

AbstractID: 5516 Title: Retrospective Sorting of 4D CT into Breathing Phases based on Imaging Analysis of a Fixed-Geometry Fiducial

Purpose: To evaluate a novel fiducial method for retrospective sorting of four-dimensional computed tomography (4D-CT). Breathing-induced motion and deformation of internal anatomy confounds planning and delivery of radiotherapy. Patient-specific assessment of respiratory motion using 4D-CT is becoming more clinically accepted as it depicts discrete sampling of the internal anatomy throughout the respiratory cycle. Various strategies for sorting the images exist. External strategies rely on integration of a motion sensor with the CT device but may lack robustness with respect to sensor location. Internal strategies based on image analysis alone may not be robust enough. This work proposes a hybrid retrospective sorting method based on an easily positioned fiducial device that does not require additional hardware and is usable with any multi-slice or helical CT scanner. An image-processing algorithm automatically extracts the breathing phase of each slice by fiducial position and sorts images into phases accordingly.

Method and Materials: A 50 cm rod-like device covering the entire field-of-view is placed along the patient, providing a well distinguishable fiducial position in each CT slice without impacting image quality. Image analysis determines the fiducial centroid position in each slice with sub-mm accuracy, allowing phase-based binning of the image slices according to breathing phase. To validate the method, a motion phantom with the rod affixed was subject to a cine 8-slice CT scan with 2.5 mm slice thickness. Images were sorted with the fiducial method and compared with images sorted by a commercial 4D-CT system.

Results: Phase-sorted images of the phantom were reconstructed using the fiducial method. Image quality was comparable to those reconstructed by the commercial 4D-CT system.

Conclusions: Image analysis of a rod fiducial allows retrospective sorting of 4D CT according to breathing phase. This method does not require additional hardware, interfacing with the CT scanner, or manual interaction with the images.