

AbstractID: 5852 Title: Image Fusion and Deformation using a Genetic Algorithm

Purpose: To develop an image fusion application utilizing genetic algorithms, segment the fused images using treatment-planning contours, perform a slice-by-slice sub-fusion of the segmented images in order to measure deformation, and then utilize the measured deformation for adaptive therapy on a helical tomotherapy treatment delivery.

Methods and Materials: A reference CT image of a density and spatial resolution phantom was obtained using a MVCT imaging. A secondary MVCT fusion image was obtained with the phantom offset by a known amount with plugs removed or rotated. An image fusion algorithm was created using genetic programming to perform image registration of the MVCT images. Contours of the plugs were used to extract sub-images that were separately registered and deformed using the genetic algorithm. Adaptive therapy was achieved through a treatment delivery sinogram deformation algorithm. The sinogram deformation algorithm was tested using a geometric test case that consisted of a dose triangle with a 5.2-cm base located inside a dose circle with of 3.14-cm radius. The test dose pattern was moved by known amounts by deforming the treatment delivery sinogram.

Results: The initial genetic fusion of the reference and secondary MVCT images was achieved in approximately 15 generations. The time required to perform the genetic fusion was typically 10 to 15 seconds. The images were fused to within 0.7-mm of the correct position. At the end of the initial fusion, the genetic algorithm correctly identified one of the plugs as missing in the secondary MVCT dataset. The genetic algorithm correctly segmented the second resolution plug in a sub-image and deformed it to within 1-degree and 0.7-mm of the correct position. The delivery deformation tests moved the dose to within 5-mm of the desired position.

Conclusions: A genetic algorithm has been developed for performing image fusion and simple deformation of defined regions of interest.