AbstractID: 12728 Title: Robust Fluoroscopic Tracking of Multiple Implanted Fiducial Markers: Exploiting the Spatial Constraints

Purpose: We report and compare two new fluoroscopic fiducial trackers that exploit the spatial constraints among the multiple implanted fiducial markers to achieve fast, accurate and robust tracking.

Method and Materials: The spatial constraints are modeled as Gaussian distributions of the pairwise distances between the markers. The means and standard deviations are learned from training data. Pairwise distances that deviate too much from the learned distributions would have a low spatial matching score. The first method (M1) is a variant of the particle filters. In M1, the importance of the sampled marker locations is a product of an image matching term (s_image) and the spatial matching terms (s_spatial). Patient specific motion models need is required for M1. The second method (M2) tracks the markers via nonserial dynamic programming without using motion models. In each frame of the fluoroscopic video, template matching is used to detect candidate marker locations. Optimal marker locations are determined through optimizing a score function which is the sum of s_image and s_spatial. We compare the performance of M1 and M2 with an existing tracking method (M3). 16 fluoroscopic videos with groundtruth from different sessions of 3 liver patients are used in this retrospective study.

Results: M2 gave the smallest error (mu: 1-2 pixels, sigma: ~1 pixel) and run at ~5 frame per second (fps). M1 performed well (mu: 1-5 pixels, sigma : 1~2 pixels) at ~7.5 fps when patient breathed consistently, the accuracy dropped (mu: ~8 pixels) when the patient breathes differently across sessions.

Conclusion: Exploiting spatial constraints makes M1 and M2 robust and accurate. M2 enables tracking without motion models but tracks at a lower frame rate. M2 is promising for applications like tracking marker locations using intermittent imaging to reduce the imaging dose in IGRT.