AbstractID: 7754 Title: Temporal constrained registration of arbitrary surface contours for use in 4D radiation therapy.

Purpose:
To quantify the validity of the temporal interpolation provided by a nonlinear uncorrelated contour based path length minimizing deformable registration algorithm in 4D radiation therapy.

Method and Materials:
The anatomical surfaces are represented as triangulated meshes. The registration algorithm is implemented by defining a norm between the triangulated meshes, based on the algorithms of Glaunès and Vaillant. This algorithm matches two surfaces as opposed to image intensities or specific points. Additionally, it optimizes the path between them allowing for a temporal interpolation. The registration is defined as the flow of an unlabeled 3D point set to an arbitrary target surface that minimizes both the norm between the target and registered surface and the non-linear path length between the source and registered surface. Ground truth surfaces were generated from 4D lung datasets using the semi-automatic mesh segmentation routine from a research version of Pinnacle, with expert manual correction.

Results:
To test this algorithm we compared its ability to interpolate intermediate shapes with a standard linear interpolation technique. We found that this algorithm performs comparably.
The similarity metric used was an Euclidean distance error metric between the ground truth surface and a surface interpolated between a previous and subsequent ground truth surface. It was calculated between the interpolated and truth vertexes and their closest points on the truth and interpolated surfaces, respectively. This metric is independent of the interpolation and surface triangulation used, and thus is applicable to other interpolation algorithms.

Conclusion:
This work shows that this general, path length minimizing deformable registration algorithm based interpolation performs similarly to linear interpolation in approximately correlated, intrafractional datasets. This algorithm has the advantage of utilizing surfaces with arbitrary triangulations without point correspondences. We further discovered that this specific algorithm exhibited numerical instabilities that require further investigation.

Conflict of Interest (only if applicable):