AbstractID: 11622 Title: Model-based esophageal motion and margin determination

Purpose:
The quantification of respiration-induced esophageal motion and margin determination using model-based approach.
Method and Materials:
We use ten 4D-CT scans. The phase assignment was assured with an independent respiration phases' calculation. The esophagus was segmented from post-cricoid level to gastro-esophageal junction(GEJ) on phase 50 by a single physician. Three reference points were used for esophageal divisions into Cervical(from top to T1-T2 level), Thoracic(from T1-T2 to T5-T6), and Abdominal(from T5-T6 to GEJ) parts. The image registration provided deformation fields between phase50 and other phases. The conceptual average 3D patient volume was constructed using the inverse of the mean deformation field. The esophagus was modeled as a set of centroids of its contours. The deformation vectors at esophageal centroids at its average position to other phases quantified the motion that was considered to be independent along the DICOM-axes. Assuming one-dimensional normal distribution, the margins were determined from motion standard deviation using confidence level L=0.9.
Results:
Margins of Esophageal segments for medial-lateral and anterio-posterior directions are: for Cervical 2.0 and 4.0mm, for Thoracic 7.0 and 8.0mm and for Abdominal 14.0 and 12.00mm. The determination of the distal part motion along inferior-superior direction yielded the magnitude of 9.0mm.
Conclusion:
The magnitude if esophageal motion increases along superior-inferior direction. The margins should reflect this variability especially for IMRT. In addition the described method allows for an patient's individual margin determination as well as the generalization for patient population. It is especially relevant for gated treatment ITV definition using a given reference phase and deformation maps derived via image registration