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# Design and Test of a Soft Muscle

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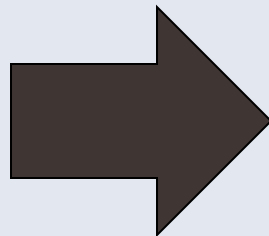
University of California Santa Barbara

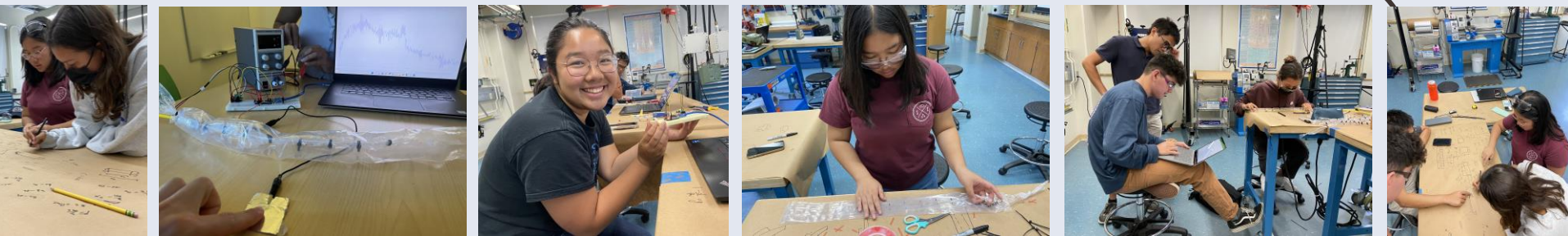
September 2, 2022



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# Soft robots can take robotics out of industry and into the home

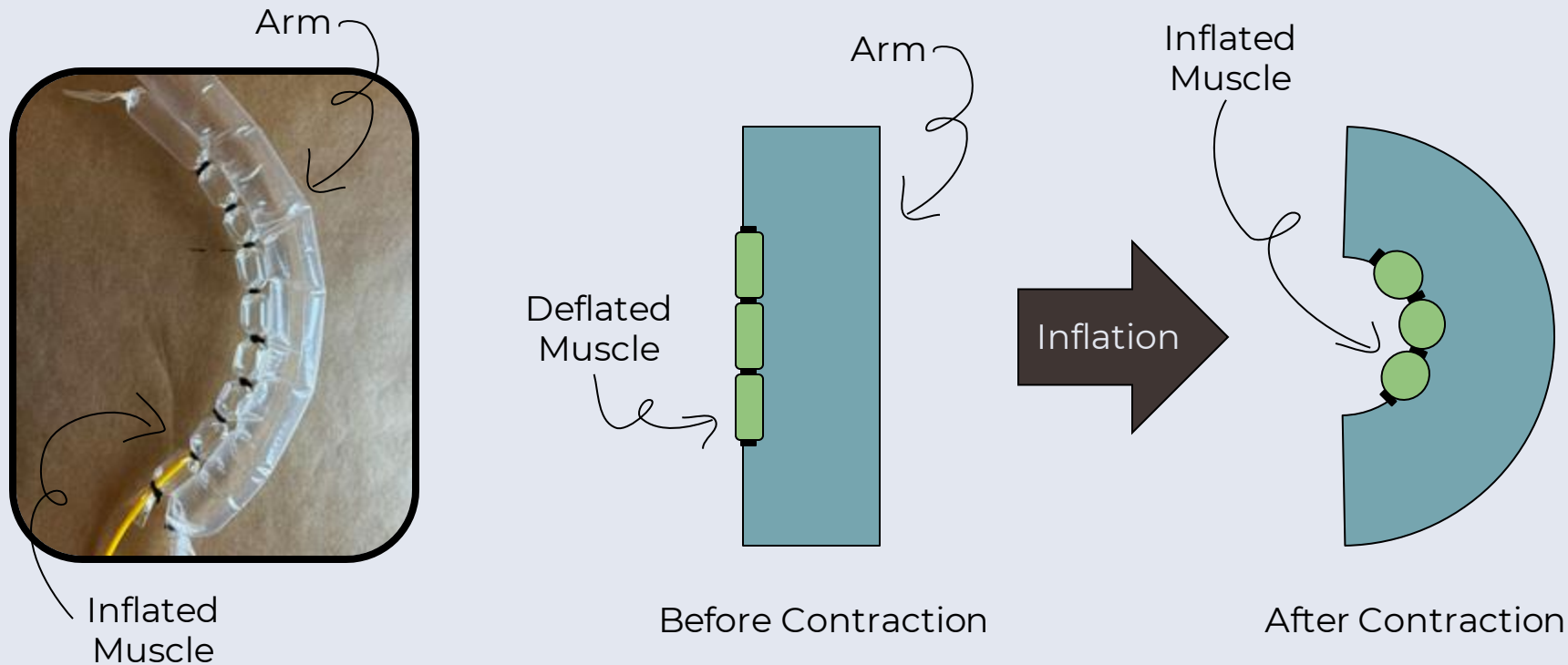




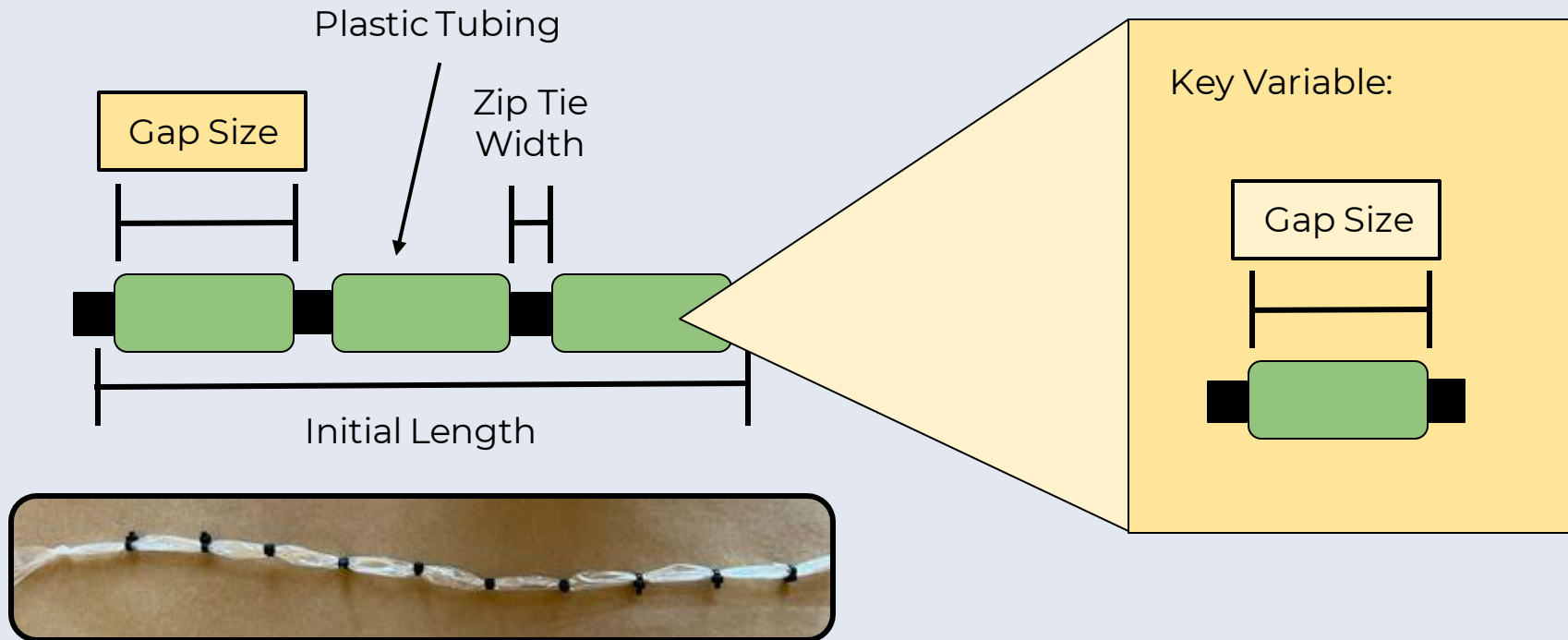
The designs for a sensitive and adaptive robot are an open question



# Changes in muscle length cause bending



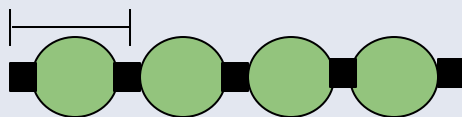
# Gap size determines effectiveness of muscle



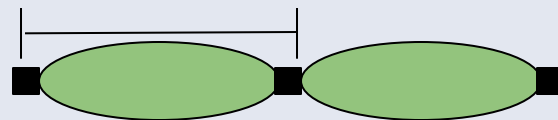
# There are three different regimes based on spacing



Spaghetti



Meatball



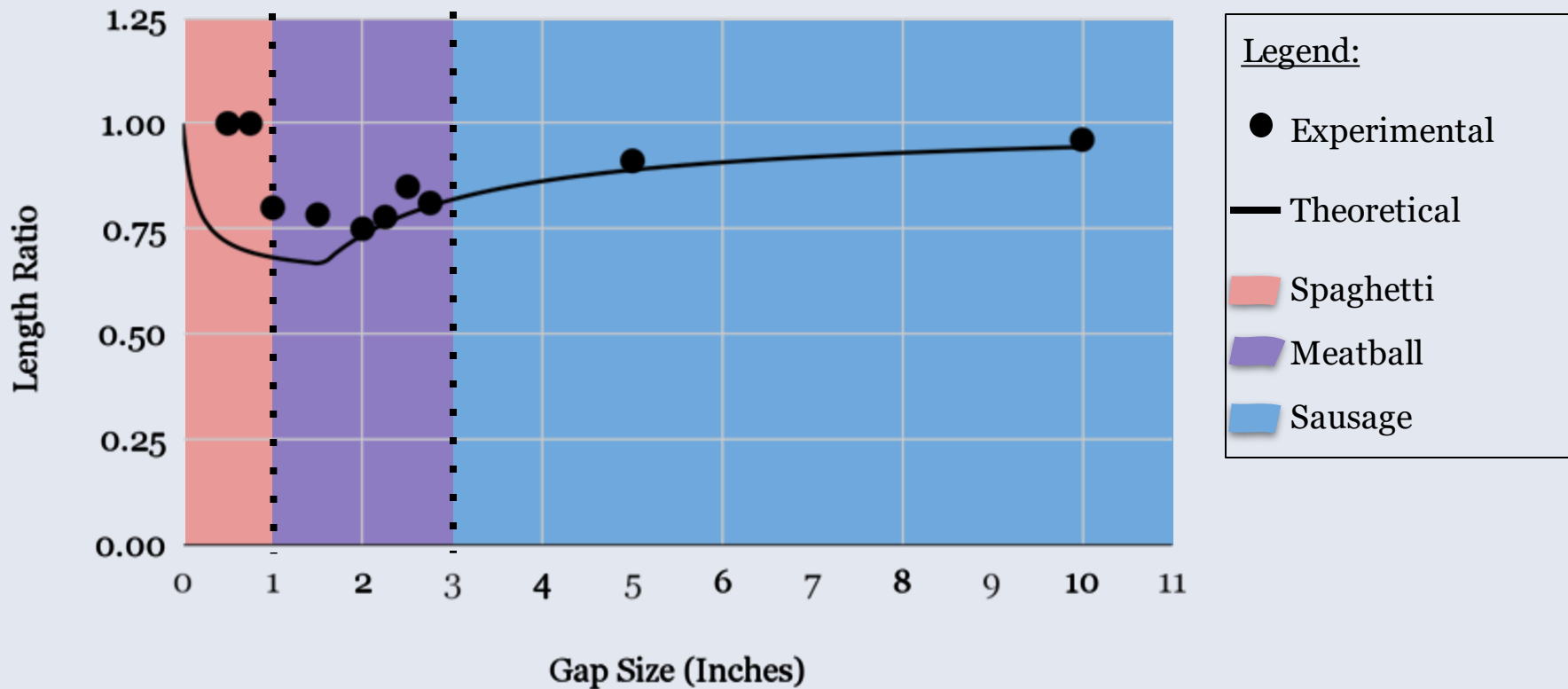
Sausage

Smaller  
Gap Size



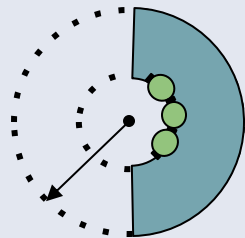
Bigger  
Gap Size

# Contraction Varies on Zip Tie Gap

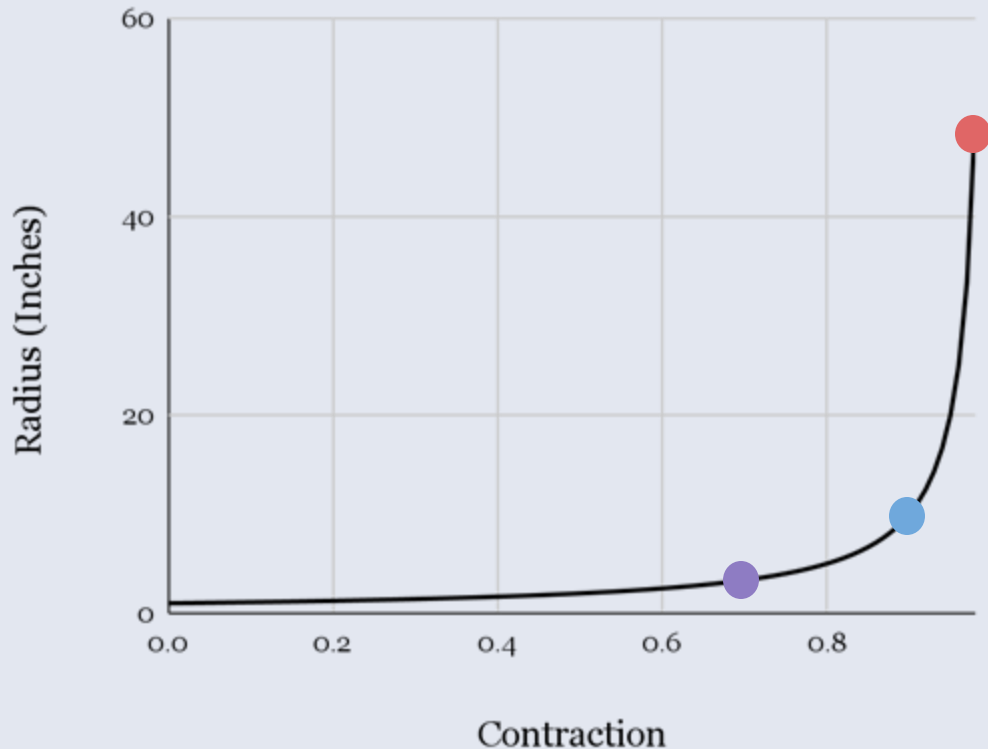
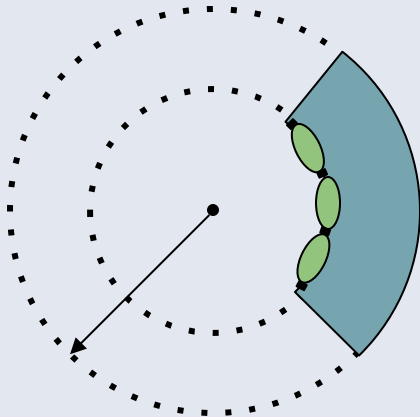


# Contraction correlates to radius

Sharper Bend  
↑ Length Ratio  
↓ Radius

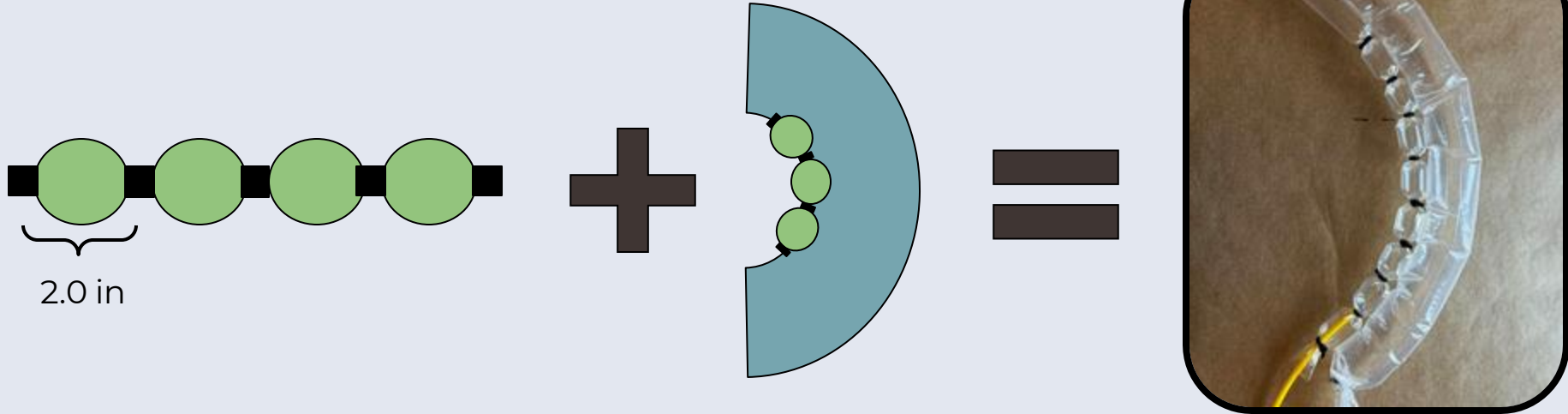


Softer Bend  
↓ Length Ratio  
↑ Radius

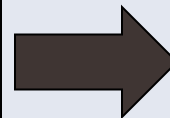
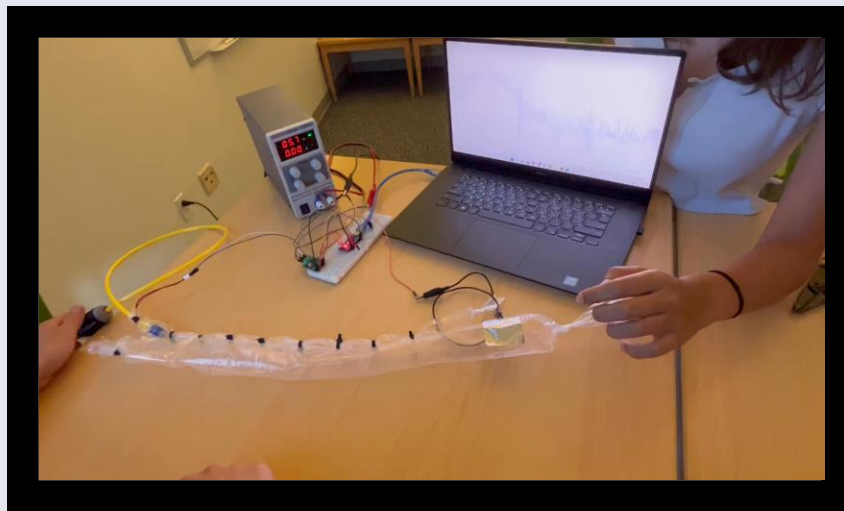
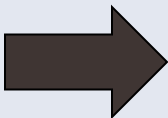
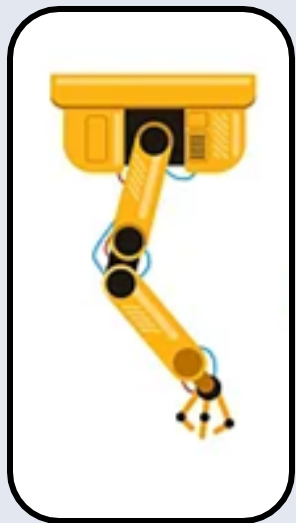




# Soft muscle contracts most at 2 inch spacing



# Next steps include building a soft robot



# Acknowledgments

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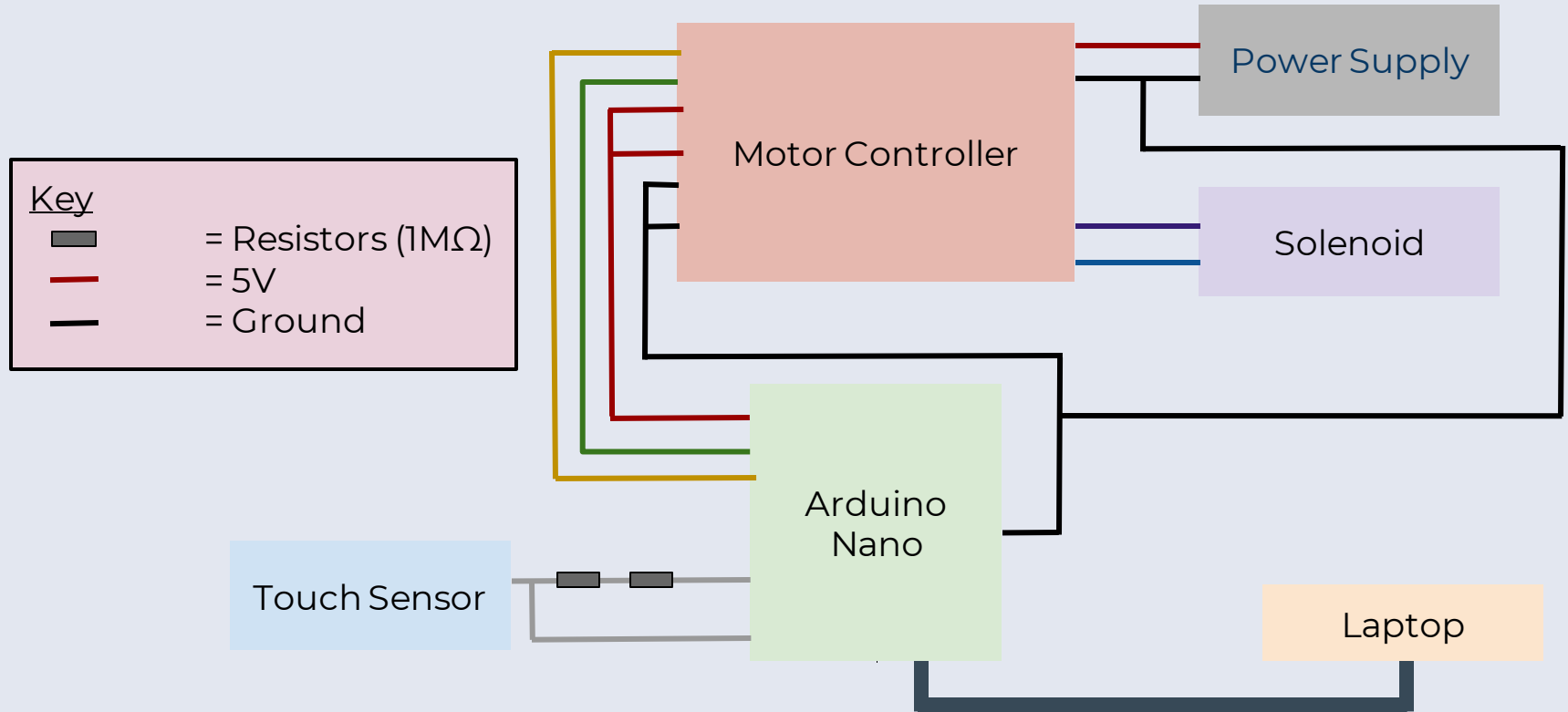
Steven Gomez



# SIMS



# Electronics Layout (Simplified)



# Length/Contraction Ratio

$\gamma$  Length ratio  
 $\frac{1}{b}$

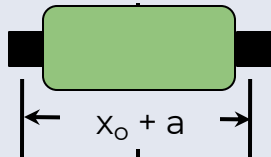
$x_o$  Gap size

$w_o$  Width of tube

$a$  Zip tie length

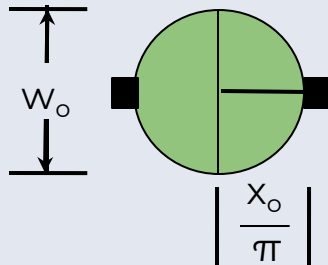
$x_o + a$  Initial length

$\frac{2x_o}{\pi}$  2(Radius)



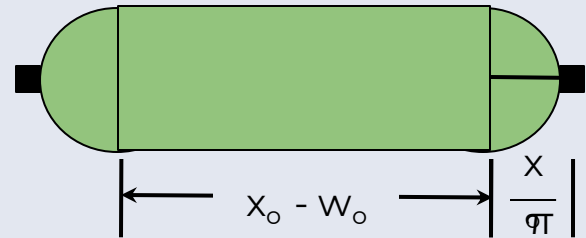
Spaghetti and Meatball Regime:

$$\gamma = \frac{\frac{2x_o}{\pi} + a}{x_o + a}$$



Sausage Regime:

$$\gamma = \frac{x_o - w_o + \frac{2x_o}{\pi} + a}{x_o + a}$$



# Radius in relation to length ratio

$$R = \frac{d}{(1 - \gamma)}$$

R      Radius  
 $\gamma$       Length ratio  
d      distance between inner and outer radius

