AbstractID: 13775 Title: Validation of a Proposed Optimal Slow Gantry Rotation Technique for On-Board Four-Dimensional Imaging Using Lung Patient Data

Purpose: Substantial efforts have been made in recent years to develop on-board four-dimensional (4D) imaging techniques using gantry mounted cone-beam imaging devices. This study validates a slow gantry rotation 4D imaging protocol using lung patient data.
Methods & Materials: The proposed 4D imaging protocol determines optimal gantry rotation speeds and frame rates based on patients' respiratory cycles and desired phase windows to optimize projection distributions in phase bins by reducing numbers of tightly spaced projections and avoiding large gaps between projections. The effect of frame rate on projection distributions was tested using data from three lung patients. Projections were acquired using an on-board kV imager (OBI)® (Varian Medical Systems, Palo Alto, CA). Gantry rotation speeds and frame rates were 0.59-0.73 ^{o}/s and 4.9-7.3 fps. Subsets of data were extracted to represent frame rates that were lower (50% and 75% of the predicted optimal) equal to and higher than (125%,150%) predicted optimal frame rates. The protocol predicts that large gaps between projections will occur in the low (50 and 75%) frame rate data sets and excessive tightly spaced projections will occur in high (125 and 150%) frame rate data sets.
Results: As predicted, large gaps occurred in the 50 and 75% frame rate sets. This effect was worse for the 50% data sets than for the 75%. Up to 23.8% of the intervals between projections in the 50% data sets exhibited large gaps, while up to 1.2% presented in the 75% frame rate sets. Percentages of tightly spaced projections averaged 6, 39 and 61% for 50, 100 and 150% frame rate data sets.
Conclusion: A slow gantry rotation protocol for determining optimal acquisition parameters was validated using lung patient data and may serve as a foundation for further on-board 4D imaging investigations.
Conflict of Interest: Research sponsored by Varian Corporation.