic Thorax Phantom were acquired using an on-board imager (OBI) mounted on a clinical accelerator. The trajectory of a radiopaque marker attached to the phantom was monitored in projection space and used to assign phases to and sort projections for 4D-DTS reconstructions. 4D-DTS images were reconstructed for motion profiles ranging in superior-inferior amplitude from 10-40-mm and ranging in period from 3.5-7-sec. DTS images for each profile were reconstructed from various sets of projections, simulating different projection acquisition frequencies and phase windows.
Results: For a desired phase window, the frequency of projection acquisition must be optimized based on the respiratory period. If projections are acquired at too high of a frequency, many of the projections will not be used in the reconstructions, resulting in unnecessary imaging dose. If projections are acquired at too low of a frequency, 4D-DTS images can be reconstructed with missing projections or with larger phase windows. The effect of reconstructing with missing projections is minor if the fraction of missing projections is small. As the number of missing projections increases, vertical streaking artifacts appear in the images.
Conclusion: This work is part of a feasibility analysis for 4D-DTS imaging. It establishes relationships between optimal projection acquisition frequency, phase window and respiratory motion characteristics. Projection acquisition frequency based on respiratory period was derived and demonstrated.
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