



PROBE-PLACEMENT FIXTURE FOR MICROWAVE ABLATION

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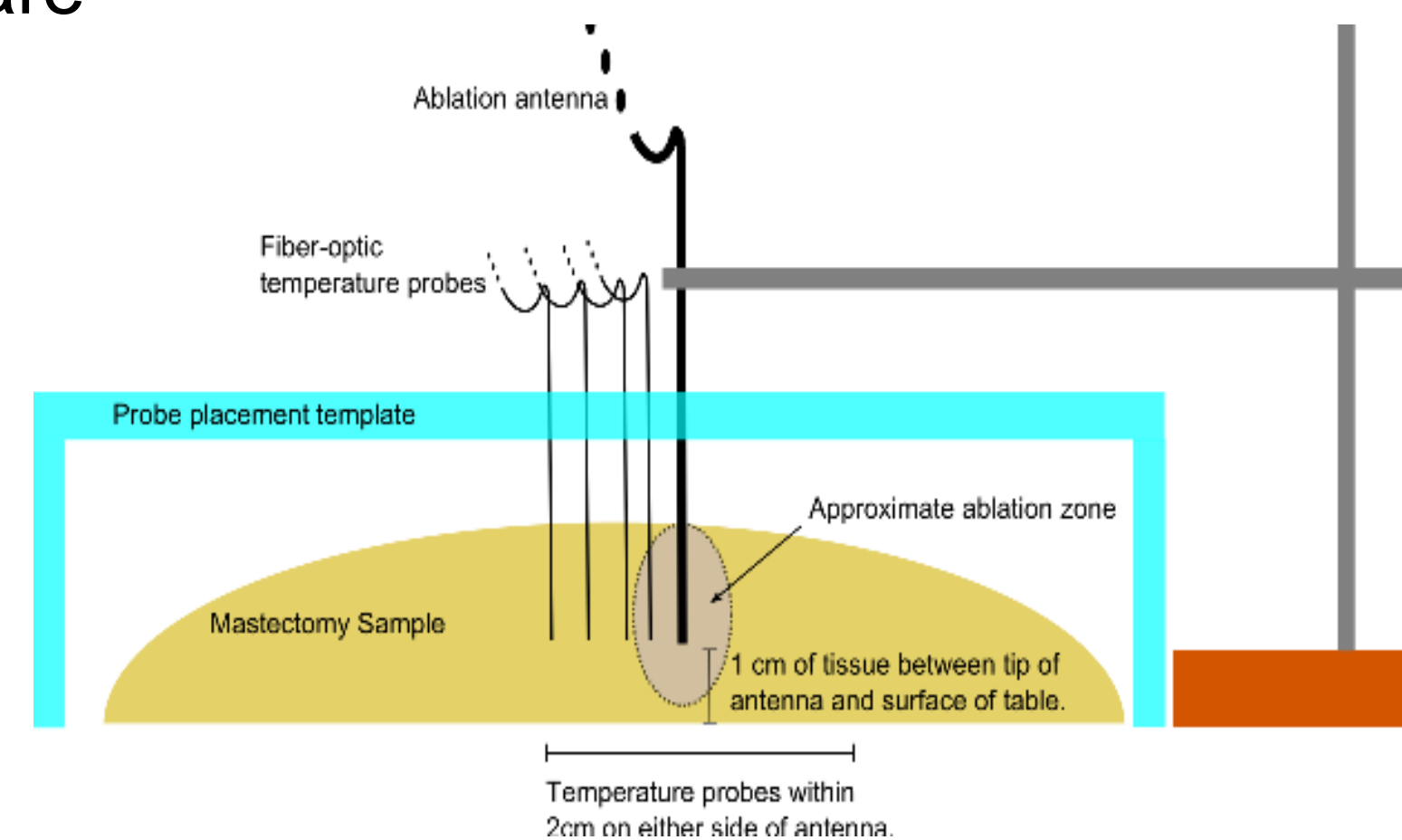
ABSTRACT

Microwave ablation is a type of thermal therapy being used to treat the kidney, bone, liver, and lung cancer. Although this process has worked for these types of cancers, it is currently being researched in hopes of being a successful treatment for other types of cancer. Microwave ablation treatment denatures and destroys cancerous cells using the heat generated by microwaves. The power of microwaves is delivered to the cells through an antenna, and monitored through small temperature probes. This technique, if proven effective, would be a preferred method for future tumor treatments because it prevents many side effects that traditional treatments pose for many patients. The goal of this project is to design a fixture for microwave ablation probe placement that can be easily used by researchers during experimentation. In order to test the design, the probe-placement system will be tested using ex vivo mastectomy samples provided by a local hospital.

BACKGROUND

What is Microwave Ablation?

- Microwave ablation uses different intensities of electromagnetic energy to destroy cancer cells [1]
- The heat generated by microwaves is transferred through a narrow antenna[1,2]
- As the energy is transferred through the antenna into the tissue, the malignant tumor cells are destroyed [3]



PREVIOUS METHOD

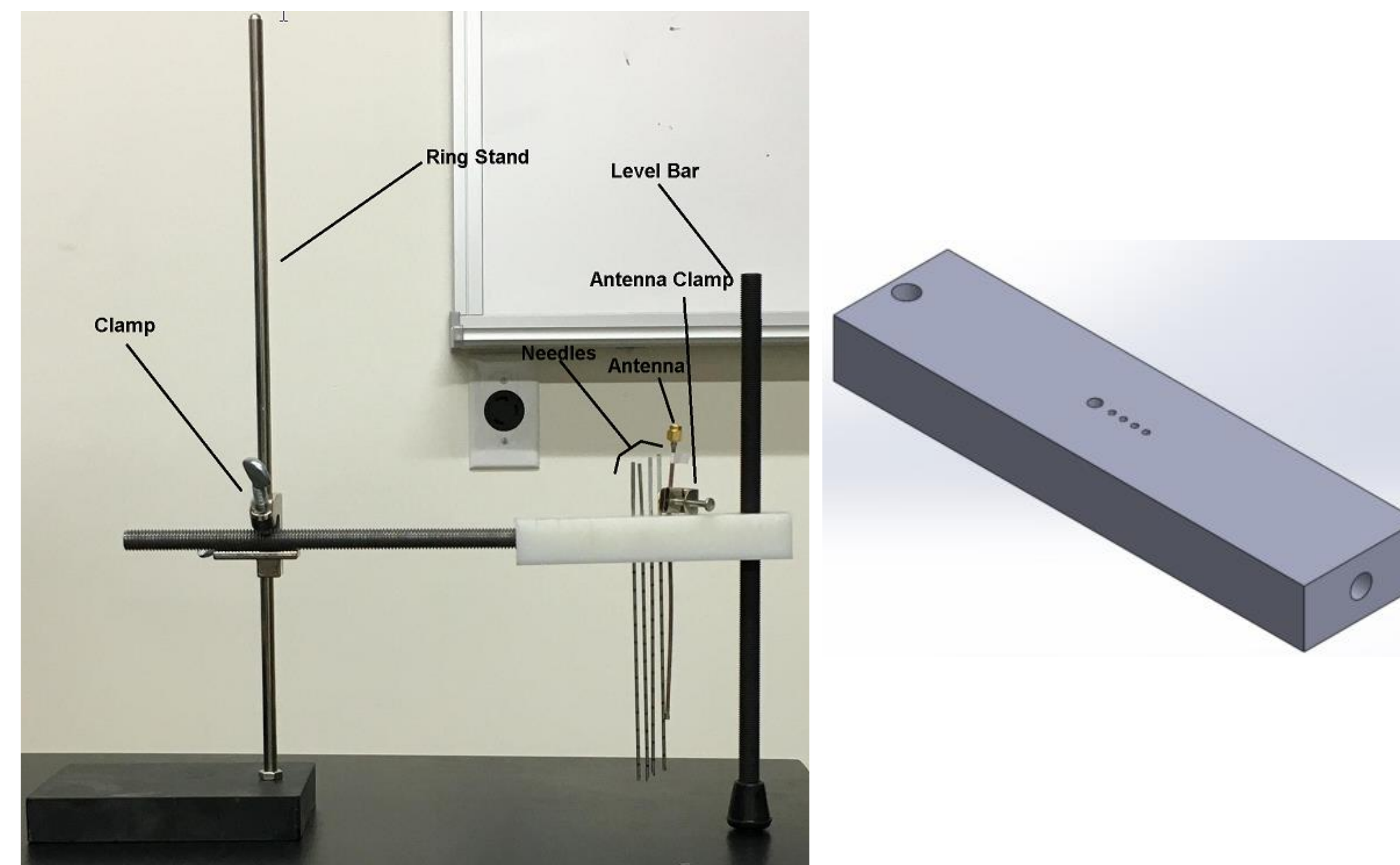
- Ablation antenna and four fiber optic temperature probes
- Hollow needles utilized to insert probes
- 0.5" needle increments are approximated
- Exact depths of needles and probe unknown
- Needles are unguided, no way to keep them parallel
- Inefficient setup time

DESIGN CRITERIA

Design Criteria

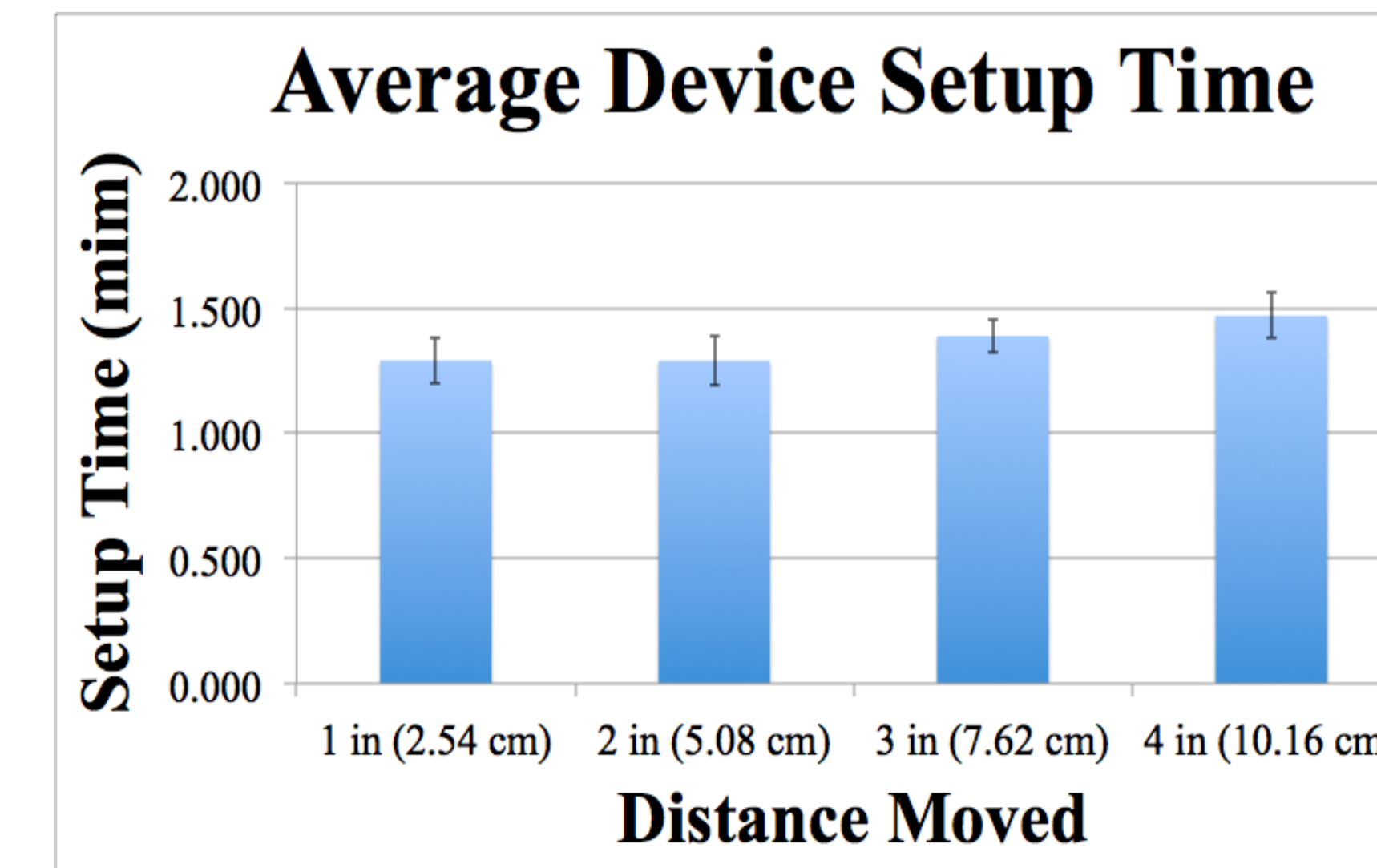
- Device must be easy to use due to time constraints
- Must place temperature probes .5 cm apart
- Must preserve the integrity of the tissue sample
- Must cost less than \$150
- The temperature probes have to be placed parallel into the tissue
- Must be able to accommodate tissues of different sizes

FINAL DESIGN



- Our final design implemented the use of the ring stand our client currently uses to level and stabilize the device
- The device itself consisted of a rectangular cutout of HDPE with five holes in the middle, for the antenna and four temperature probes
- It also uses a level bar to allow fast and easy height adjustability
- The design enables accurate placement of temperature probes and antenna equidistance apart into the sample tissue
- The needles are easily removable once the temperature probes are in place

TESTING

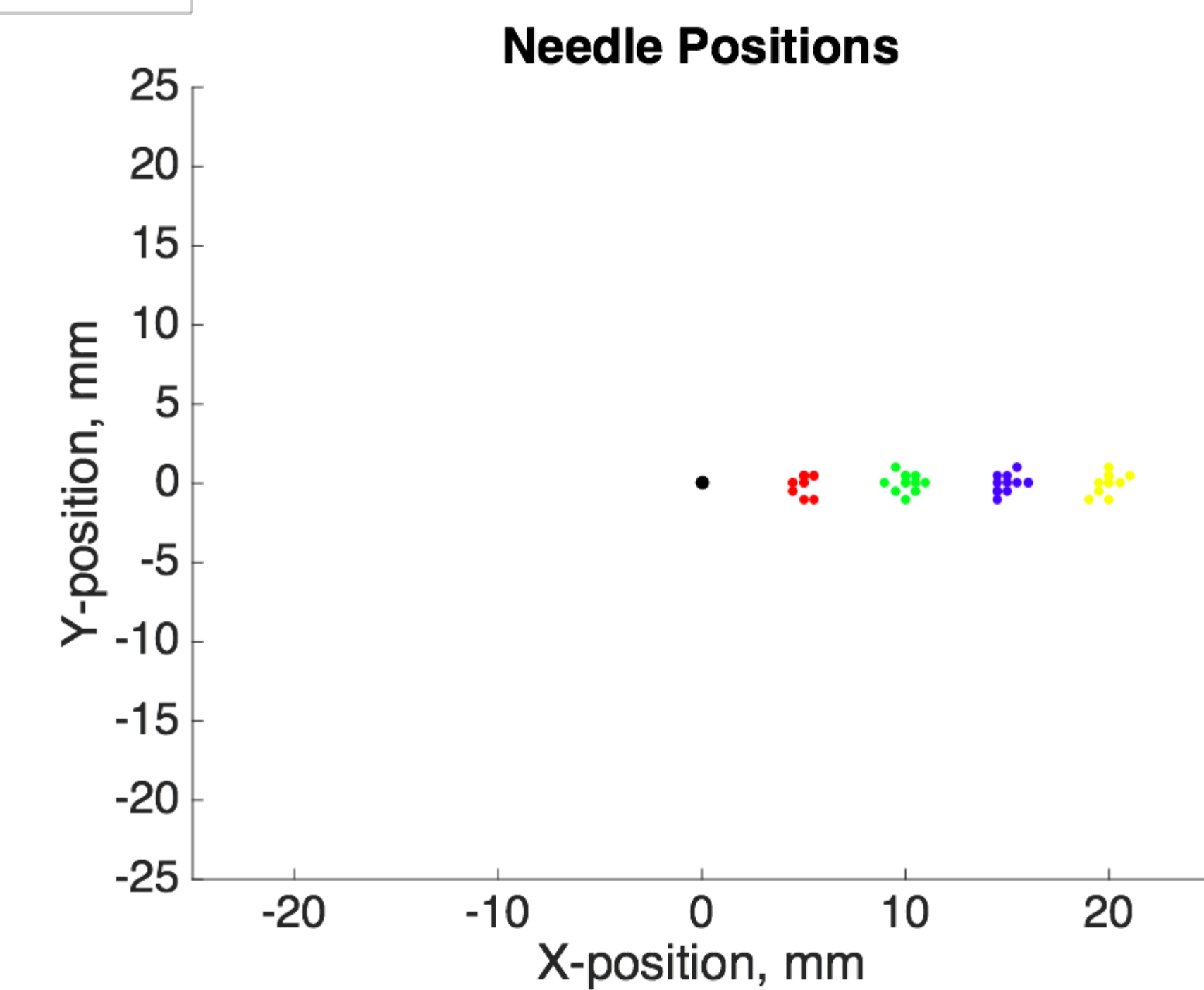


Speed Test:

- Assembled the device to validate setup time falls within desired 2 minute window.
- Determined the device can be setup easily within 2 minute window.

Accuracy Test:

- Needles and antennae were inserted into respective holes.
- Imprinted needle and antennae locations and measured the relative distances.
- Determined all of the needles fall within 0.5mm of the desired location.



FUTURE WORK

- The device will be used for research purposes to analyze patient's mastectomy samples used in microwave ablation
- Research students will use the device when in need of a fast set up time and precise incisions of the needles
- Possibly implement an additional temperature probe hole to allow more extensive analysis of the tissue sample
- The research this device is being used for could help develop a treatment for cancer



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References

[1] S. Gordon. (2014, October 15) *Novel antenna breaks down barrier in tumor ablation technology* [Online]. Available: <http://www.engr.wisc.edu/news/archive/2014/oct15-vovel-antenna-ablation.html>

[2] C. J. Simon *et al.*, "Microwave ablation: principles and techniques," *RadioGraphics*, vol. 25, no. 1, pp. 69-71, Oct. 2005.

[3] H. Luyen, S. C. Hagness, and N. Behdad, "A Balun-Free Helical Antenna for Minimally Invasive Microwave Ablation," *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 3, pp.959-965, March 2015.