AbstractID: 2102 Title: Robust Pose Recovery for Fluoroscopic Reconstruction

The majority of practitioners use C-arm fluoroscopy in prostate brachytherapy, but only in a qualitative manner, without the ability to reconstruct (measure) the locations of seeds. A major obstacle in fluoroscopic reconstruction is discerning the pose of the X-ray source and image in 3D space. Optical/magnetic trackers are prohibitively expensive and intrusive. Referencing to implanted objects (needles) [1] is not robust. Inspired by Yao [2], we propose single image based pose recovery with the use of an external fiducial consisting of lines and ellipses. The fiducial is designed to encode six degrees of freedom from a single image by creating a unique view from any direction. The current embodiment has salient attributes: small dimensions of 3 x 3 x 5 cm, it need not be close to the anatomy of interest and the features can be segmented automatically. We tested the fiducial for brachytherapy using three simulated images separated by 30 degrees. Assuming an ideally calibrated fluoroscope, manual segmentation of synthetic images resulted in 0.17, 0.70, and 0.18 mm translational errors and 0.10º, 0.09º, 0.07º rotational errors along the X, Y and Z axes, respectively. This method appears to be applicable for brachytherapy and other procedures. Full experimental validation is being carried out with a precise fiducial carrier providing controlled motion, where each position is also recovered from single fluoro images and the two compared.

References:
[1] Gong et al., Int J Radiat Oncol Biol Phys. 2002 1;54(5):1322-30.
[2] Yao et al., CAS. 2000;5(6):373-90.