Deformable Dose Mapping Accuracy Using a Framework for User-Intervened Correction of Deformable Registration

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Purpose
To evaluate the accuracy of deformable dose mapping using a method for user-intervened correction of deformable registration.

Methods
Two treatment plans were calculated on a 4DCT dataset from the POPI model(1-2). POPI2 was chosen due to significant respiratory motion between end-inspiration to end-expiration (14.0mm +/- 7.2mm ). Plans were created on the 0% phase for a mediastinal primary (MP) tumor and a lung primary (LP) tumor. The 0% phase CT was deformed to the 50% phase CT using a commercially available free-form intensity-based deformable registration method (MIM Software, Cleveland, OH). The MP and LP doses were deformed using the transformation between the 0 to 50% phases. Doses were recorded at 100 corresponding landmarks on each phase. Differences between expected dose and deformed dose were calculated for all corresponding points. This process was repeated using an interactive tool to influence the deformation through local alignments. Seven local alignments were used to guide the deformation and dose differences were again calculated.

Results
The mean absolute percent difference in dose (Gy) for MP before and after locally guided deformation was 5.6 +/- 10.6% and 1.7 +/- 2.5% respectively (p=0.0002). The percentage of points with <2% dose difference were 59% and 74% respectively. The percentage of points with >5% dose difference were 25% and 7% respectively. The mean absolute percent difference in dose for LP before and after locally guided deformation was 10.3 +/- 22.4% and 1.6 +/- 2.5% respectively (p=0.0001). The percentage of points with <2% dose difference were 47% and 65% respectively. The percentage of points with >5% dose difference were 27% and 5% respectively.

Conclusion
A method for user-intervened correction of deformable registration provided accurate results for dose mapping with average dose deviations <1.7% even for a challenging subject with significant respiratory motion.

References
2 http://www.creatis.insa-lyon.fr/rio/popi-model/