AbstractID: 5580 Title: Automated segmentation of radiographic fiducials for C-Arm tracking

Purpose: Intraoperative quantitative C-arm fluoroscopy guidance depends on discerning the relative pose of images (pose recovery). A possible method is to use radiographic fiducials visible in fluoro images [1,2]. We propose a robust and fast method for segmenting fiducials designed for brachytherapy applications.
Methods and materials: The fiducial contains points, lines and ellipses made from BBs and wires[1]. The algorithm integrates the a-priori knowledge of fiducial's mechanical construction in a cleverly devised workflow. The BB segmentation is achieved using morphological top-hat transform. This information serves as a heuristic input to line segmentation realized by a curve tracing algorithm which operates on edge image, followed by augmenting information from intensity image. Once the lines are segmented, this information feeds to the ellipse extraction step. For ellipse segmentation, intensity image is morphologically processed to eliminate background noise, followed by elimination of BB-s and lines from the information obtained in prior steps. The resulting image consists of only ellipse segments. A fast variation of Hough transform is used to rectify the full ellipse from the segments.
Results: The fiducial algorithm identified all the features (BBs, lines and ellipses) visible to human eye in all ten clinical images. Next the accuracy of fiducial segmentation was assessed numerically by feeding the results to the pose recovery algorithm of [1]. The fiducial was moved on an accurate mechanical platform (as ground truth) while the C-arm was stationary. We reconstructed the relative poses with an accuracy of 1.2 mm in translation and 0.3 degrees in rotational based on the segmented fiducials.
Conclusions: The algorithm makes effective use of a-priori knowledge and combines the techniques of morphological segmentation, curve tracing, and Hough transform, resulting in a novel curve segmentation strategy.
References:
[1] Jain et al, Med Phys 32(10):3185-98
[2] Zhang et al, Phys Med Biol 49: 335–345