

AbstractID: 13737 Title: Inclusion of effects of image registration errors in accumulated dose distributions

Purpose: To consider the effects of image-registration error in dose accumulation across different geometry instances and to display the resultant errors in a meaningful and useful way.

Method and Materials: 4DCT phases acquired of a lung cancer patient were non-rigidly registered by a B-spline interpolation method (www.plastimatch.org) to the first phase chosen as a reference geometry. Dose was calculated on each phase and warped back to the reference phase by linear interpolation. The error in the deformation values at each voxel were assumed to be independent of that of neighboring voxels or of adjacent phases. This allows an error instance to be simulated by randomly perturbing the deformation used in dose accumulation by a value sampled from a Gaussian distribution for each voxel. The dose was accumulated for each instance and thirty instances were simulated to sample the total error distribution. Three methods of assigning the standard deviation of the error distribution to each voxel were considered: (i) fixed value of 3mm; (ii) intensity-matching method: the local value is scaled by a distance to agreement metric calculated by comparing the registered phase image with the reference image; and (iii) vector-discrepancy method: the local value is scaled by evaluating the invertability of the deformation maps. The effects of the simulated error were visualized by a spread of the accumulated isodose contours.

Results: The vector-discrepancy method resulted in the representation of reduced errors in the posterior region of the target where the extra image detail provided by the ribs and vertebrae increased the accuracy of the registration. Differences between the intensity-matching method and fixed-error method were less noticeable.

Conclusion: A method of including image registration error in dose accumulation has been developed. Further work is required to compare results to a gold standard on a number of image datasets.