AbstractID: 13414 Title: Robust Tracking of Fiducials and Interventional Tools during Image-Guided Interventions

Purpose: The purpose of image-guidance during clinical interventions is to provide information on the location of objects of interest, often relative to other anatomical structures. Robust methods for real-time tracking of such objects are necessary to provide quantitative information to the interventionalist. Most tracking algorithms fail when the assumptions of the algorithm are not met or when cases are encountered that are unaccounted for by the model used. This study highlights some of the challenges involved in tracking objects in 2D image sequences, particularly in X-ray fluoroscopy, and proposes methods to address them.

Method and Materials:
Experiments are conducted by simulating three fundamental cases of noise, occlusion and unexpected dynamics in X-ray fluoroscopic images. An extension to particle filters is developed and is used to track objects under these challenging conditions. The proposed extension to particle filters (i) adapts the number of particles used during tracking in response to noise in the image, (ii) modulates the resolution of particles for robustness to occlusion, and (iii) adjusts to unexpected dynamics or 'surprises' in motion exhibited by the object of interest. The performance of this algorithm is contrasted with a conventional particle filter using the mean squared error (M.S.E.) as a metric.

Results: When compared to a conventional particle filter, a reduction in the M.S.E is observed for the proposed particle filter in all three fundamental cases evaluated.

Conclusion: The proposed adaptive particle filter offers an improvement in robustness to factors unaccounted for in the dynamic and observation models that constitute the tracking algorithm. This method would be valuable in image-guided interventions as it can provide real-time feedback that can improve the performance of a surgeon, control robotics, and optimize imaging parameters.