AbstractID: 1361 Title: Non-rigid Registration of 2-D Lung CT Images Using a Deformable High-order Finite Element Mesh

Purpose

We present an approach for non-rigid registration of two-dimensional lung CT images based on deformable high-order finite element mesh and image intensity information.

Methods

We used a lung CT image as reference and deformed it in a non-linear, non-rigid fashion to generate a test image. Lung contours were automatically extracted from both images using threshold and morphological operations. In the reference image, eight nodes were automatically chosen, distributing evenly around the contour and at identifiable geometrical feature points. From these nodes, high-order finite element meshes were created, fitted and superposed to the reference image. The approach is to deform this mesh to fit the segmented lung in the test image while satisfying image similarity constraints. As a starting point, nodes reflecting geometrical features were mapped directly while other nodes were placed evenly around the deformed mesh contour and allowed to move along it incrementally. For each movement, the mesh was refitted, pixel displacements and intensities within affected elements were re-interpolated using bicubic Hermite basis functions, and the local image intensity correlation coefficient was re-calculated. Node position and local shape parameters were optimized to achieve a local maximal correlation. The global maximal correlation and global optimized node parameters were acquired by repeating the above procedure on each node iteratively.

Results

The results using our registration method show a good correlation. Before registration, the image intensity correlation coefficient of images with lung segmentation and blank background is 0.896. After registration, it is improved to 0.977.