AbstractID: 8860 Title: Experimental validation of an iterative forward projection matching algorithm for seeds center localization using conebeam-CT x-ray projections

Purpose: To experimentally validate a new algorithm for reconstructing the 3D positions of implanted brachytherapy seeds from 2D projection images.

Methods and materials: The iterative forward projection matching (IFPM) algorithm consists of finding the 3D seed geometry that minimizes the sum-of-squared-difference of the pixel-by-pixel intensities between computed projection images and measured auto-segmented images of implanted seeds. IFPM starts with an approximation to the initial seeds configuration, e.g., the pre-implant seed arrangement. It then iteratively refines the 3D seed coordinates until the computed projections match with the measured projections. Three pairs of computed and measured projection images, with known imaging geometry, are used. Two brachytherapy phantoms were fabricated with 12 and 72 seeds in known configurations. Three projections of each phantom were acquired using an Acuity digital simulator along with a full 660 projection Conebeam CT (CBCT). Image pre-processing steps were performed to create the binary seed centroids images for use by IFPM algorithm. To quantify IFPM accuracy, the actual seed positions were extracted from the CBCT images by the Brachy Vision-planning system.

Results: For the 12 seed phantom data, the mean reconstruction error was found to be 0.83±0.34mm where as for 72 seed phantom it was 0.97±0.37mm. The each test trials converged in 4-10 iterations with computation time of 2.8-62 min on a 2 GHz processor.

Discussion: The IFPM algorithm avoids establishing seed projection correspondence required by standard back-projection methods. In phantom studies we have demonstrated 1 mm accuracy in reconstructing the 3D positions of brachytherapy seeds from 2D projection images. This supports the potential of this algorithm for accurate and robust seed reconstruction in patients.

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