AbstractID: 10637 Title: Targeting accuracy in real-time tumor tracking via external surrogates: a retrospective clinical study

Purpose: To quantify the accuracy of real-time tumor tracking via external surrogates in a large patient population..

Method and Materials: A database of 339 fractions in 86 patients, who received hypofractionated stereotactic body radiotherapy with a robotic linear accelerator (CyberKnife®) between July 2005 and June 2007, was analyzed. The system tracks the tumor in real-time by using a correspondence model between external marker motion and implanted fiducials. Such model is updated during treatment by intermittent stereoscopic X-ray imaging, providing ground truth tumor position. The corresponding model includes prediction in the future in order to account for the time lag due to data processing and robot motion (~115 ms). Predicted tumor positions were compared to ground truth data acquired during treatment to quantify the achieved targeting accuracy.

Results: Intermittent imaging provided a statistically robust description of tumor motion 89% of the fractions. Clinical data show that the mean error contribution due to the need for prediction is approximately 0.5 mm. The overall average accuracy in tumor tracking, expressed as the 95% confidence interval of targeting errors, is ~3.4 mm. We proved that the targeting error increases as a function of the tumor range of motion and treatment site. Larger effects were measured in the superior-inferior direction, with a 3 mm error increase per 1 cm range of motion variation. Also, unevenly spaced model updating was found to significantly reduce the accuracy in tumor tracking.

Conclusion: The accuracy of a state of the art solution for tumor tracking, developed for high precision radiotherapy with a robotic linear accelerator, has been analyzed. Adequate accuracy can be achieved, with caveats when the range of motion is large and the model updating scheme is irregular. Future work will include detailed analysis on progressive upgrades in the correlation model.

Conflict of Interest (only if applicable):