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Abstract of Artificial Intelligence Factors in Image Registration for Lung SBRT

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Abstract
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Abstract

Objective: Image registration is an important process in radiotherapy when multiple imaging modalities are employed to define the treatment target. The imaging modality distinction, the temporal period difference, and patient geometry status variation could be decomposed into significant changes in decision making of define target boundary. Operation of clinician in selecting appropriate registration could result different outcome. Among these fuzzy continuously parameters, clinician had to make a quick decision given the limit resource. This abstract of artificial intelligence factors study attempts to slow down the clinician's decision-making process by simulating the discrete viewing action in to digitized step in order to eliminate the potential overlook by omitting some singularity in the procedure.

Methods: A PETCT set and a simulation CT set for lung patient with tumor at upper lobe of the left lung were selected to execute this intelligence factor abstracting process. Both image sets were acquired with Siemens Biograph CT at version PETsyngo VG6x. The fusion procedure was done with Image Registration model and data attained were done with contouring module in Eclipse treatment planning system form Varian Medical System. During the rigid registration procedure between simulation CT set and PETCT set, the clinician's focus region was from whole body, lung, heart, bony structures such as ribs, spinal cord, and sternum, and tumor lesion with 1mm,2mm, 3mm, 5mm,10mm and 20mm expansion review through manual operation and auto registration algorithms, which could be separated with human interaction judgment and computational approach. The evaluation scores are based pixel statistical information in activity with unit of Bq/ml within the region of interest, normalization average pixel activity value and standard variation distinguishment.

Results: For the observation volume from 1mm to 20mm diameters, there are no significant differences for the mean activity and activity standard deviation. And the range of their mean activities was from 5289 to 5388 in Bq/ml. However, with the volumetric regions of interest in these observations increasing to heart, spinal cord, lung and body, the largest difference between the minimum pixel activity at these ROIs was 37%, and the maximum differences among the mean pixel activity at these ROI was 22% with average at about 5369 Bq/ml, and the activity standard deviations of these ROIs were at the level of 10%.

Conclusion: A slowing process decomposing method is developed to simulating the human decision-making procedure during the manual imaging registration clinical application. Clinically, different volumes of registration focus may include hints in the consequences of treatment outcome besides delivery dosimetric variation. The significant level of these human interacting approach could possibly imply the dose delivery variation due to the decision-making procedure in target definition as PETCT reflecting the different activity levels. And the resource limit due to the clinician could be improved with the power of computer with approximately exhaustive search or search dimension alternation in handling small step variation. And correspondingly, target activity based radiotherapy could possibly execute in precise treatment with more data availability.