RadVision integration with TRUS robot for Brachytherapy

Computer Integrated Surgery II
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Introduction

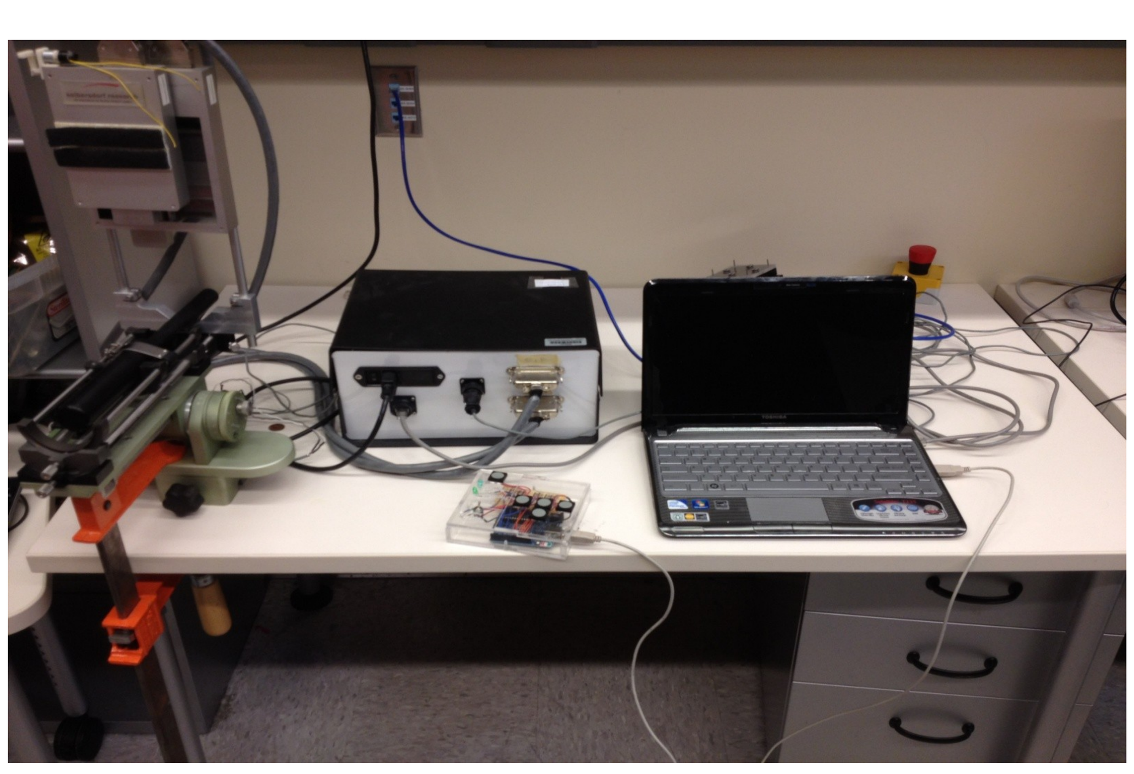
- Modified robot system in order to achieve better radioactive seed placement in prostate brachytherapy
- Integrated TRUS (Transrectal Ultrasound) Robot for prostate brachytherapy with RadVision simulation and planning software
- Preformed accuracy study developed by Danny Song to meassure accuracy of robotic system using graph paper and phantom

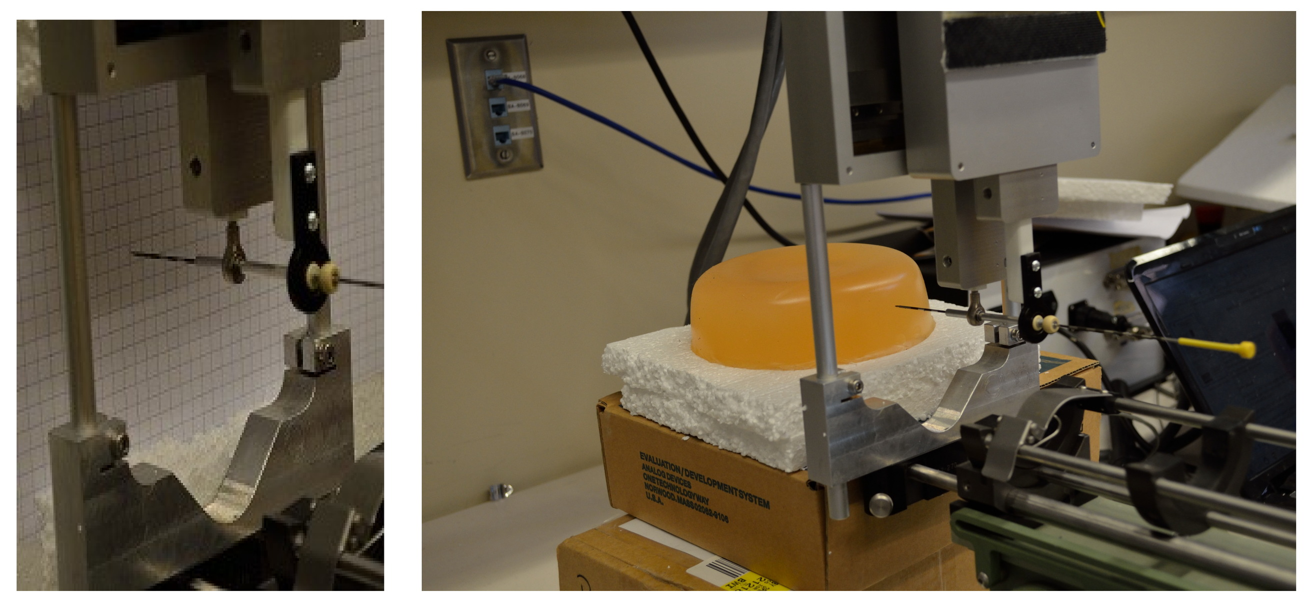
The Problem

- The American Cancer Society reports that 240,890 cases of prostate cancer were diagnosed and about 33,720 men will die from it.
- Prostate Brachytherapy is one of the most popular treatments for prostate cancer
- Conventional approach uses physical template that lacks flexibility and maneuverability, and lacks ability to insert needles as different angles
- Robotic systems allow for greater accuracy, flexibility, and maneuverability in radioactive seed placement theoretically resulting in better outcomes.
- Integrating simulation and planning software with robotic systems will allow for seamless and accurate surgery
- At the moment there is no standard for measuring the accuracy of these robotic systems.

The Solution

- Integration of RadVision, a planning and simulation software with the TRUS robotic system allows for good planning and execution of the surgery to ensure seeds are place in planned location.
- Robot control software was modified in order to be compliant with the new Galil driver.
- OpenIGTLink protocol was used to talk between the robot need to be updated and debugged
- Fingers for holding needle needed to be redesigned, fabricated, tested, and installed.
- Accuracy study experiments involving graph paper had to be done
- Experiment was performed with breast phantom to test 3D accuracy





Images of both the graph paper test (right) and phantom test (left) in progress

Outcomes and Results

- RadVision successfully integrated. Able to control robot through RadVision
- Conducted graph paper accuracy experiment with 20 samples
- Believe that improved encoder count conversion will led to higher accuracy
- Phantom experiment needs to be redone in order to produce better image.

Error in needle position			Repeatability in needle position		
Axis	Average	SD	Axis	Average	SD
X	.8	.2	X	.3	.2
Y	.8	.3	Y	.3	.2

Future Work

- Calibrate encoder tick counts for more accurate motions
- Reinforce structure to reduce effect of wobbling on accuracy and repeatability
- Use a material with better x-ray attenuation in CT scan for more accurate results.
- Finish accuracy study with standardized phantom
- Try to work with company to integrate button controller into RadVision
- Seek IRB approval and conduct clinical trial

Lessons Learned

- Sturdy robotic frame increases accuracy of robotic movements
- Objects that attenuate x-rays are much better to use in CT scans work much better

Publications

Gabor Fichtinger, Jonathan P. Fiene, Christopher W. Kennedy, Gernot Kronreif, Iulian Iordachita, Danny Y. Song, Everette C. Burdette, Peter Kazanzides, Robotic assistance for ultrasound-guided prostate brachytherapy, Medical Image Analysis, Volume 12, Issue 5, October 2008, Pages 535-545, ISSN 1361-8415, 10.1016/j.media.2008.06.002.
(http://www.sciencedirect.com/science/article/pii/S1361841508000613)

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