AbstractID: 5740 Title: A novel use of a real-time tumor positioning system in reducing cone beam CT artifacts

Purpose:
The Calypso® Medical 4D Localization system is capable of tracking real-time dynamic motion without ionizing radiation. A limitation of any fiducial based system is the inability to visualize surrounding tissues. Cone beam CT (CBCT) of moving objects results in image blurring due to long acquisition times. We investigated the use of the Calypso® 4D localization system to improve motion artifacts obtained from the Varian Trilogy CBCT.

Materials and Methods
A research Calypso® 4D tracking system was installed in a Varian Trilogy vault. A rectangular phantom with implanted transponders was attached to an internally-developed 4D stage. A CBCT was obtained while moving the phantom under the Calypso® measurement array using a patient tumor derived trajectory. The projection images were obtained and shifted using the corresponding Calypso® transponder positioning information and then reconstructed into CBCT images. This process was repeated for a dog with transponders implanted in the lung as part of an IRB-approved study.

Results
The Calypso® based image shifts caused the radiographic projection of the transponders remained stable in sinogram space. CBCT images from the shifted sinogram exhibited reduced image motion artifacts. Without artifact reduction, the transponders were visualized as multiple streaks and the surface of the phantom was heavily deformed. With artifact reduction, the transponders were accurately localized, and the deformation was removed. The dog's breathing cycle made qualitative image motion artifact reduction review difficult. Quantitative analysis of the reconstructed CT numbers showed sharper gradients through the transponders, indicating that the shifting process had improved the image quality.

Conclusions
Use of a wireless electromagnetic implanted transponder system for motion correction of CBCT is possible. This preliminary sinogram shifting technique was very effective for non-deforming objects. Further work will increase the synergy between real-time tracking systems and volumetric imaging.

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