iPASS: Photoacoustic Catheter Tracking

Computer Integrated Surgery II
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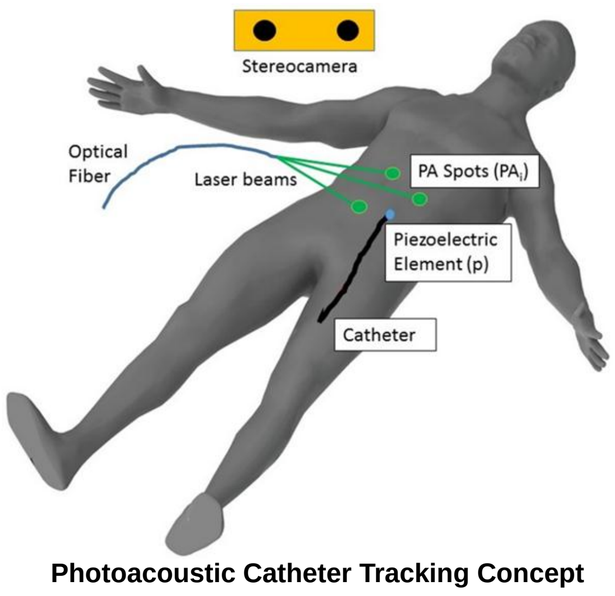
Introduction

- This work is another way for tracking a catheter inside the patient body
- Using the photoacoustic effect to generate an ultrasonic image that can appear on stereo camera video
- We detect the motion of catheter by attaching the piezoelectric element to the catheter

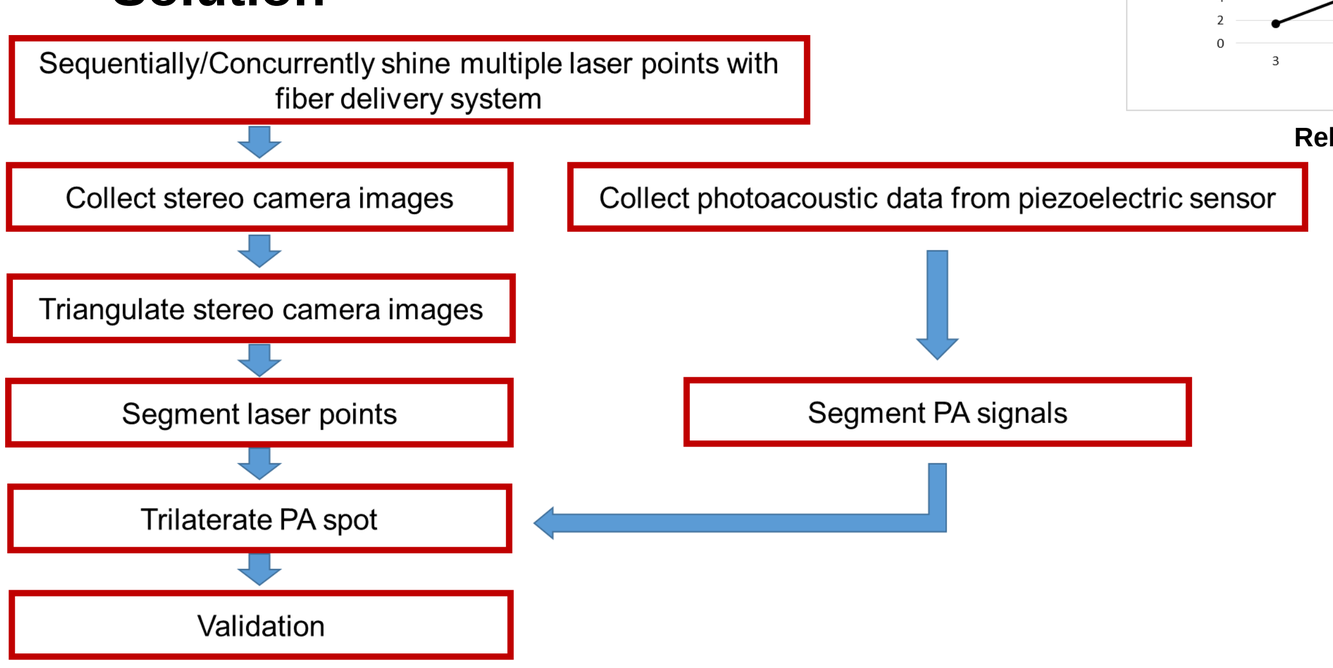


Photoacoustic Catheter Tracking Concept

Problem

- Catheter tracking is commonly done by using X-ray
- Using radiation during the catheter tracking by using X-ray is harmful to patients' health
- In standard X-ray catheter tracking, there is only two-dimensional view where the catheter is
- They also require surgical tools to be modified with tracked markers
- Standard optical or electromagnetic trackers are limited to errors larger than 3 mm

Solution



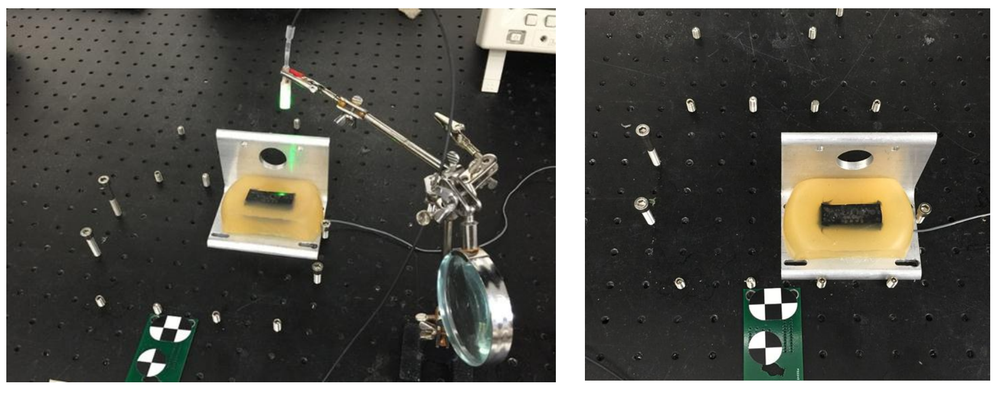


Image of Shining Laser on Synthetic Phantom

Credit

- Yuttana Itsarachaiyot was responsible for all parts

Results

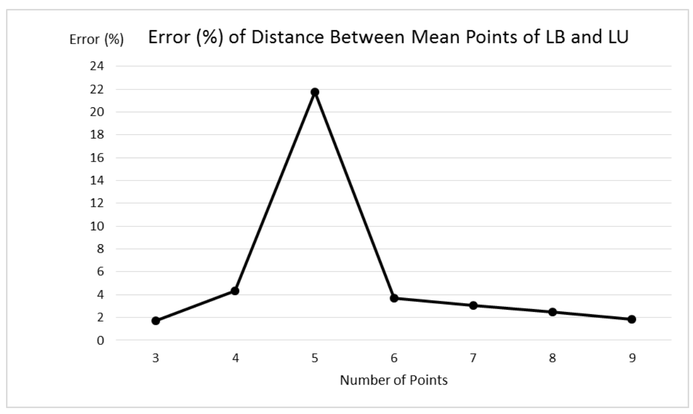
- N = 20 at each location for synthetic phantom
- This system shows lower errors (~ 1-2 mm) than the standard optical or electromagnetic systems (~ 3 mm)

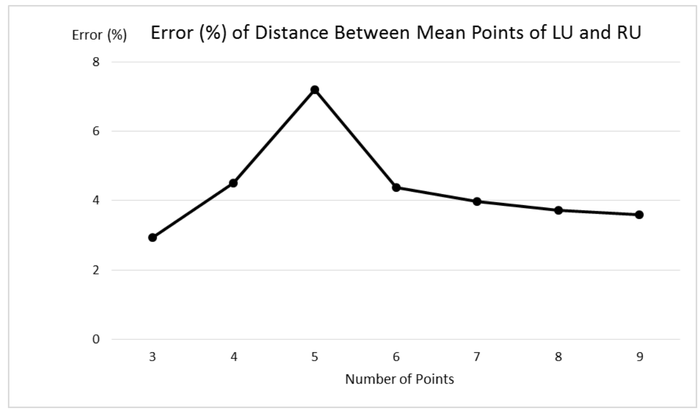
Location	Repeatability (mm)
Bottom Left (LB)	1.60 ± 1.13
Upper Left (LU)	1.46 ± 0.94
Bottom Right (RB)	2.14 ± 1.46
Upper Right (RU)	3.12 ± 2.43

Repeatability Validation Results of Synthetic Phantom Experiment at Each Locations Using 3 Points

Locations	Calculated Distance (mm)	True Distance (mm)	Error (%)
Bottom Left & Upper Left	69.93	71.12	1.71
Bottom Right & Upper Right	68.43	71.12	3.93
Bottom Left & Bottom Right	96.66	93.47	3.30
Upper Left & Upper Right	96.30	93.47	2.94

Relative Distance Validation Results of Synthetic Phantom Experiment between Mean Points of Locations Using 3 Points





Relative Distance Validation Results of Synthetic Phantom Experiment between Mean Points of Locations With Different Number of Points

Future Work

- Develop real-time tracking system
- Conduct more experimental trials
- Conduct *in-vivo* trials

Lessons Learned

- Store all data for debugging purposes
- Data analysis and validation need to be rigorously executed
- Project plan needs to be regularly revised

Publications

- Paper submitted to MICCAI 2016

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