

AbstractID: 5113 Title: Robotically Assisted Needle Placement for Prostate Brachytherapy

Purpose: To present preliminary results for a robotically-assisted prostate brachytherapy treatment system.

Method and Materials: A 4 degree-of-freedom (DOF) robotic device was developed to replace the ultrasound template in a commercially available prostate brachytherapy treatment system (Interplant, Computerized Medical Systems, St. Louis, MO). The robot mounts to the existing template mounting points on the ultrasound stepper, and is capable of positioning the needles at arbitrary positions and orientations. The robot is spatially co-registered to the Interplant treatment planning software through a calibration procedure. We performed a seed-implantation experiment on a prostate training phantom in which the needles were positioned by the robot. The needles were preloaded with one seed, then inserted manually by the operator under transrectal ultrasound (TRUS) guidance. In this experiment, ten seeds were implanted, and their implanted positions were reconstructed using data from a post-implant CT of the phantom and the Interplant post-implant analysis software (iPAS).

Results: Using the results from the iPAS software, we measured both the relative error of each seed (with respect to the other seeds), and the absolute error of each seed with respect to the treatment plan. The relative root-mean-square (RMS) transverse error was 0.8 mm (worst case 2.1 mm, 70% under 0.7mm), and the relative RMS sagittal error was 2.5 mm (worst case 4mm, 60% under 2.5 mm). The absolute transverse RMS error was 2.4 mm (worst case 4.3 mm, 50% under 2.4 mm), and the absolute sagittal RMS error was 2.5 mm (worst case 4.5 mm, 80% under 2.5 mm). However, the absolute transverse errors were characterized by an offset in each direction, most likely resulting from errors in the measurement of the robot position relative to the phantom.

Conclusion: Our system for robotically-assisted prostate brachytherapy shows potential for improved needle placement, repeatability, and accuracy.