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# Using Machine Learning to Model Soft Robotic Motion

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## Introduction

- Soft robotics is a new field of robotics that studies the manipulation of soft matter to perform robotic functions

- This research developed a camera system and image-processing technique to measure the motion of our soft robot

- We then trained a machine learning model to predict our robot's motions for unique situations

## Methods

- The soft robot we made was 3D printed from an elastic TPU material to let the arm bend

- We then measured the position of seven stickers along the robotic arm that are shown in Figure 1

- To control the robot and measure its motion we created a data-collection chassis shown in Figure 2

- The chassis is connected to a motor system that will pull a string that is connected to the arm which bends it back and forth

- The data we collected was then used to train our machine-learning program and allows us to predict the robot's motion

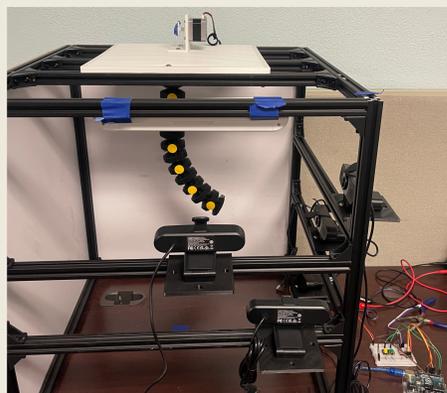

**Figure 1. Soft robot contained within the chassis**



**Figure 2. Overall soft robot and data collection system**

## Results

- Ultimately, this project was successful because we created a machine-learning model that can predict the motion of our robot in situations we did not train it on

- We were able to successfully create an environment where the soft robot could be controlled and monitored at the same time

- The chassis allowed us to collect meaningful data that was used to train the machine-learning model

- The model training loss converged down to low values (see Figure 4) meaning we can predict information that closely follows the data we used for training
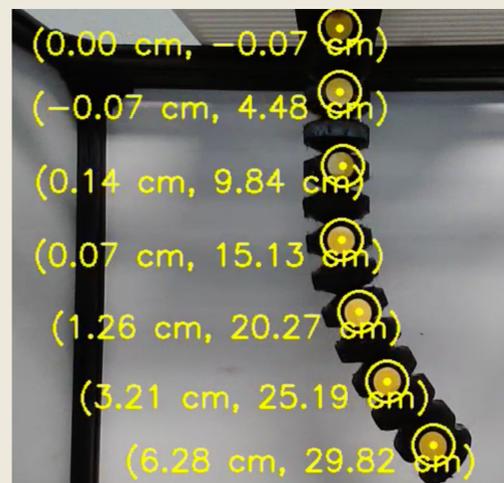


(0.00 cm, −0.07 cm)
(−0.07 cm, 4.48 cm)
(0.14 cm, 9.84 cm)
(0.07 cm, 15.13 cm)
(1.26 cm, 20.27 cm)
(3.21 cm, 25.19 cm)
(6.28 cm, 29.82 cm)

**Figure 3. Camera frame after using color filtering to provide point coordinates**
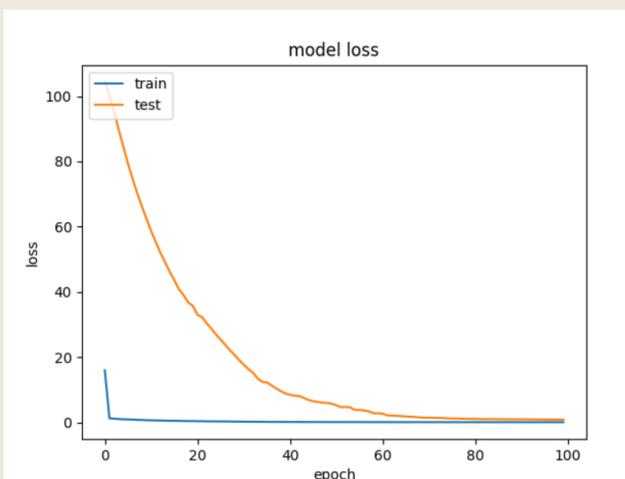


**Figure 4. Progression of model training per epoch.**

## Future Work

- The next step in the research is to compare the machine-learning results to other research papers

- This will help us learn more about how soft robots move

- Doing so will allow people in the future to implement soft robots in our daily lives
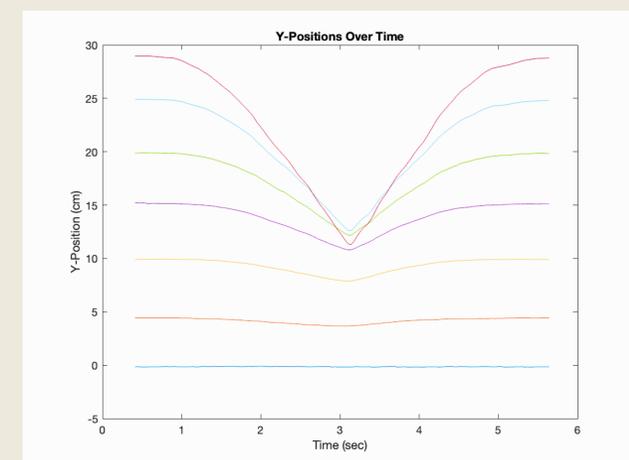


**Figure 5. Y-position data over time from every position sticker as the robot undergoes deformation**
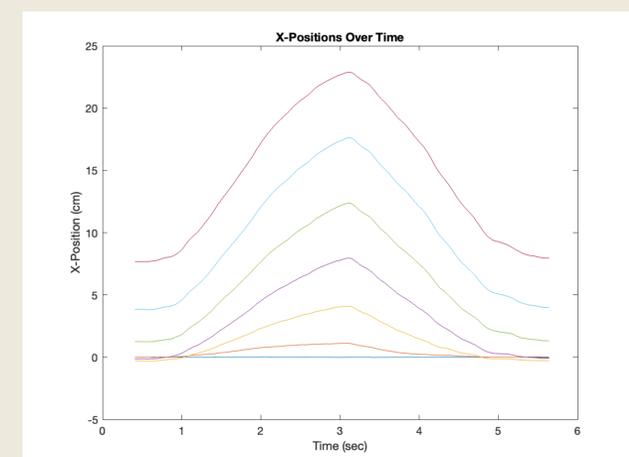


**Figure 6. X-position data over time from every position sticker as the robot undergoes deformation**