

AbstractID: 2918 Title: Dose Mass Histogram and Its Application for 4D Treatment Planning

Purpose: In evaluating dose distributions of lung treated during respiration, dose volume histogram (DVH) may not be an appropriate term because of variable lung volume with respiration. The purposes of this work are to investigate the use of dose mass histogram (DMH) for lung and assess the differences between DVH and DMH for conventional and 4D treatment planning.

Method and Materials: DMH was calculated based on a similar concept of DVH excepted mass of each voxel, which was calculated from CT number to density conversion, was used in tallying dose distributions. For conventional treatment planning, DVHs and DMHs of normal lung (excluding GTV) were calculated and compared for 51 lung cancer cases and 52 esophagus cancer cases. For 4D treatment planning, ten lung cancer cases were analyzed, each of which had 4DCT scans of full lung and optimal CT image quality. Total normal lung was delineated on CT images of all respiratory phases using auto-thresholding with a single CT number. Dose distributions were computed on all respiratory phases with DVH and DMH being calculated for the lung.

Results: For conventional plans, difference between DMH and DVH existed for cases with highly inhomogeneous lung tissues. For a majority of cases, such differences were small and may not be clinically significant. For 4D treatment planning, lung volume changed on average by 16.3% between inspiration and expiration. As expected, variation of lung mass was much smaller, only by about 6.6% as assessed from the 4DCT. The change of lung DMH with breathing was often different from that of lung DVH, indicating that deformation of lung mass followed different patterns than that of the lung volume during breathing.

Conclusions: DMH may be more relevant than DVH considering varying alveolar-cell density in lung and conservation of lung mass in 4D treatment planning.