AbstractID: 9519 Title: A Fully Automated 4D-CT Registration Algorithm for Lung Studies

Purpose: To develop an automated 4D-CT registration algorithm that performs without the aid of data collected from an external respiratory surrogate. **Method and Materials:** 5 patients with lung cancer were scanned with a GE Healthcare 4-Slice CT scanner using an overlapping ciné protocol: the thorax was scanned with 4x2.5 mm ciné scans. The couch was translated 7.5 mm's between adjacent ciné scans, resulting in a common 2.5 mm overlapping slice linking the two adjacent ciné scans. A 4D-CT dataset was produced by aligning entire 3D volumes at each phase of the breathing cycle: a reference couch position was selected, images at that position were truncated to 1 breathing cycle and then interpolated into 16 evenly spaced phases. To begin, the images of the reference couch position were matched to images from the adjacent couch position by maximizing the Normalized Cross Correlation of the overlapping slice. The process continued in a 'daisy chain' fashion through all couch positions using the selected images until an entire 3D volume was selected. The algorithm was repeated for all 16 phases to complete a 4D-CT dataset. The data were also registered using a reference external marker 4D-CT amplitude registration method. Image quality was quantified by calculating the mean difference of the registered overlapping slices from adjacent couch positions. Banding artifacts, as the result of image misalignment, cause higher mean differences. The values obtained from each registration method were compared using t-statistics. **Results:** The NCC volumes showed a decrease of banding artifacts. Artifact correction was accompanied by a significant decrease in mean difference for 3 of the 5 patients ($p < 0.01$). The other patient data, that showed no initial artifacts, showed no significant differences. **Conclusion:** An automatic 4D-CT registration method was developed and shown to perform as well or better than an external marker method.