

Introduction: Using Image guided radiation therapy on a regular basis can increase the clinical burden substantially. Our goal is to develop semi-automated deformable registration tools to monitor anatomical changes in order to make consistent treatment decisions without increasing the clinical workload.

Methods: We used a B-spline deformable image registration package to analyze images obtained from IGRT procedures for lung cancer patients. CT and CBCT datasets were imported into our software and processed as follow: (1) physician contours were extracted via the DICOM-RT protocol; (2) A first deformable registration was performed to register the plan dataset to the first CBCT and deformation maps were applied to contours to generate new contours for the CBCTs; (3) deformable registrations were then applied between all CBCTs and new set of contours adapted to the changed anatomy were automatically generated. Information extracted from each registration was: average magnitude of deformation; displacement of the center-of-mass; regions most affected by deformations.

Results: Deformations were performed on 40 lung CBCTs. A visual inspection of each case found no significant anatomical errors in the registration although in case of strong deformation the deformation map slightly underestimated anatomical changes. Precision was assed by repeating the same deformable registration 10 times. We found variations of less than 0.1 mm (1 standard deviation) thus indicating that the deformation process is precise. The average magnitude of the displacement vector and the variation in the center-of-mass of each contour varied between 0.9 mm and 16 mm. We could differentiate between displacement of a contour and anatomical variation by taking the ratio between these two values. An action threshold of 6 mm for both was used to differentiate between “strong” anatomical change and “small” anatomical changes.

Conclusion: We have developed a semi-automated deformation registration tool that let us consistently monitor anatomical changes on weekly/daily CBCTs