AbstractID: 7282 Title: Three-dimensional deformable image registration using ALE moving mesh

Purpose: Arbitrary Lagrangian-Eulerian (ALE) moving mesh is a finite-element based technique that preserves mass and topology during deformation. We have developed a two-dimensional (2D) image registration method using ALE moving mesh. This study is aimed to extend the method for three-dimensional (3D) deformable image registration.

Method and Materials: The image registration is contour-based. 3D structures are reconstructed using slice images. A dynamic contour method is used to establish the correspondence of the surface points between a reference image and a target image. ALE mesh is generated in the reference image. With the correspondence of the surface points, the surface of the reference image is deformed to match the surface of the target image. The displacement of the moving surface propagates to the interior nodes throughout the domain. Displacement vectors of the volume can be obtained and the deformation of the interior can be tracked.

Results: Two sets of 3D CT images of a patient's head and neck tumor were used in the study, which were taken on different dates. The external contour (volume) of the first set of images was taken as the reference and that of the second set of images was taken as the target. By moving the surface of the reference to match the surface of the target, displacement vectors of the domain enclosed by the surface were derived from the moving mesh, which were then examined with the deformation of gross target volume (GTV). The image-warped GTV was found similar to the GTV of the second set of images.

Conclusions: It is feasible to perform 3D deformable image registration using ALE moving mesh. Further studies are needed to verify the accuracy of this method by either improving the technique for surface matching or comparing with other more established method of deformable image registration.