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Title: Modeling Correlation Between External Surface Motion and Internal Organ Motion based on 4 dimensional computed tomography (4DCT)

Purpose: To develop a method for modeling the dynamic relationship between patient surface motion and internal target motion using 4DCT data. Then, to verify its capability to interpolate internal target motion with real-time patient surface motion information.

Methods and Materials: At discrete phases of a respiration cycle, the coordinates of points in a grid with specific interval on patient surface and internal target were automatically extracted from 4DCT data, then used for the experiments. A radial basis function (RBF) based neural network was employed for modeling purpose. The model was examined by eight sets of data, which consists of the coordinates of points on a patient surface and a region of interest (ROI) on either the left lung or right lung.

Results: With fine sampling (grid interval < 5 voxels) of the patient surface and internal target, less than 5% interpolation error was found in seven experiments. one patient (right side of left lung) with error more than 8% and unexpected displacement more than 10 mm in 4DCT was observed. Coarse sampling (grid interval >10 voxels) will result in a larger interpolation error. In seven successful cases, the interpolation errors less than 2mm. The only failed one had interpolation error of 4 mm.

Conclusion: A dynamic model is established for correlating patient surface motion with internal target motion based on 4DCT data. An acceptable interpolation accuracy is achieved for 7 of 8 cases examined in this study. The only failed one implied that for target motion with larger displacement and higher frequency, the model based on 4DCT data might be not sufficient because of its limited time resolution in acquiring those information in a respiration cycle.