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BME 4910
Week 1 Report: 1/25 – 1/31

WORKS COMPLETED:

The objectives for this week were as follows: 1) construct the mounting bath, 2) perform another pilot study using the biaxial CCD camera, and 3) process the obtained images. Mike did a lot of work at the Machine Shop this week designing and constructing the mounting bath. So far, he had completed building the inner bath and parts of the outer bath. Figure 1 below shows the mounting bath that was almost completed. The holes on the bottom surface of the inner bath were drilled to accommodate for the different tissue sizes. As previously mentioned, the tissue specimen will be attached to two posts in the mounting bath. The two posts will be put into the holes, which will not only secure the posts, but also allow the distance between the posts to vary. This way, different tissue sizes can be used, and the user is not limited to only one tissue size. In addition, as can be seen from Fig. 1, the outer bath has two holes drilled into it on opposite sides. These two holes will provide the attachment to the flow loop system which will soon be constructed. Basically, a flow loop will be attached to the two holes, and this will allow the water to circulate in and out of the mounting bath. This is crucial to maintain the constant temperature inside the mounting bath.

![Fig. 1 – Mounting Bath](image)

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Aside from the mounting bath, Eric and I also performed another pilot study with an aortic tissue and markers using the CCD camera we already had. This CCD camera is currently being used by the biaxial machine in the Tissue Mechanics Lab. We wanted to see if this CCD camera has the resolution we needed. The problem we encountered with the CCD camera, however, was that the camera zoomed too much into the image and there was no way to zoom out. In other words, the camera was unable to capture the whole field of view of the image. It could only capture a few markers on the tissue. It could not, however, capture the two posts and the bending and references bars.

Thus, instead of using the CCD camera, we used another digital camera with around 3.2 megapixels. We recorded a video of the flexural test. The images that we obtained from this camera were processed using Vision Assistant. As an aside, the week before, we had captured some images of the pilot study of the bending test. These images could not be processed, however, because the images were extremely blurry and the camera was not stable. Hence the reasons why we performed another pilot study this week. Figure 2 below shows an image from a frame of the recorded video. This figure shows the two posts the tissue was attached to, the markers on the tissue, the bending and reference bars, and the ruler for calibration and measurement purposes.

![Fig. 2 – Captured image from pilot study](image)

![Fig. 3 – LabVIEW code used to process images](image)
Figure 3 above shows the LabVIEW code that was used to process the captured images. These codes were originally written in Vision Assistant as script. Specifically, Vision Assistant was first used to process a frame of the video. Several functions in Vision Assistant were used to separate the markers from the background and track the positions of the markers, as well as the positions of the two posts and the bending and references bars. These functions were then exported into LabVIEW to form a LabVIEW program.

Several data were obtained from the image processing. First, and foremost, it was determined that the maximum displacement of the tissue was approximately 1.5 cm. In addition, the maximum force applied on the tissue was about 40 g. The force applied on the tissue was determined from the calibration of the bending bar the previous week. To recap, the calibration was done by first measuring the distance between the bending bar and the reference bar when no force was applied to the bending bar. Then a 50 g load was hung to the bending bar and the distance was again recorded. The same was done for 100 g load. Figure 4 below illustrates this process.

![Calibration of the bending bar](image-url)

**Fig. 4** – Calibration of the bending bar
Graph 1 below shows the calibration of the bending bar, its associated trendline, and the equation for the trendline. This equation was used to determine the amount of force applied to the tissue. Using this equation and the displacement data for the bending bar obtained from image processing, it was determined that the maximum load applied to the tissue during the pilot study was about 40 g.

\[ y = 37.115x - 72.334 \]
\[ R^2 = 0.9838 \]

**Graph 1 – Graph of the bending bar calibration**

**FUTURE WORKS:**

In the next few weeks, we will continue to process the obtain images to better track the positions of the markers on the tissue. Furthermore, we have already ordered some graphite powder, thus we will perform another pilot study with the aortic tissue using graphite powder. Mike will finish up constructing the mounting bath. We will start constructing the flow loop system as well as the force application unit. I will begin coding the motor control system using the LabVIEW program. In addition, we will start designing ways to attach the motor unit to the mounting bath.