AbstractID: 9278 Title: Utility of a calibrated deformation map to aid treatment position and monitoring guidance in deforming anatomy with electromagnetic transponders

Purpose: To investigate the utility of tracking motion and deformation in various regions of a deforming geometry given a predetermined "calibrated" deformation map and relative position of a small number of embedded electromagnetic transponders.

Methods and Materials: Three electromagnetic transponders were inserted into a reproducibly deformable phantom and localized with CT. Tumor-simulating spheres were embedded at different positions relative to the transponders. The phantom was imaged at 7 compression ("breathing") states, and the transponders and tumors were localized on each image volume. Deformation maps relating a reference (end inhalation) to all other states were estimated using a B-spline based registration technique. Principal component analysis was applied to the deformation maps to find the most significant modes of deformation in the phantom. This created a calibration state for the deformation which can be used along with the measured transponder positions to estimate the deformation at arbitrary time point during a breathing cycle.

Results: Tests performed based on information from one transponder showed variable uncertainty (8 mm) in predicting arbitrary target positions at different states during a breathing cycle. Application of all three transponders to the first component of deformation showed very high accuracy with a mean error of less than 1mm for deformation maps calibrated on 5 breathing states. Using only the 2 extremes of the breathing cycle, the mean error increased to 2mm, showing some dependence on the number of states used in calibration of the deformation map. Extrapolation of the breathing state past the calibration data by an additional 1cm of compression showed reasonable accuracy (3.5 mm).

Conclusion: A calibrated deformation map can potentially be used as an aid to dynamic tracking of deforming anatomy during treatment. Experiments are ongoing to evaluate the dynamic behavior of the calibrated maps to real-time data from the tracking system.

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