AbstractID: 3405 Title: Novel 4D CT scanning protocol using a helical single-slice CT scanner

Purpose: In radiotherapy, respiratory motion poses a significant challenge during tumors imaging, treatment planning and radiation delivery. A method to alleviate respiratory motion problems is to use 4D radiotherapy. We propose novel 4D CT scanning protocol using a helical single-slice CT scanner (SSCT).
Method and Materials: In our protocol, patient's torso is scanned three times using the helical mode of a SSCT scanner. CT slices are acquired simultaneously with real-time tracking of a marker placed on patient's torso. At the end of the three scans, CT data is binned into different respiratory phases according to the externally recorded respiratory signal and the volume of interest is reconstructed for several respiratory phases.
Results: The protocol was tested on an anthropomorphic phantom to which a realistic respiratory motion was induced by placing it on an inflatable mattress driven by an air pump controlled by a pulsing power supply. 4D CT images were compared with images obtained after a conventional scan of the static phantom and with the conventional scan of the "breathing" phantom. 4D CT images show a net improvement with respect to conventional CT images. The ANIMAL deformable registration algorithm was used to calculate a 3D vector mesh which maps volumes at any given phase to the exhale volume. This vector map and the external breathing signal are used to reconstruct the anatomy at any breathing phase.
Conclusion: Our scanning protocol uses the helical scan mode so it is faster than the axial/cine scanning protocols. The gap between CT slices available for each breathing scan is alleviated by taking three successive scans but the use of low tube current keeps the dose to the patient to an acceptable level. Our protocol is easy to implement in any clinic where a single-slice CT scanner and a real-time motion tracking system are available.