AbstractID: 5863 Title: 4D Dose Calculation using 3D Elastic Dose Registration in Lung IMRT

Purpose: To develop an elastic registration algorithm that will register dose distributions computed on each 3D data set of a 4D CT images set.

Methods and Materials: The goal of image registration is to find the best matching point pair of two images. The coordinates between the two points were related by a transformation field. Mean-squared intensity difference was used for similarity measurement. The optimal transformation was found by maximizing similarity.
Eight 3D CT image set were obtained by phase based sorting. CT image corresponding to end-exhale was selected as reference image. The remaining images were registered to the reference image.
We performed an IMRT planning on the reference image. The prescribed dose was 66 Gy with 2 Gy/fraction. The plan parameters were superimposed on the images corresponding to the remaining phases. A convolution algorithm was used to calculate the resulting dose distributions. After that each 3D dose was transformed to the reference phase by applying the resultant transformation fields. Equally weighted superposition of these transformed dose was calculated. DVH of the planned and registered doses were compared.

Results: Image registration improved the matching of anatomical features. RMS error of the intensity difference between the reference and floating images reduced from 81.2 before registration to 70.6 after registration. When compared the planned and registered doses, 95.4% of the tumor will receive the prescribed dose without motion compensation. However, after registration only 81.8% of the tumor received the prescribed dose. The heart and left lung had a less than 1% mean dose difference between the planned and registered doses. The right lung had a 5.8% mean dose difference.

Conclusions: Our algorithm has the potential for automatic registration. It further helped us determine the difference between the planned and true dose distribution.