AbstractID: 13426 Title: Real Time Tumor Motion Monitoring during IGRT based on Manifold Learning and Dynamic Registration between 4DCT and Fluoroscopy

Purpose: To develop a real time tumor respiratory motion monitoring methodology for thoracic cancer IGRT by integrating manifold learning and dynamical registration of 4DCT and fluoroscopy technique during the radiation treatment.

Method and Materials: 10-phases retrospective 4DCT have been acquired from 6 patients (5 lung, 1 pancreas) with audio coaching. During their gated radiation treatment, fluoroscopy videos were collected with the same audio coaching. A radiation oncologist delineated the contours including the GTV in the 50% phase 4DCT. The methodology is divided into three steps. First an object-constrained registration has been used to register 4DCT at other phases to the reference 50% phase in order to build a spatial-temporal tumor motion model. Then the 4D motion model has been used as the constraint in the spatial registration and temporal matching of the 4DCT with the fluoroscopy. An Isomap based manifold learning has been used to establish a global matching scheme between the 4DCT phases and fluoroscopy frames. In the last step, the GTV in newly acquired fluoroscopy frames were monitored in real time based on the fast registration between the frame and the DRR of the corresponding 4DCT phase using the global constraint and local image information.

Results: The registration between 4DCT phases is within 30 minutes. The 4DCT to fluoroscopy registration and tumor motion monitoring are close to real time. After registration and training, for all 6 patients, the tumor (GTV) in an arbitrary fluoroscopy frame can be tracked with motion error less than 2mm, based on comparison between manually delineated contours in the fluoroscopy and the deformed GTV.

Conclusion: The proposed tumor monitoring approach can achieve real time efficiency as well as satisfactory accuracy and precision and has the potential to be used in IGRT to improve setup and tumor tracking accuracy to achieve desired dose coverage.