AbstractID: 11593 Title: Prostate localization using daily cone-beam computed tomography imaging: assessment of accuracy using similarity metrics and observation-based measures

Purpose: To estimate the accuracy of daily CBCT/CT prostate rigid-body registrations using different similarity metrics (SM) and observation-based measures, and to determine the tradeoffs of these methods.

Methods and Materials: Daily CBCT images of 29 prostate cancer patients were retrospectively analyzed; 14 patients with calcifications in the prostate (calcification dataset) and 15 patients without calcifications (no-calcification dataset). Three groups of test registrations were performed. Test1: 70 CT/CBCT pairs in the calcification dataset were registered using 17 SMs and their various parameters (6580 registrations), and compared using the calcification mismatch vector length as an end-point. Test2: Using the 4 best SMs based on Test1, 75 CBCT/CT pairs from the no-calcification dataset were registered using visual comparison as the endpoint (300 registrations), i.e. the accuracy of prostate contour overlays on CBCT images were visually ranked. Test3: For the top ranked SM based on the above 2 tests, the registration accuracy was estimated from 356 CBCT/CT registrations from 11 patients in the calcification dataset with and without calcification filtering from registrations.

Results: Test1: Incremental-sign-correlation (ISC), gradient-correlation (GC), gradient-difference (GD), and normalized-cross-correlation (NCC) were the SMs with the least vector length errors ($\mu\pm\sigma$: 1.6±0.9~2.9±2.1 mm). Test2: Using visual criteria, 2 of the 3 reviewers ranked GC slightly higher than the other SMs. Test3: Using GC, 96% of registrations (341/356 registrations) showed less than 3 mm error when calcifications were filtered. Corresponding errors were L/R: 0.1±0.5 mm, A/P: 0.8±1.0 mm, and S/I: 0.5±1.1 mm. Existence of prostate calcifications increased the number of successful registrations to 97%.

Conclusion: The estimated <3 mm error was approximately 96% (1.1 mm SD) using GC, ISC and GD similarity measures. These measures offer a relatively quick and accurate means of assessing CBCT/CT registrations in the routine clinical setting. User observation is a necessary requirement in the overall QA of the process.