Automated Brachytherapy Calibration: System and Phantom Design

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Introduction

Background

Success of transperineal brachytherapy treatment for prostate cancer critically depends on the accurate positioning of implanted radioactive seeds. For this reason the transrectal ultrasound (TRUS) image, the electronic encoder of the probe stepper, and the needle insertion template must be spatially (and temporally) co-registered [1].

Building off the automated brachytherapy calibration system developed by Chen *et al*. [2], this poster presents a design that will allow for automated calibration of both the sagittal and transverse transducers of the TRUS probe, as well as making it easier for medical physics staff to store, transport and setup the integrated system.

Design Features

Phantom Design

The goal of this design is to create a dual-plane wire configuration that will allow calibration of both the transverse and sagittal transducers of the TRUS probe using automated brachytherapy calibration software [2].

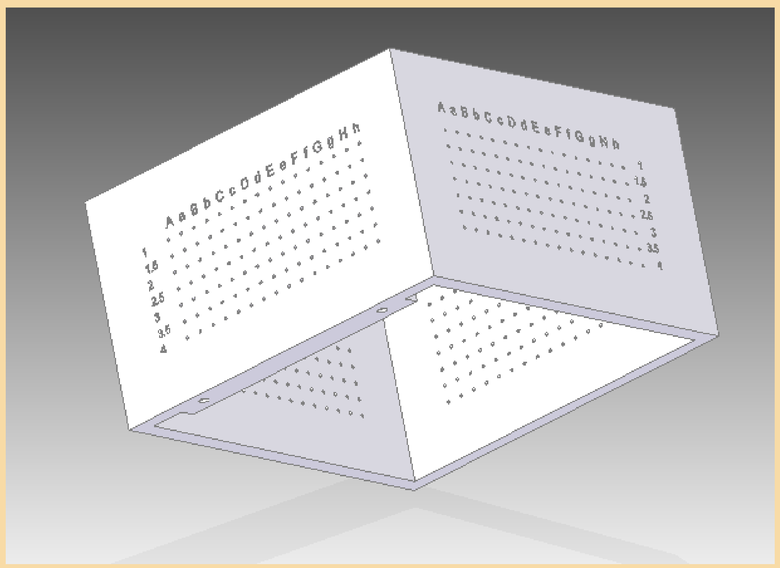


Figure 1: 3D CAD Model of the Proposed Phantom Design

Mounting System

The mounting system serves the purpose of holding the stepper in a vertical, Partially submerged position in a container of water during calibration. The mounting system will be placed inside and bolted to a container containing enough liquid to submerge the phantom and the transducers of the TRUS probe.

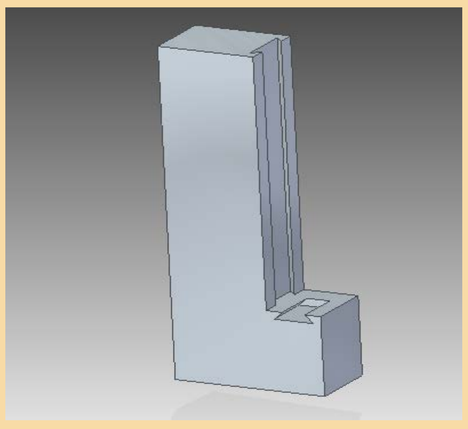


Figure 2: CAD Model of the mounting system

System Storage

The system is to be contained and stored on a cart as shown in Fig. 3. The system also includes a liquid-filled container to submerge the phantom during calibration.

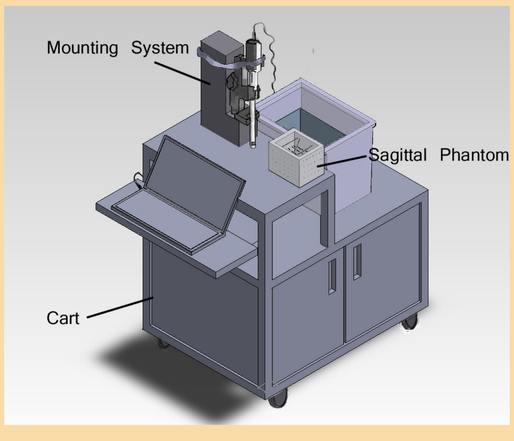
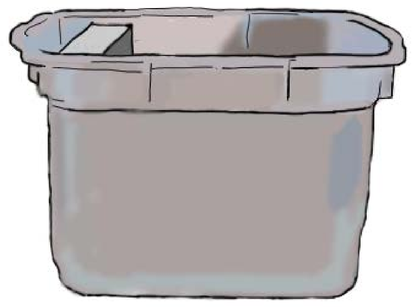


Figure 3: CAD Model of the system storage

Use of System

1)



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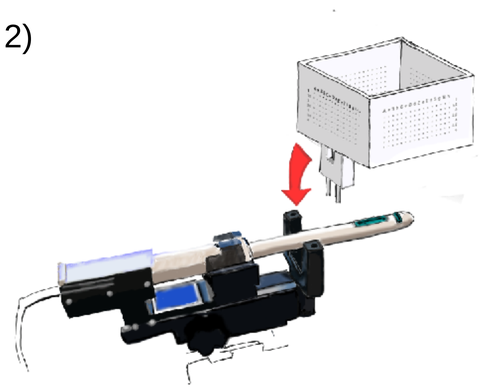

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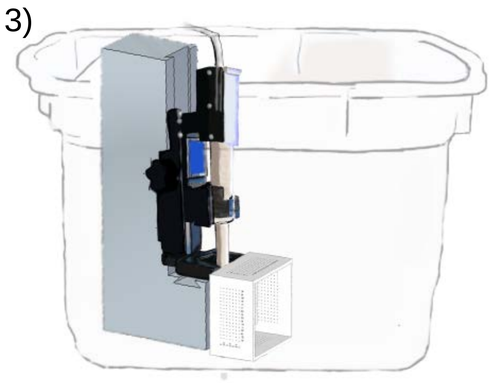

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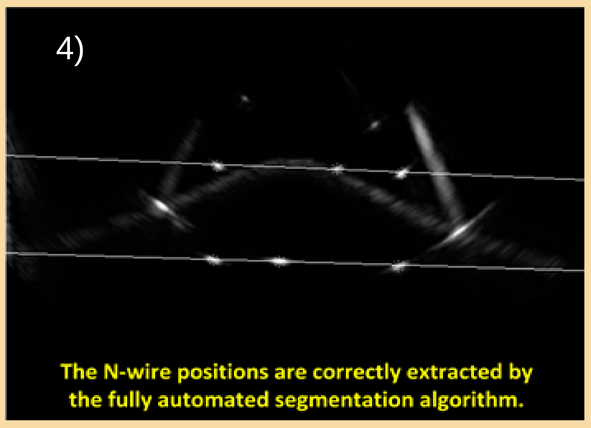

Sequence of Use

Upon bringing the stepper and probe to the cart, the following steps will provide the set up and run the calibration software.

1. Remove lid from container
2. Position phantom on stepper
3. Position stepper on mounting system
4. Run automated brachytherapy calibration software
5. Remove stepper and TRUS probe an proceed with Brachytherapy

Continuing Work

The proposed design will serve two purposes. First, it will provide a simple and convenient apparatus to contain the calibration system. Second, it will allow the probe to be calibrated accurately and with minimal technician interaction. The next step in this design will be to 3D print a prototype in ABS plastic and to experimentally validate the ability of the system to calibrate with less than 1 mm error of both the transverse and sagittal image planes.

Acknowledgements

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References

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[2]TK. Chen, T. Heffter, A. Lasso, Cs. Pinter, P. Abolmaesumi, EC Burdette, and G .Fichtinger, “Automated intraoperative calibration for prostate cancer brachytherapy,” Med. Phys. 38(11), 6285-6299 (2011)