AbstractID: 3752 Title: A Novel Metric for Automatic Assessment of Deformable Image Registration Accuracy

Purpose:
The purpose of this research is to develop a metric that automatically assesses the accuracy of deformable image registration by evaluating the difference in voxel values and the minimum distance to agreement between the predicted and actual images.

Methods and Materials:
A metric, κ, has been developed, which is based on two parameters 1) difference in voxel value and 2) minimum distance to voxel agreement. Voxels within the predicted image, or a selected subregion within the region, are randomly selected for evaluation. Each voxel is assessed to determine if it is within 3 image units (i.e. Hounsfield Units or MR number) of the voxel value on the actual image or within 0.3 cm of its corresponding voxel on the actual image. The κ index indicates the percentage of points passing at least one of the parameter.

The correlation between κ and the error in the image was established by introducing known random error into an image. Mathematically deformed CT and MR data was generated for analysis (mean = 0 – 0.5, SD = 0 – 1.0 cm).

Results:
Although the metric can overestimate the percentage of points meeting the criteria, due to similar voxel values in the search region, a unique correlation was established between the effective error in the image with known deformation and κ. A power law relationship between described 98% of the variance between the known error and κ. This relationship was then used to assess the error in deformable image registration using a finite element based method. The results show good agreement with prior manual accuracy evaluation.

Conclusions:
A novel metric, κ, describing the error in deformable image registration has been investigated providing a unique correlation between κ and the residual error in registration.

Conflict of Interest:
This research was supported in part Varian Medical Systems.