AbstractID: 9000 Title: Correcting For Missing Data In 4D-MVCT

Purpose: A technique has been developed to retrospectively sort helical tomotherapy sinogram detector data based on the respiration phase. It is not possible to obtain complete sinograms for multiple respiration phases without delivering excessive imaging doses. As such, the sinogram detector data for each respiration phase will be missing projection data necessary to reconstruct an image. The purpose of this study was to develop and test a technique for replacing these missing projections.

Materials and Methods:
An algorithm has been developed that re-bins raw detector data into specific respiration phases. Redundant rays are used to further complete missing sinogram data. In CT imaging, the attenuation along a ray through a medium can be assumed to be independent of the direction it originates. In rigid slip-ring geometry, the detector data from the opposite direction may be used in place of the missing projections.

To fill in the remaining missing data, In-Painting is used. In-Painting is a technique that has been used for many years in the restoration of photographs and museum artwork. Digital In-Painting, however, is a newer technique that has been used in this study to complete missing sinogram data.

Results: The incorporation of redundant ray data and In-Painting showed a considerable improvement in image quality, especially during periods of fast movement (mid-inspiration, mid-cycle, mid-expiration). The resulting increase in image quality represents a significant improvement over previous 4D-MVCT techniques.

Conclusions: A custom 4D-MVCT application was developed that retrospectively sorts the sinogram detector based on the measured respiration cycle, calculates and adds redundant rays into the reconstruction, and uses iterative In-Painting to fill any additional gaps. Tests performed with a moving CT resolution plug indicate that the image quality could be increased without additional dose delivered to the patient.

Conflict of Interest : Research sponsored by TomoTherapy, Inc.