AbstractID: 1736 Title: Accuracy of multi-organ deformable registration using finite element analysis

The increasing use of multiple imaging modalities and repeat imaging studies to capture multiple instances of patient geometry in radiotherapy treatment planning, combined with frequent 3D soft-tissue imaging for guiding treatment demands the ability to relate regions of interest (ROIs) on multiple images to a common patient representation. Multi-organ deformable registration using finite element analysis (FEA) offers accurate biomechanical-based registration of multiple ROIs (e.g. organ models). This semi-automated approach uses surface-projection alignment of designated ROIs, combined with biomechanical models and surface interfaces, to model a deformable multi-organ system. The method was tested on five female volunteers who underwent two consecutive days of MR scans. Each day, inhale and exhale MR scans of the thorax and abdomen were obtained. Lungs, breasts, liver, spleen, stomach, and kidneys were contoured and assigned biomechanical tissue properties. Deformable alignment using FEA was performed between inhale and exhale scans on the same day and between images at the same breath hold position on separate days. Anatomical landmarks (e.g. vessel or bronchi bifurcations) in the liver, lung, and breast were identified on each MR scan and their positions were compared to the transformation predicted using FEA. The magnitude of motion, for regions of interest, ranged from 0.12 to 3.17 cm. The accuracy of the FEM-based deformable registration was AVG: x = 0.04 cm, y = 0.07 cm, z = -0.05 cm; SD: x = 0.20 cm, y = 0.18 cm, z = 0.18 cm.

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