

AbstractID: 9438 Title: Piecewise Rigid-body Image Registration for Adaptive Radiation Therapy

Purpose:

To accelerate image deformation and registration for Adaptive Radiation Therapy (ART), we propose a piecewise rigid-body image registration (PRIR). This algorithm is faster than full deformable registration by up to a factor of ten without sacrificing accuracy.

Methods and Materials:

Deformable Image Registration (DIR) may not reflect the biomechanical characteristics of the anatomy. In short, DIR may try to deform the body in ways that are not physically possible. Fluid dynamic models were adopted to address this problem. However, DIR consumes too much time to be utilized for routine clinical ART. PRIR considers the biomechanical characteristics of the anatomy while retaining the speed of rigid-body transformations. First, we import contours from a Radiation Therapy Plan (RTP) through DICOM-RT. We assume that the contour delineates an organ (or tumor), which is modeled as an independent rigid-body. Two image sets (planning CT and Conebeam CT) were aligned with our rigid-body registration using Spatial Weighted Mutual Information (SWMI). Then, rigid-body registration was performed with each organ independently from the rest of image using Mutual Information or SWMI. Users can select a specific type of registration: full translation and rotation, 3-D scaling, or 2-D scaling by considering biomechanical characteristics. One prostate case (9 image sets) and one head-and-neck case (7 image sets) were tested.

Results and Discussion:

Our image registration for 6 contoured organs took 95seconds on average. We succeeded in transforming deformable contours from RTP images to daily cone beam CT images. Our method can be utilized to re-optimize plans for Adaptive Radiation Therapy. The speed can be further improved with parallel processing. Accelerating deformable registrations is critical for implementing real-time ART. (This work is partly supported by Susan G. Komen Breast Foundation Grant: BTCR126506)