

Concomitant segmentation and registration of liver anatomy using SPECT-CT imaging

Purpose: To develop an automatic and accurate technique for concomitant segmentations and registration of liver anatomy using SPECT and CT images for unsealed source radiotherapy.

Method: The link between segmentation and registration is given by the using the level set of a liver segmentation into the registration process. In the combined approach, the liver is automatically segmented from the CT image by evolving an initial seed with a level set until it locks to the liver's border as observed in the CT images. The time-crossing map of the level set is then used to match gradients in the SPECT image to the level set by using a data structure containing the signed distance values at a small band of neighboring pixels.

Results: The technique was applied to three cases of metastatic liver disease treated with unsealed source therapy. Results indicated that the speed map of the level set plays an importance role in obtaining an accurate registration and produce a segmentation that is superior in registration time and accuracy over manual segmentation or the standard registration approach using mutual information. Accuracy measured with the convergence analysis method was of less than 0.5 mm rotation and 1 degree rotation.

Conclusion: With the proposed combined segmentation-registration technique, the uncertainty of soft-tissue target localization could be greatly reduced ensuring accurate therapy assessment to be precisely delivered as planned. The combined all-in-one approach is automated and provides excellent accuracy over manual segmentation and mutual information approaches.