

AbstractID: 4761 Title: Effects of cone-beam CT noise and cupping artifacts on deformable image registration

Purpose: Image-guided adaptive radiotherapy proposes to use sequential CT studies to track anatomical change during treatment via deformable image registration. These CT studies can be acquired with either conventional fan-beam CT systems or more novel cone-beam CT techniques. However, cone-beam CT images can have higher noise levels and more imaging artifacts than fan-beam CT, which might impact registration accuracy. We have investigated the effect of these image quality differences on the deformable registration of fan-beam and simulated cone-beam CTs.

Method and Materials: Our study used two fan-beam CT studies of a prostate patient, taken ten days apart. A deformable image registration process was used to register the two studies and then transfer treatment planning contours from one CT to the other. The accuracy of the automatically-transferred contours (and thus of the deformable registration process) was assessed by comparing them to manual contours, with the differences evaluated with respect to inter-observer variability in the manual contours. Then one of the fan-beam CTs was modified to include higher noise and cupping artifacts characteristic of cone-beam CT and the tests were repeated. Changes in registration accuracy were detected by monitoring changes in the automatically-transferred contours.

Results: We found that the additional noise and the cupping artifact caused no appreciable loss of registration accuracy at magnitudes up to and exceeding what would normally be found in an actual cone-beam CT.

Conclusions: We conclude that deficiencies in cone-beam CT quality that might reduce manual contouring accuracy do not necessarily reduce image registration and automatic contouring accuracy.