AbstractID: 3868 Title: How much 4D data is needed for estimation of dose distribution evaluation metrics at the time of planning?

Purpose: To investigate the number of intermediate states required to adequately approximate the cumulative dose to deforming/moving thoracic anatomy.

Methods: CT scans at exhale were registered to images and/or simulated data at inhale and 4 or more intermediate breathing states for several lung cancer patients using B-spline transformations. Doses to each state were computed using the DPM Monte-Carlo code and dose was accumulated for scoring on the exhale anatomy via the transformation matrices for each state and time weighting factors. Cumulative doses were estimated using increasing numbers of intermediate states and compared to simpler scenarios such as a "2-state" model which used only the exhale and inhale datasets (as these have the highest time weighting coefficients). Dose distributions for each modeled state as well as the cumulative doses were assessed using DVHs and several treatment evaluation metrics such as mean lung dose, NTCP and gEUD).

Results: Although significant "point dose" differences can exist between each breathing state, the differences decrease when cumulative doses are considered, and can become less significant yet in terms of evaluation metrics depending upon clinical endpoint. For example, differences between a "2-state" and a "6-state" cumulative dose distribution are often within a few percent of each other and can have no significant clinical impact on treatment metrics for the lung itself as it is a large volume effect organ. However, the use of more intermediate states is sometimes required to properly estimate doses to other adjacent organs at risk such as the esophagus.

Conclusions: This ongoing study suggests that for certain "clinical" endpoints it may only be necessary to properly give weight and accumulate the doses from a few well separated states (having the highest probability of occurrence) to achieve satisfactory predictions of the results of accumulating dose to the distorting anatomy.

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