

ABSTRACT

Currently, patients undergoing reconstructive surgery are awakened every hour, as a result of medical staff monitoring the triphasic signal of the artery to the newly reconstructed tissue. This arterial signal is monitored via Doppler ultrasonography, which measures blood velocity by analyzing the frequency by which the produced sound waves deflect off the blood cells. Frequent monitoring of arterial blood flow is crucial in detecting ischemia and lessening the potential damage to the newly operated tissue due to ischemia. If the tissue is too ischemic the tissue risks necrosis, therefore it is imperative that the tissue in question be operated on immediately to be salvaged. The challenge of this project is to create a device that can adhere to a patient's skin, reduce or eliminate the mess of the current ultrasonic gel, and maximize patient comfort. Currently, the medical staff use Doppler probes with hydrogel to conduct the sound. The patient is often bothered by the application and cleanup of the gel. The proposed solution is to create a device that can contain the gel and adhere to the patient's skin, marking the location of the desired artery. This will reduce the time that nurses spend looking for the artery, reduce the mess, and increase patient comfort.

PROBLEM DEFINITION

Motivation:

- Survival of tissue depends on blood flow
 - Reconstructed tissue is monitored every hour during hospital stay
- Monitoring disrupts the patient's sleep and comfort
 - It can be difficult for rotating medical staff to find the arterial signal
- Using the current method, the patient must be cleaned after each use of the Doppler

Background:

- The client requires a device to aid in blood flow monitoring after reconstructive surgery
- 5% of patients experience ischemia [1]
 - Over time, insufficient blood flow will damage tissue
- Existing devices used with Doppler pen:
 - Liquid Hydrogel
 - HydroAid [2]
 - SonoFAST [3]



Figure 1: Doppler with liquid hydrogel

DESIGN CRITERIA

- Alleviate patient stress
- Conduct sound waves
- Mark location of arterial signal
- Safe for patients and medical staff
- Five day service life
- Sterilizable or disposable

FINAL DESIGN

- Container is made from flexible resin
- Keeps hydrogel from evaporating
- Adheres to patient with atraumatic removal
- Container is reusable with disposable Tegaderm

- Marks location of the artery in question
- Ideal angle for use of Doppler pen
- Container is adhered to Tegaderm via Pros-Aid II
- Tegaderm prevents maceration of the skin

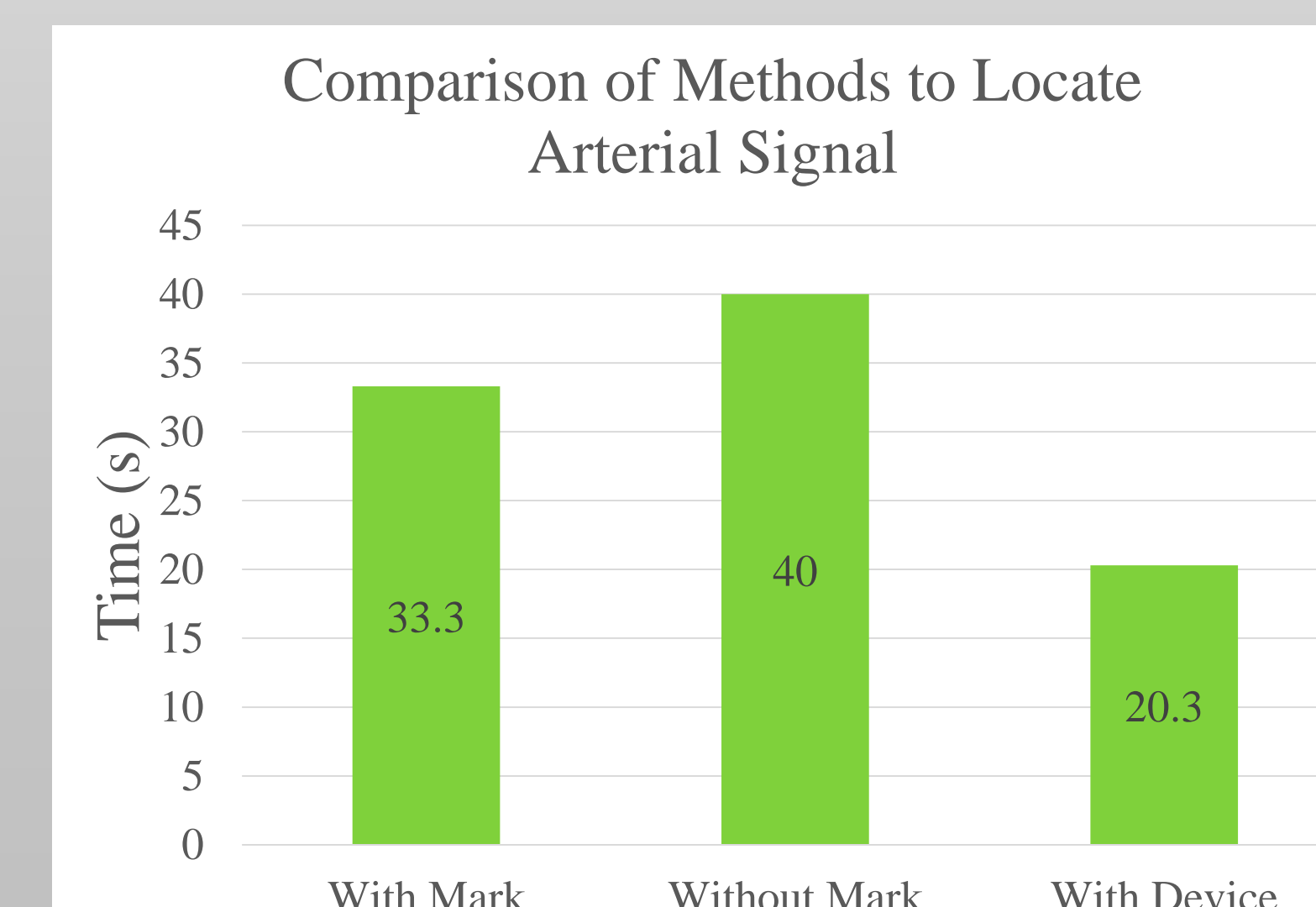
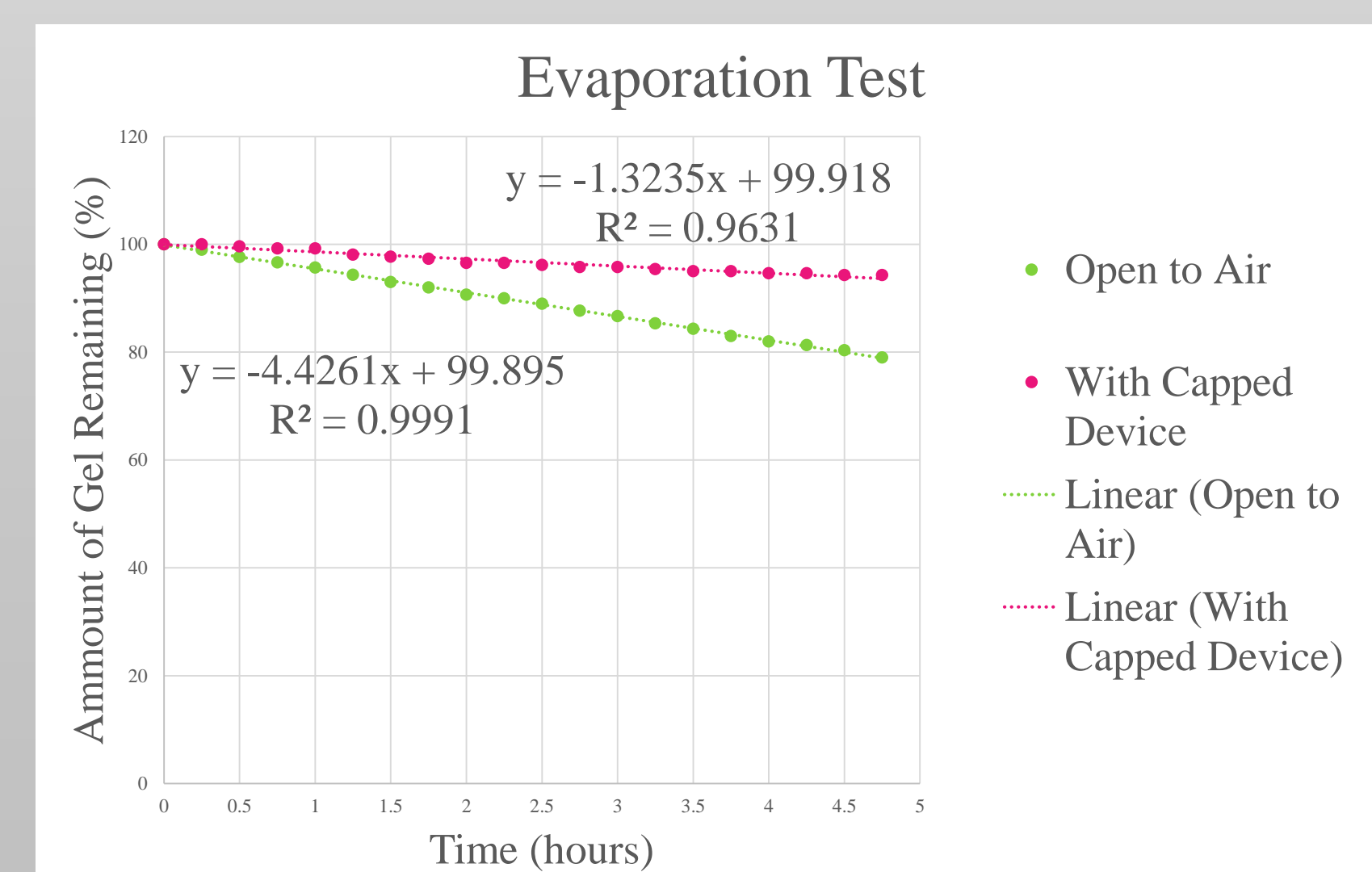
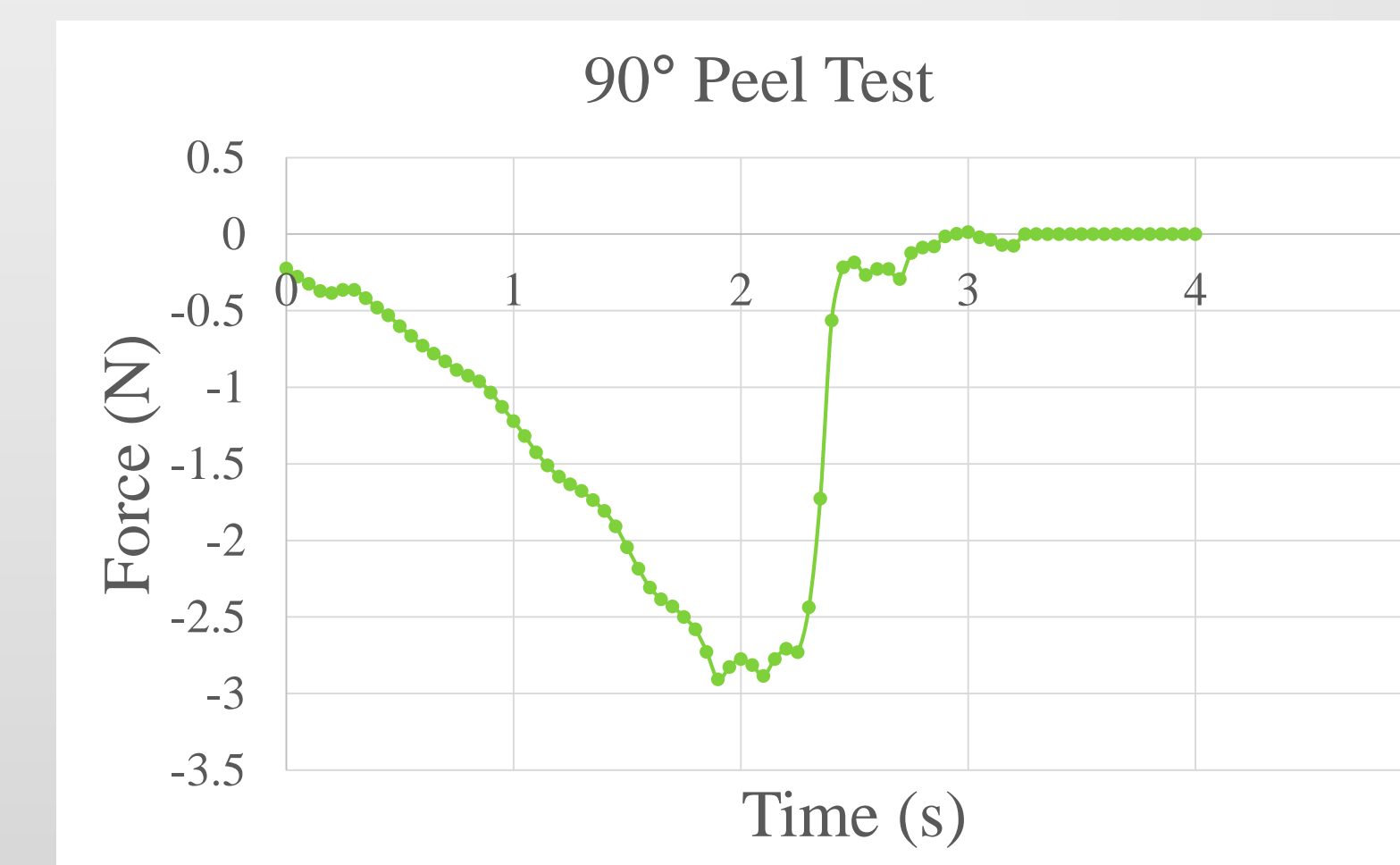
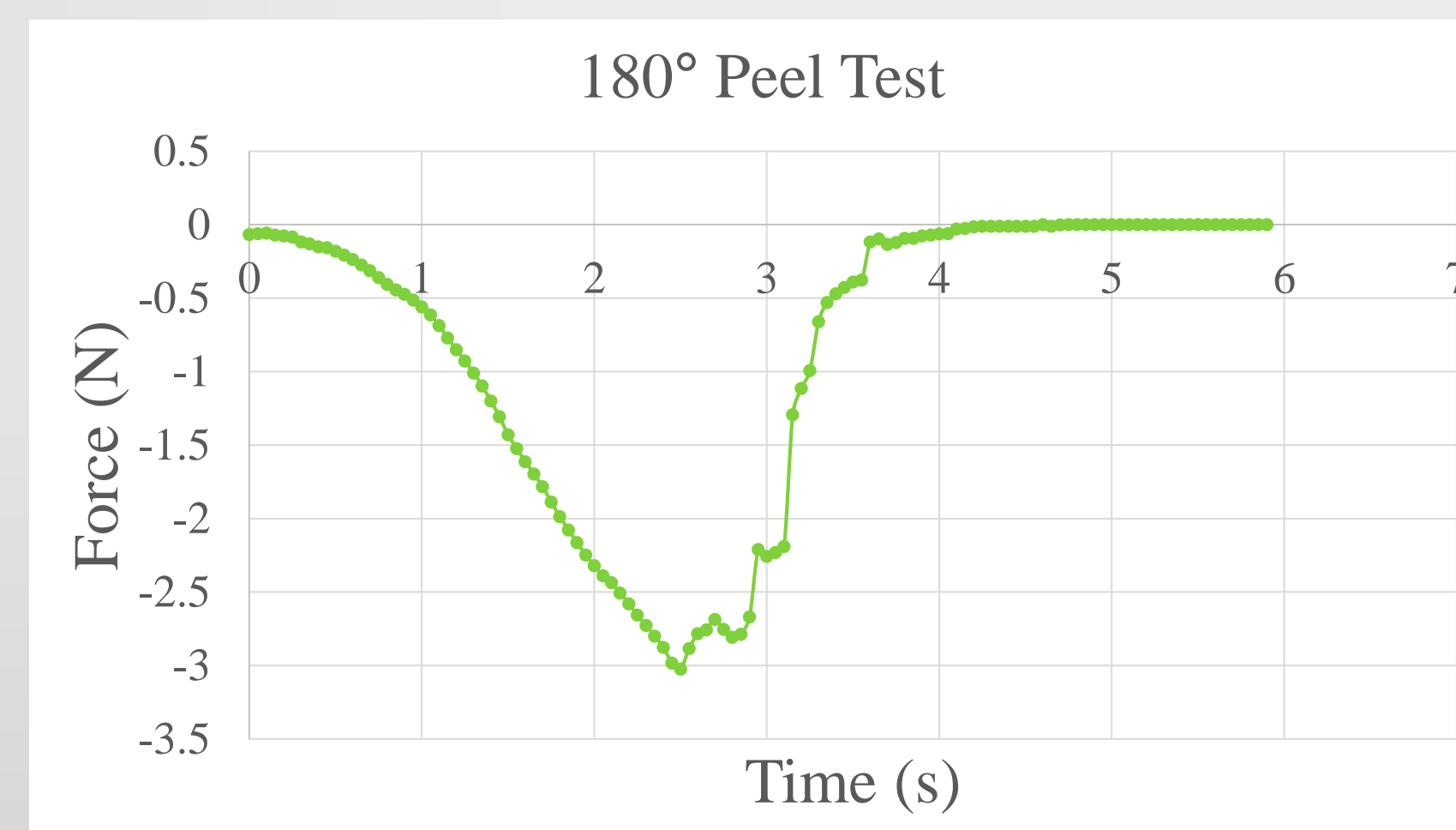


Figure 2: SolidWorks of Final Design



Figure 3: Final Design Prototype

TESTING



RESULTS

- The force required to remove the device from Tegaderm using Pros-Aide II was between 2.5 and 4.0 N
- The evaporation test shows that the device dramatically reduces evaporation of the hydrogel
 - 22.6 hours vs. 75.5 hours
- Using the device is more efficient to find the arterial signal
 - 33.3 seconds vs. 20.0 seconds
- Tegaderm can retain adhesion to the patient's skin for at least 5 days
 - A test was performed for 5 days with normal activity
- Pros-Aide II can successfully adhere the device to Tegaderm for at least 5 days
 - Loosened after heavy activity on day 5

FUTURE WORK

- Embed Doppler within device
- Temperature sensor to monitor health of patient's tissue
- Screw-on cap to prevent accidental opening
- MIT hydrogel to reduce size of device and prevent drying out [4]

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