AbstractID: 7690 Title: C-arm based Intra-operative Dosimetry for Prostate Brachytherapy

Purpose: Intra-operative dosimetry optimization of TRUS-guided prostate brachytherapy requires localization of seeds relative to the prostate [Todor et al. PMB 48(9):1153-71].

Method and Materials: Seeds were reconstructed from C-arm fluoroscopy, registered to TRUS, and exported to commercial brachytherapy system for dosimetry optimization. Technical obstacles included pose-dependant C-arm calibration; distortion correction; pose estimation of C-arm images; registering C-arm to TRUS; and seed reconstruction. We proved that calibration is not critical and distortion correction in AP suffices. A radiographic tracking fiducial was attached in known pose over the template to recover the C-arm pose from a single image, relative to the template. The 3D coordinates of the segmented seeds are calculated upon resolving the correspondence of seeds in the multiple C-arm images, by formalizing seed-matching as a network-flow problem [Jain et al. Med Phys, 32(11):3475-92]. The seed locations are exported in template coordinates to the Interplant® commercial system for dosimetry analysis and optimization.

Results: In precision-machined hard phantoms with 40-100 seeds, we correctly reconstructed 98.5% seeds with a mean 3D accuracy of 0.63*mm* (0.91mm error for mismatched seeds). In soft tissue phantoms with 45-87 seeds and clinically realistic 15^{o} C-arm motion, we correctly reconstructed 100% seeds with 1.5mm absolute accuracy (0.25mm relative accuracy), and registered them to the prostate segmented from TRUS with an accuracy of 3.4mm (0.82mm relative). In a Phase-1 clinical trial, so far on 4 patients with 66-84 seeds, we achieved intra-operative monitoring of seed distribution and dosimetry. We optimized the V100 dose by inserting 3-9 additional seeds.

Conclusion: Intra-operative dose optimization is possible with an average C-arm, at negligible additional cost to existing clinical installations.

Conflict of Interest: The work has been done in collaboration with Acoustic MedSystems for seed import into the Interplant®.

Keywords: Prostate Brachytherapy, Intra-operative Dosimetry.

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