AbstractID: 5407 Title: Robust Tracking of Interventional Tools under X-ray Fluoroscopy using Particle Filters

Purpose: Motion estimation is an important problem. In diagnostic and therapeutic interventions, intraoperative motion estimation is needed to guide interventional tools with high precision. In radiation therapy, intrafraction motion estimation is essential to improve the precision with which therapeutic radiation is delivered. The purpose of this study is to estimate the pose (location and orientation) of interventional tools such as needles in an X-ray fluoroscopic sequence using a particle filter.

Method and Materials:
Tracking Algorithm:
The tools were tracked using a particle filter. Two models are of concern in such an implementation – (i) the *observation model* was defined on the output of an edge detector by taking transverse and longitudinal samples of the tool, and (ii) the *dynamic model* was assumed to be given by Brownian motion.

Experimental Setup:
The accuracy of the tracking algorithm was validated on an X-ray fluoroscopy test bench. A modified anthropomorphic Rando™ phantom was placed in the field-of-view in order to emulate the background presented by a patient. Two sites on this phantom were used – the pelvis and the thorax. The pelvis presents a case of low signal while the thorax presents a cluttered background. The tool to be tracked was attached to a linear actuator and moved in known increments while capturing fluoroscopic images. The acquired image sequence was then sampled to generate new image sequences for testing the tracking algorithm.

Results: The algorithm was robustly able to track the tool under a low signal in the abdomen, and under dense clutter presented by the ribs in the thorax. The rms error in each case was found to be as little as 0.7mm and 0.12mm, respectively.

Conclusion: This study demonstrates the robustness of estimation under noise and clutter that can be achieved when tracking tools in a fluoroscopic sequence using a particle filtering approach.