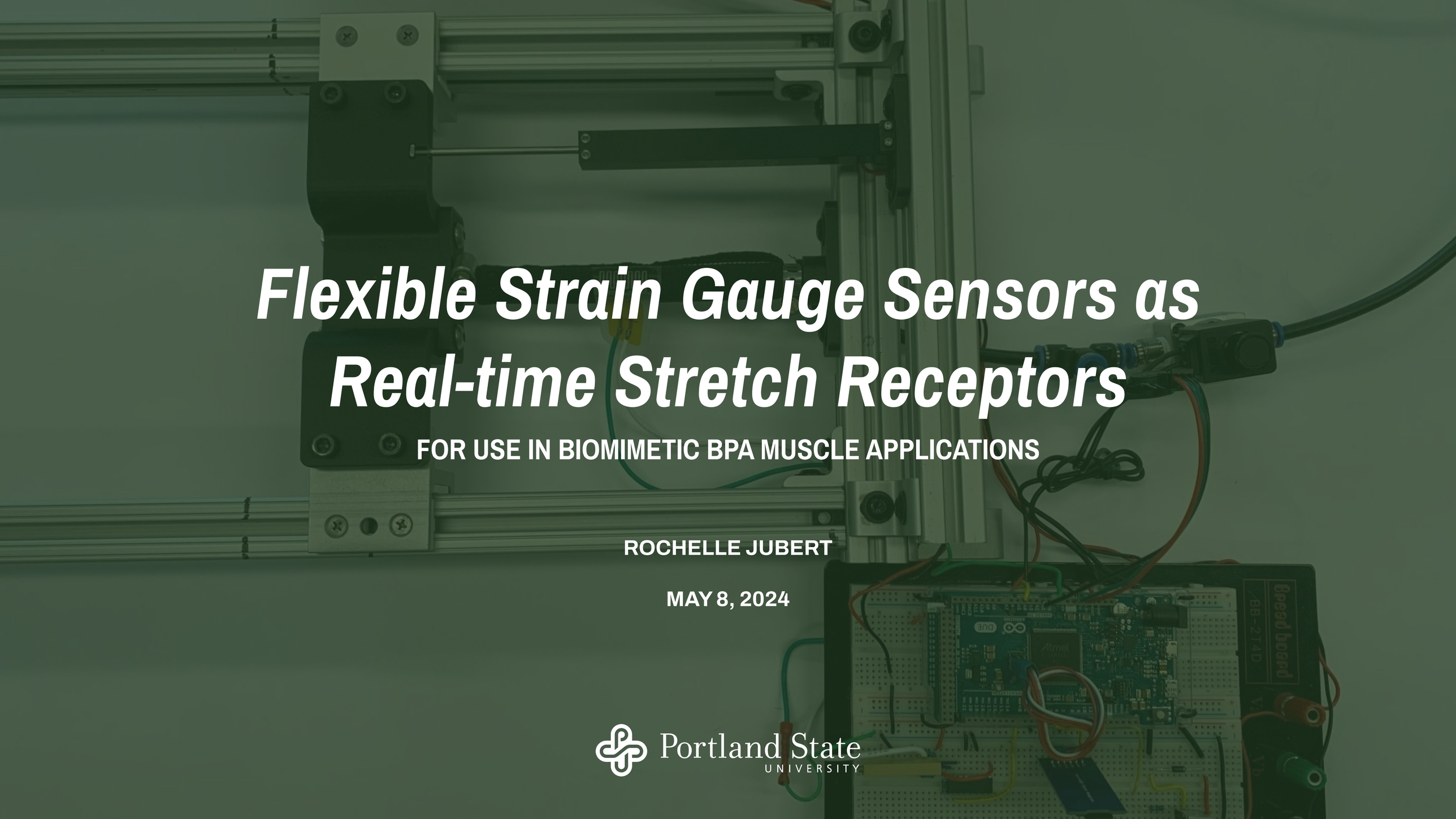
May 8th, 1:00 PM - 3:00 PM

Flexible Strain Gauge Sensors as Real-Time Stretch Receptors For Use in Biomimetic BPA Muscle Applications

Rochelle Jubert
Portland State University



Flexible Strain Gauge Sensors as Real-time Stretch Receptors

FOR USE IN BIOMIMETIC BPA MUSCLE APPLICATIONS

ROCHELLE JUBERT

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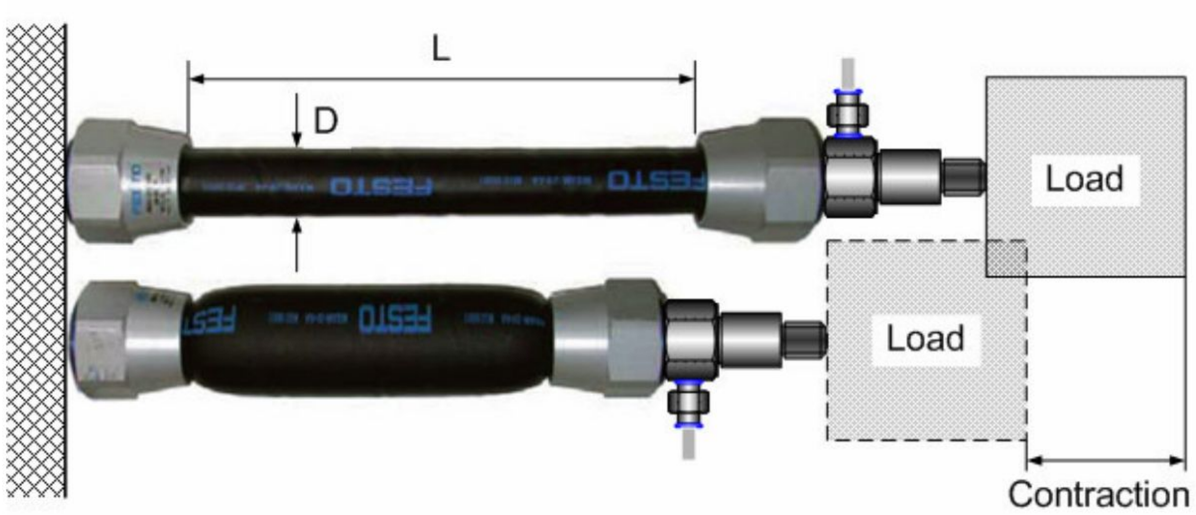
BPAs as Artificial Muscles

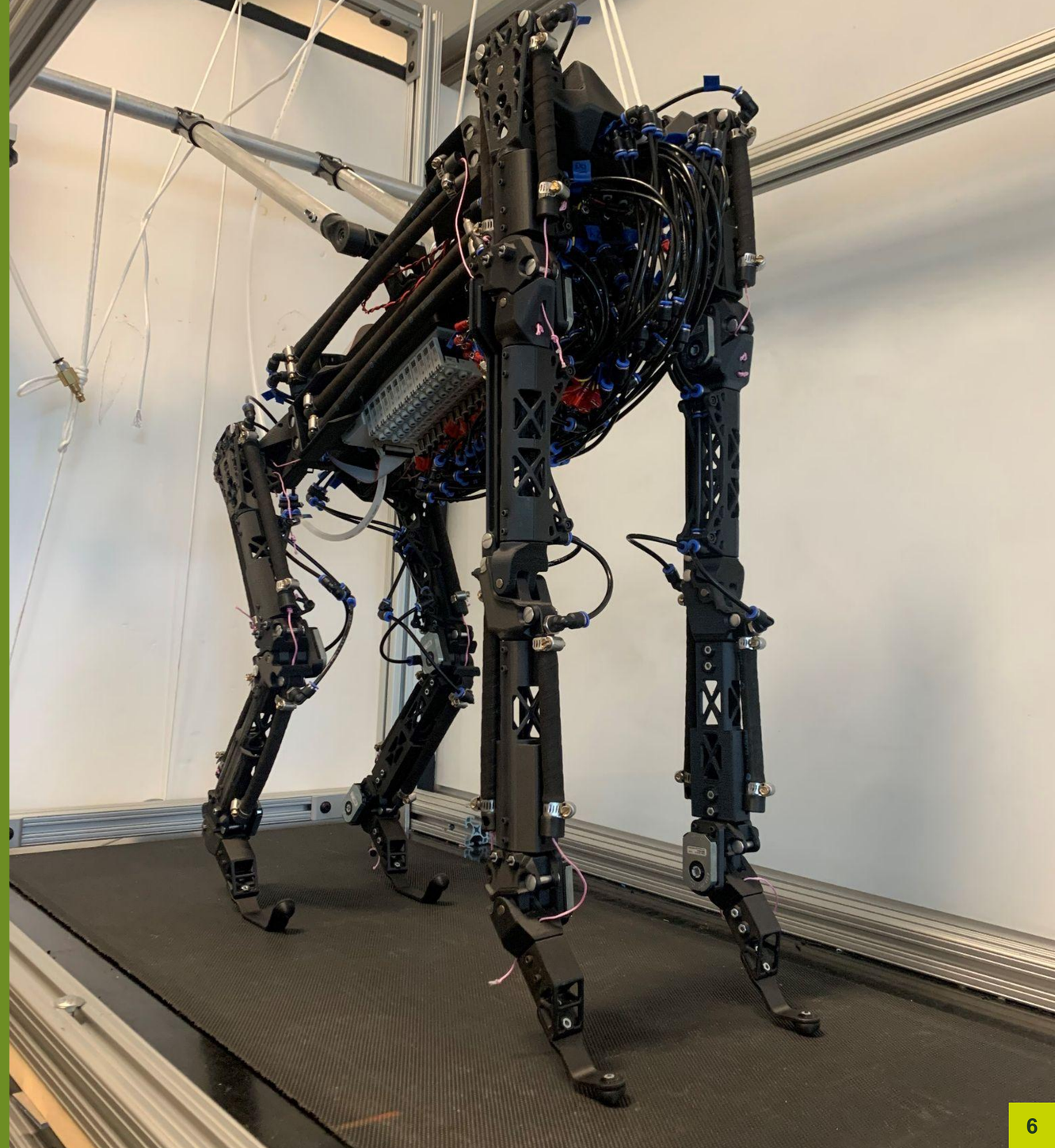
Here are your muscles...

...and here are Braided Pneumatic Actuators (BPAs)



BPAs can be used as artificial muscles in soft robotics

In the Agile and Adaptive Robotics Lab, we use BPAs to move our robot: Muscle Mutt.



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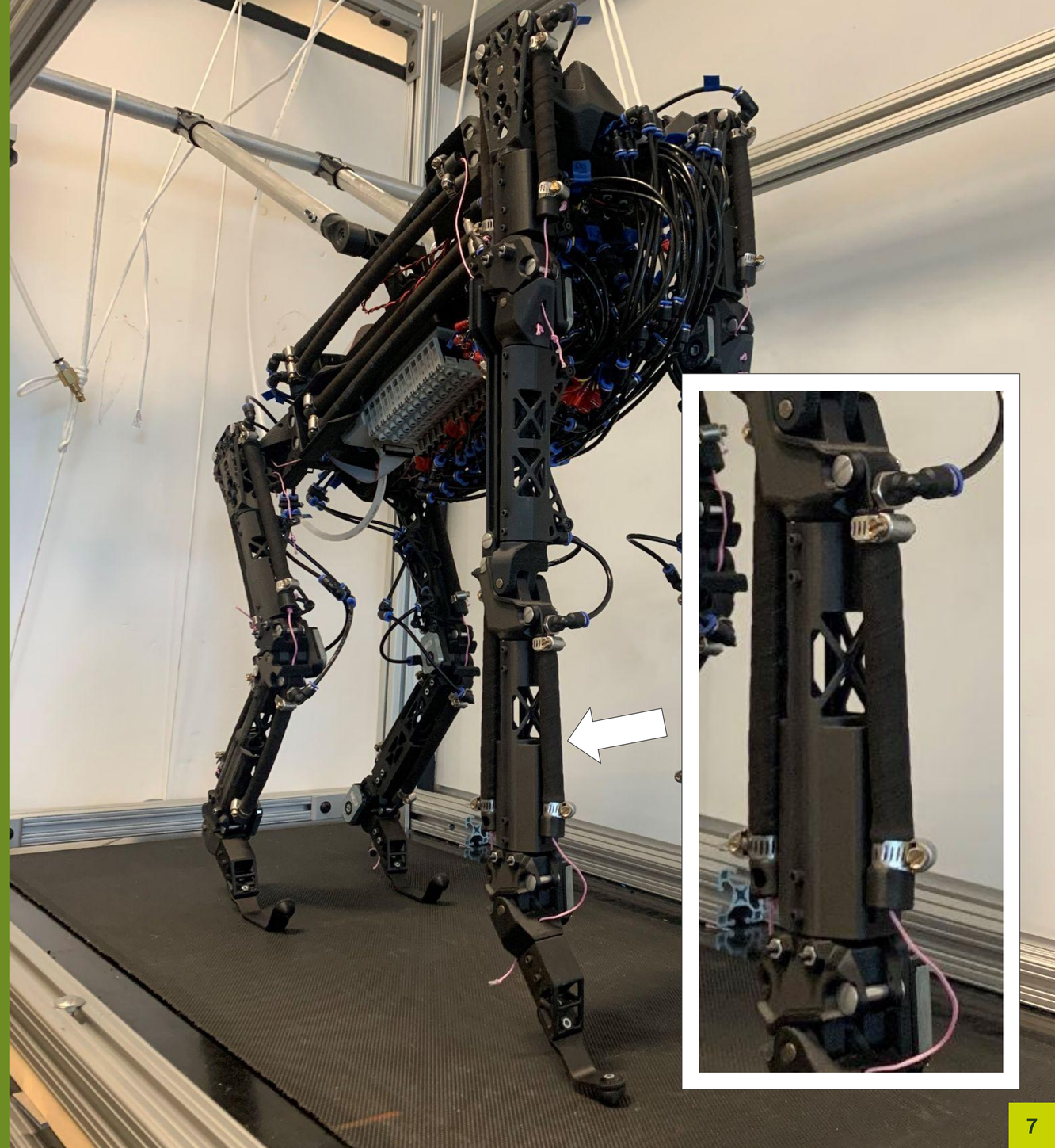
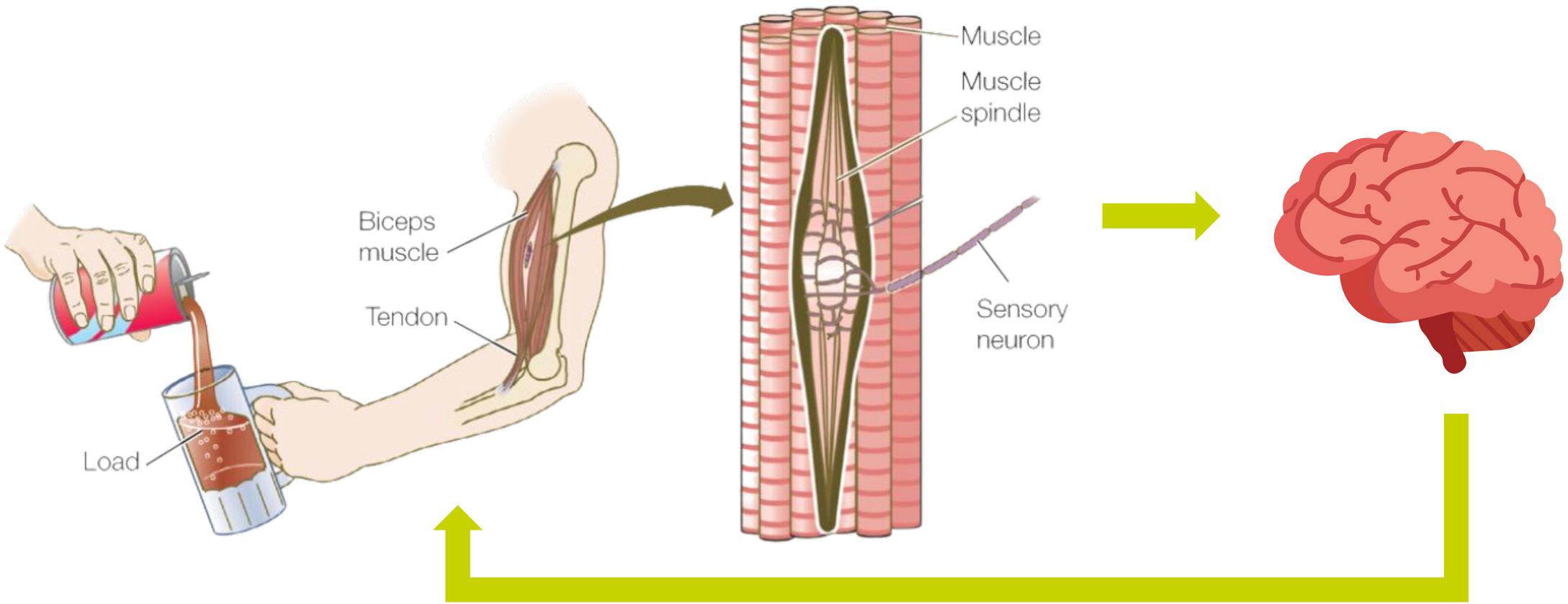
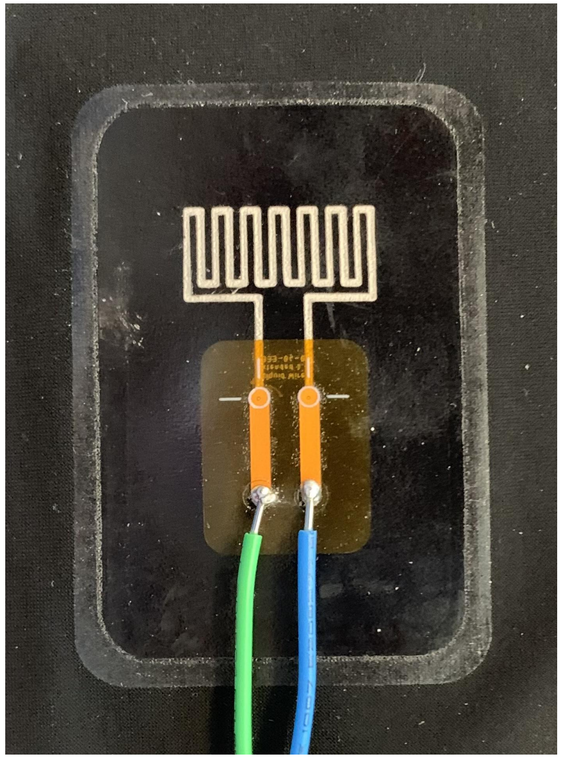


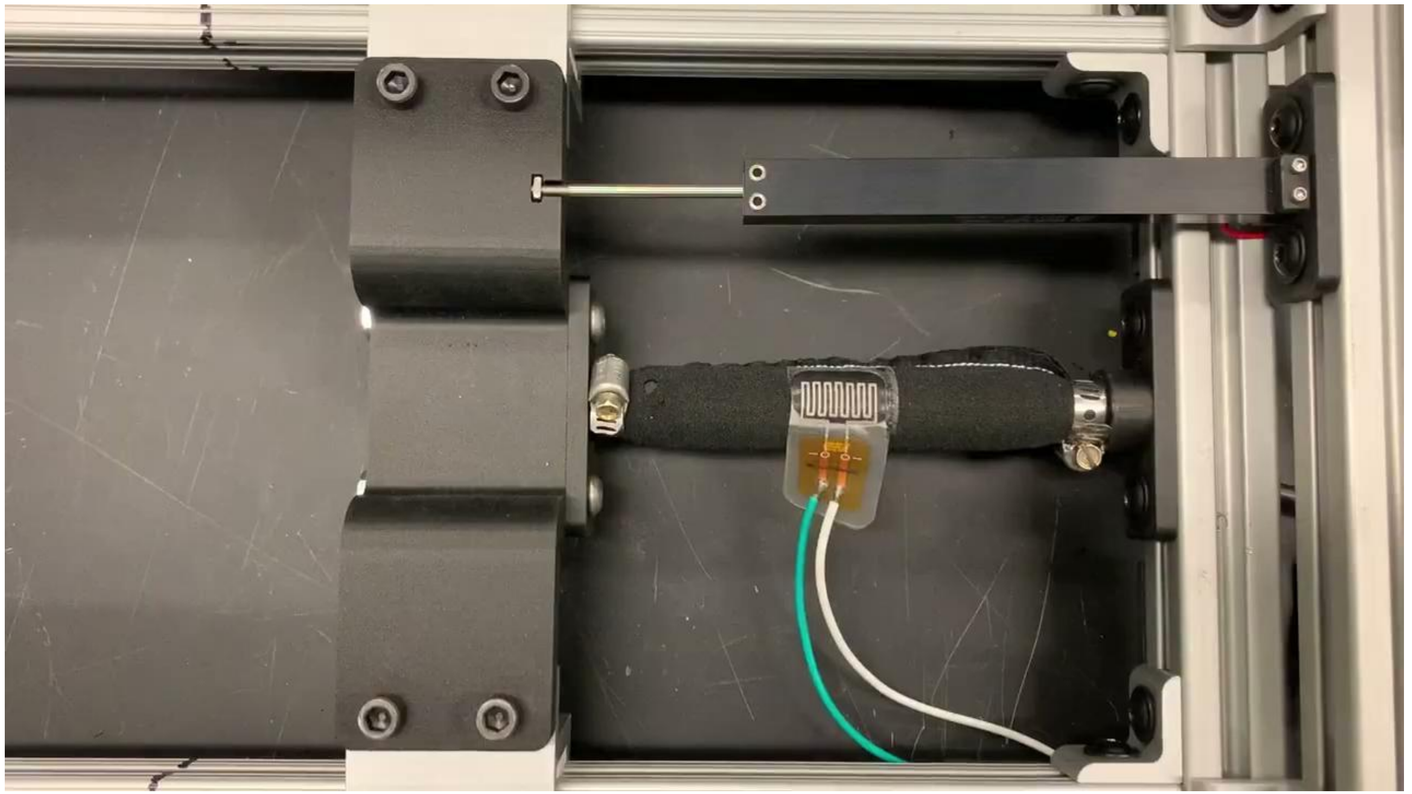
Strain Gauges as Stretch Receptors

When muscle spindles are stretched, sensory neurons transmit length information to the brain to make automatic adjustments and coordinate movement.

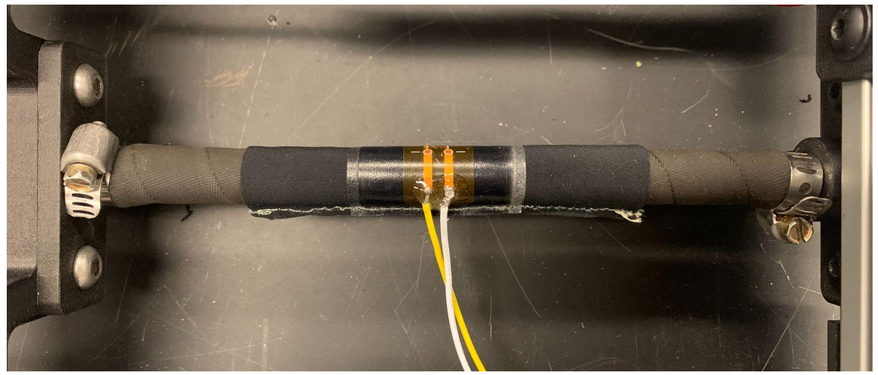


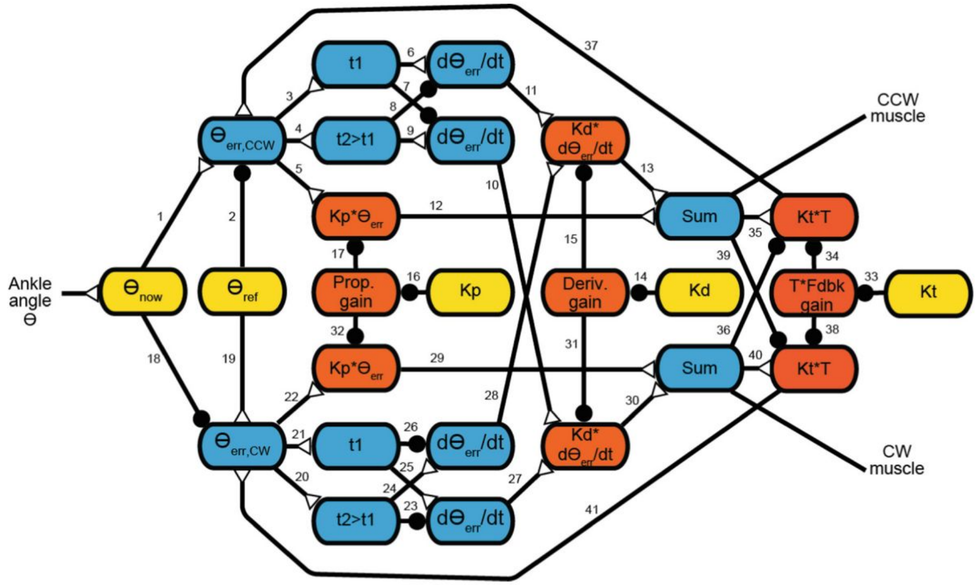
Strain gauges sense a change in electrical resistance. When mounted onto BPAs, they mimic the function of sensory neurons and can be used to measure real-time BPA length.





These real time length measurements can be relayed to the robot's brain to make those same automatic adjustments and coordinate movement.

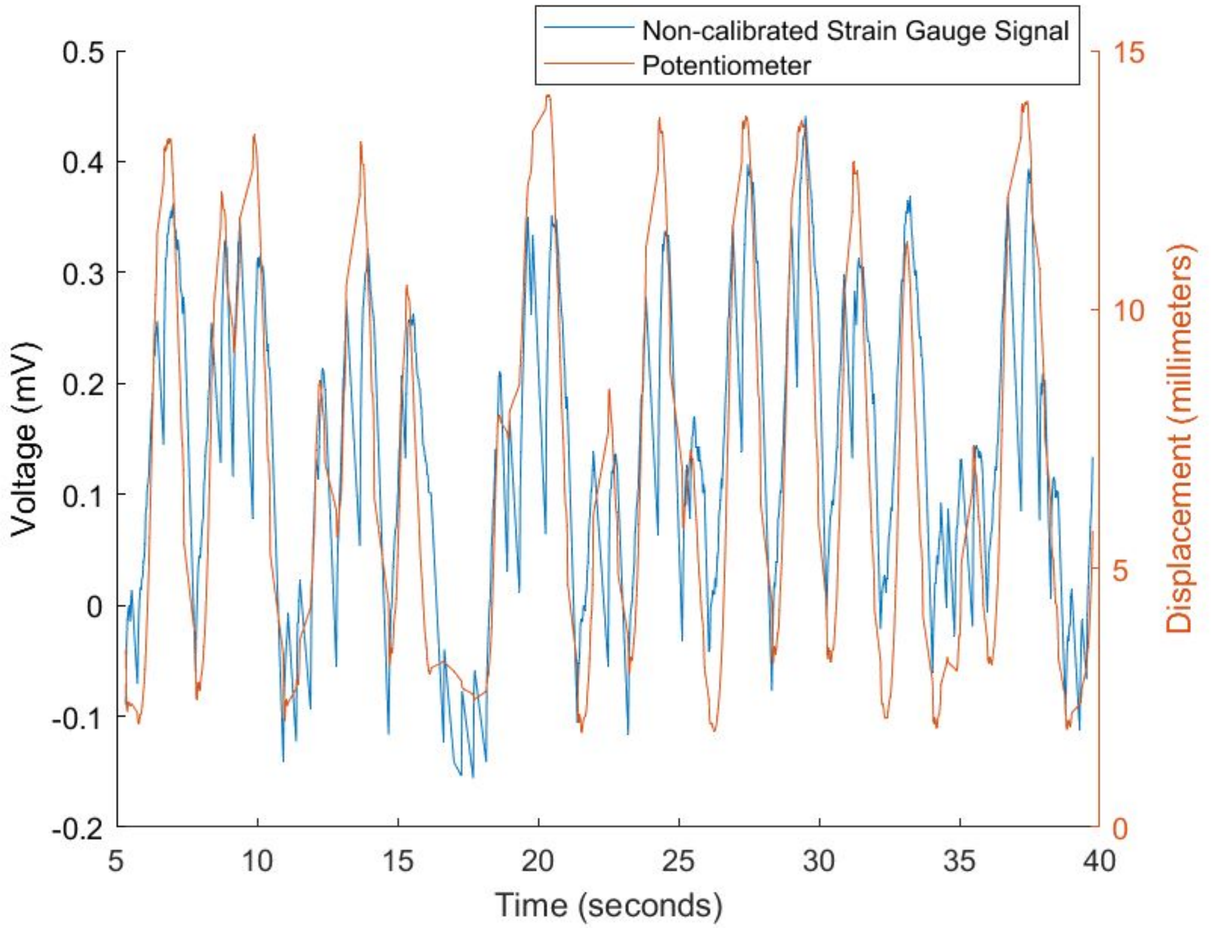




Calibrating Strain Gauges

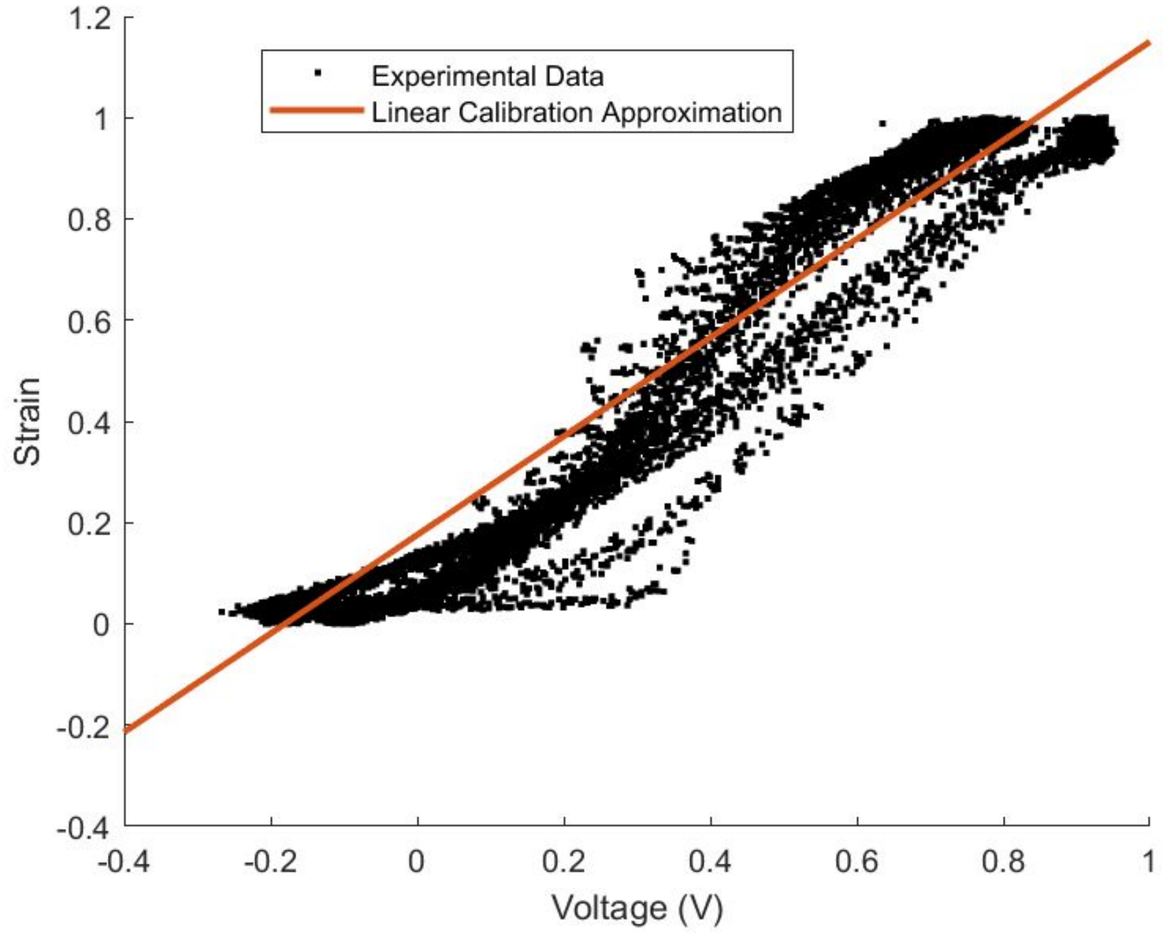
The problem?

Strain gauges can be noisy and difficult to calibrate in soft robotic applications.



The problem?

Strain gauge calibration is affected by hysteresis and strain rate.



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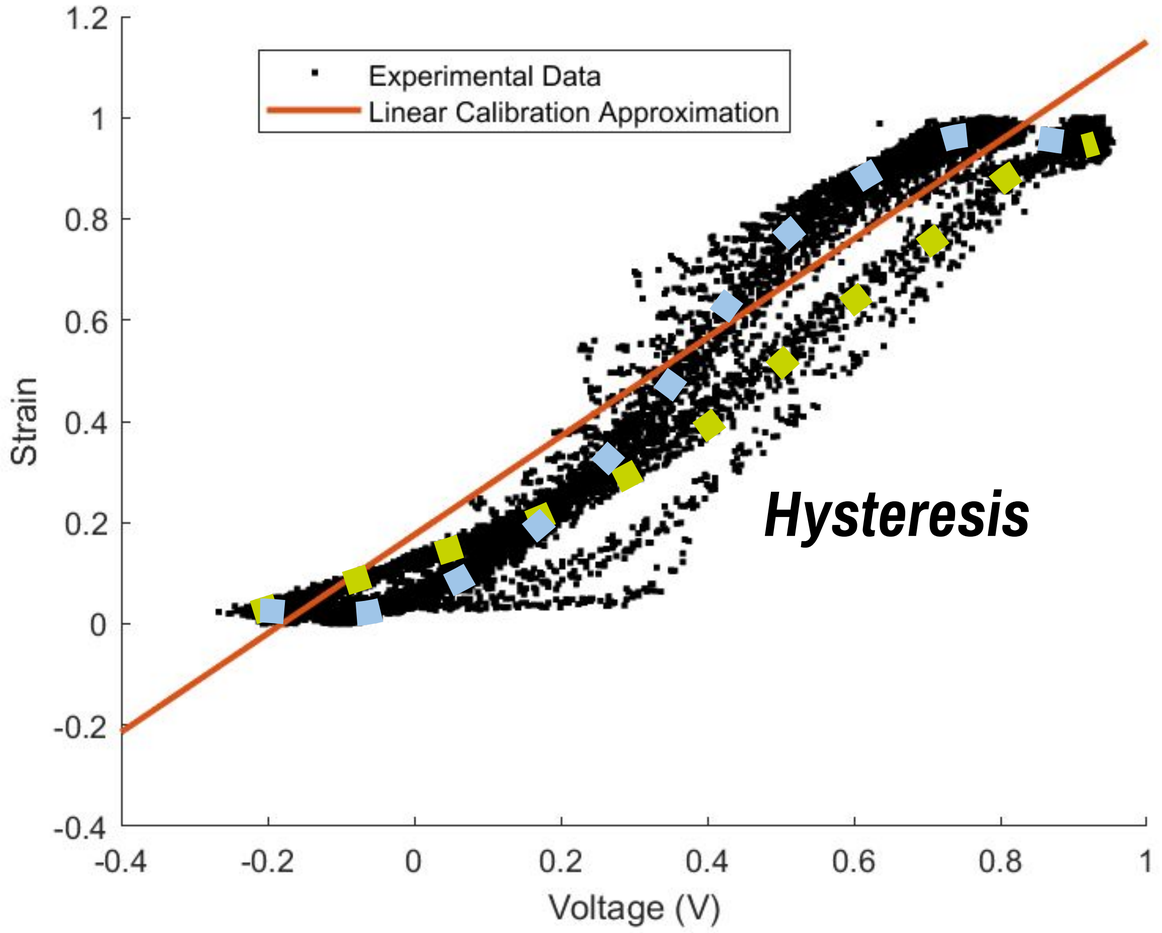

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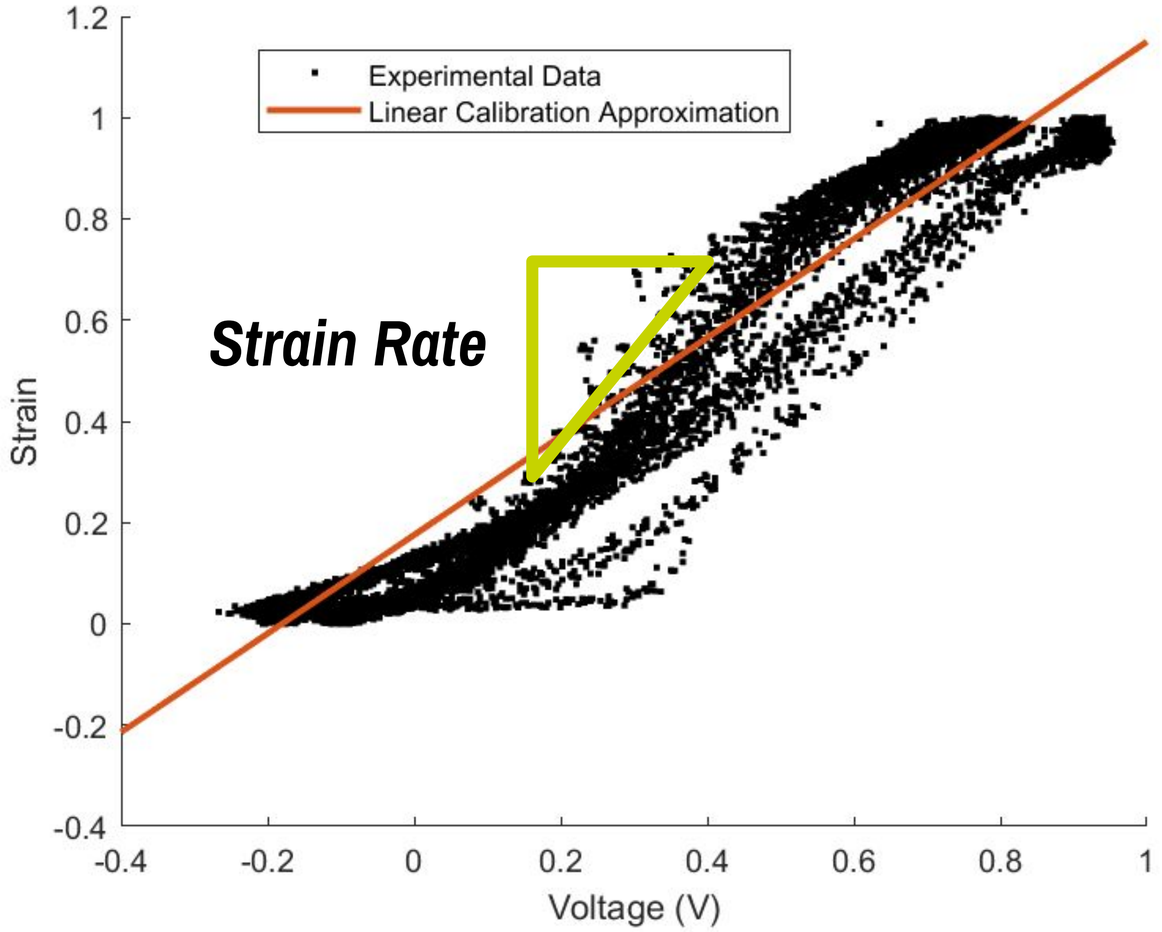
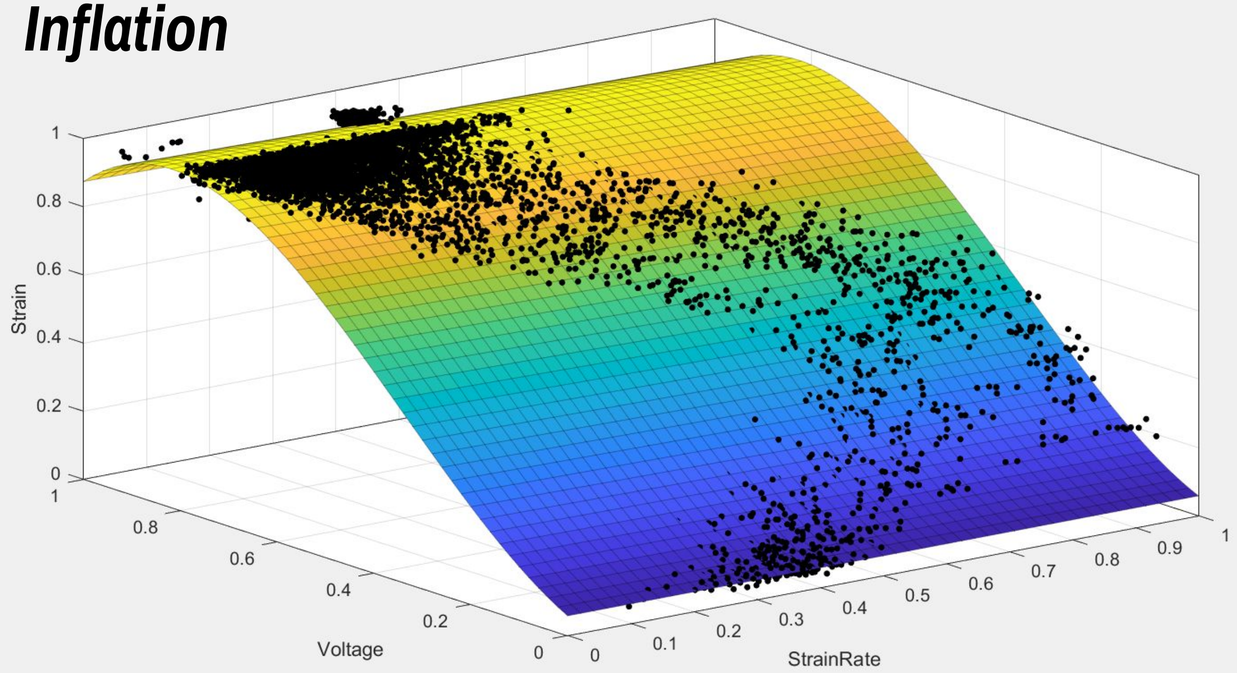


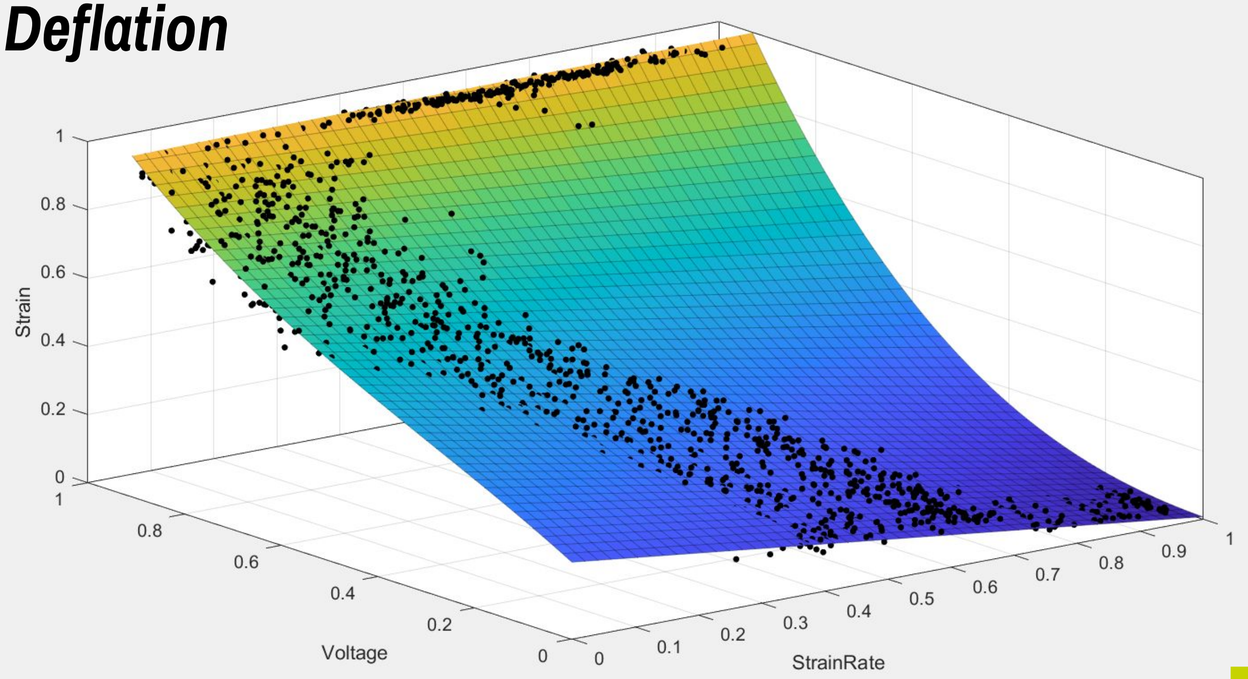
A solution?

Use 3-dimensional calibration that accounts for inflation/deflation and strain rate.

Inflation



Deflation

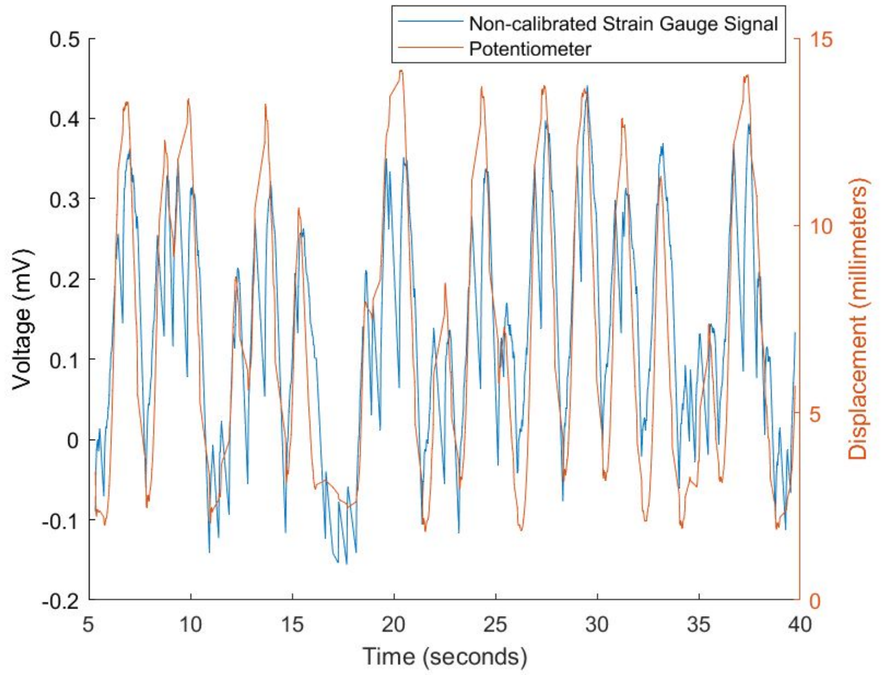


Calibration Results

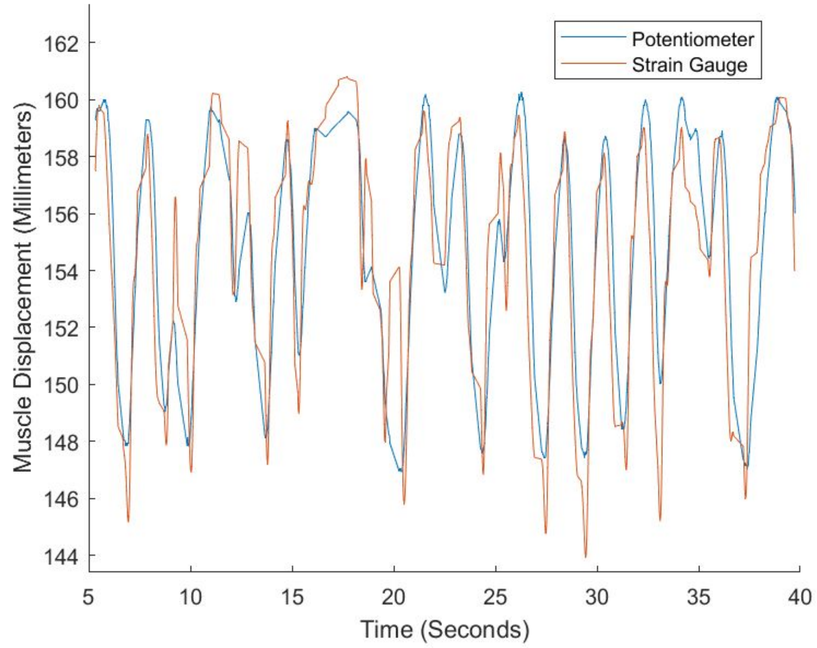
Original average error was 14.10%.

3D calibration resulted in an average error of 10.95%.

Original



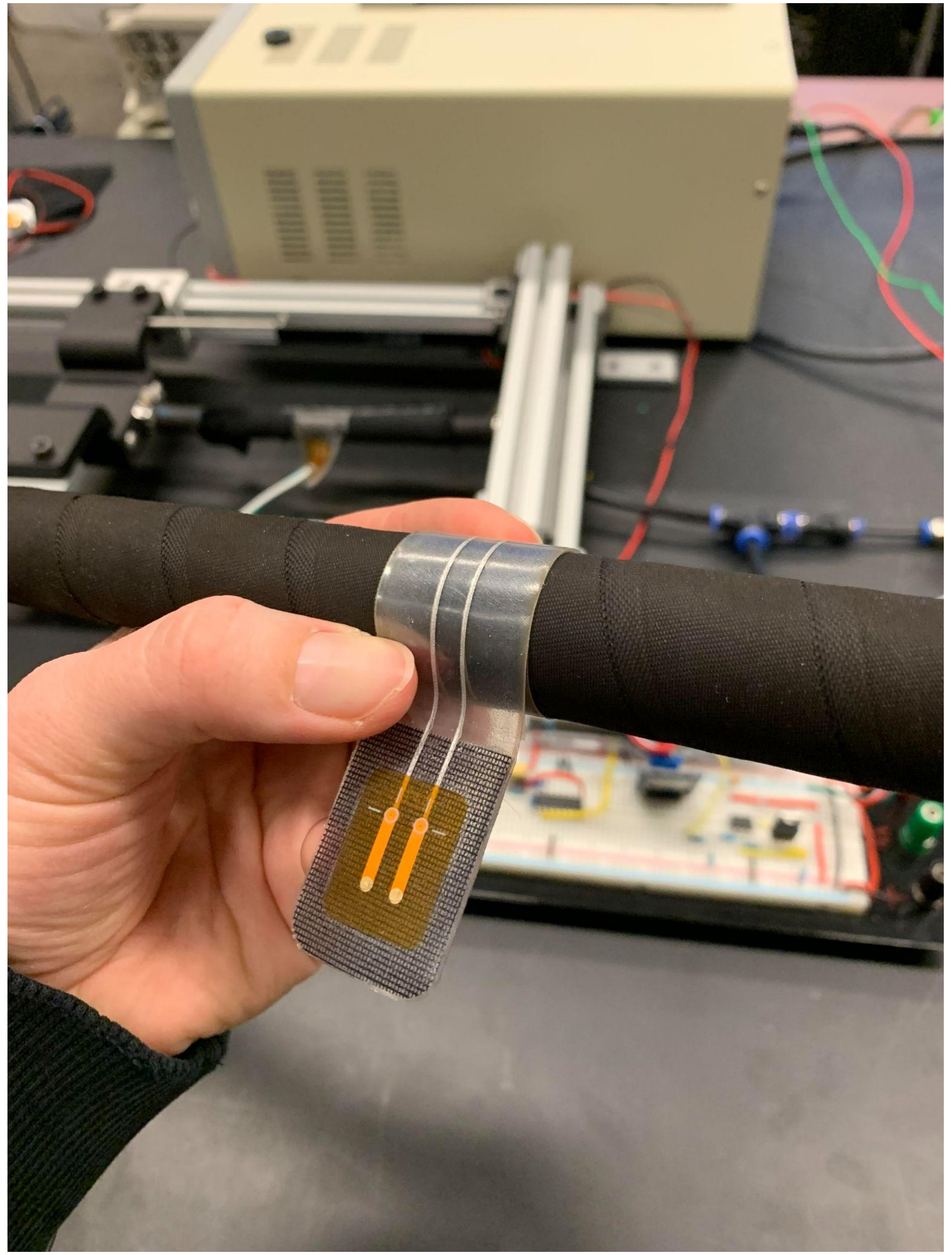
Calibrated



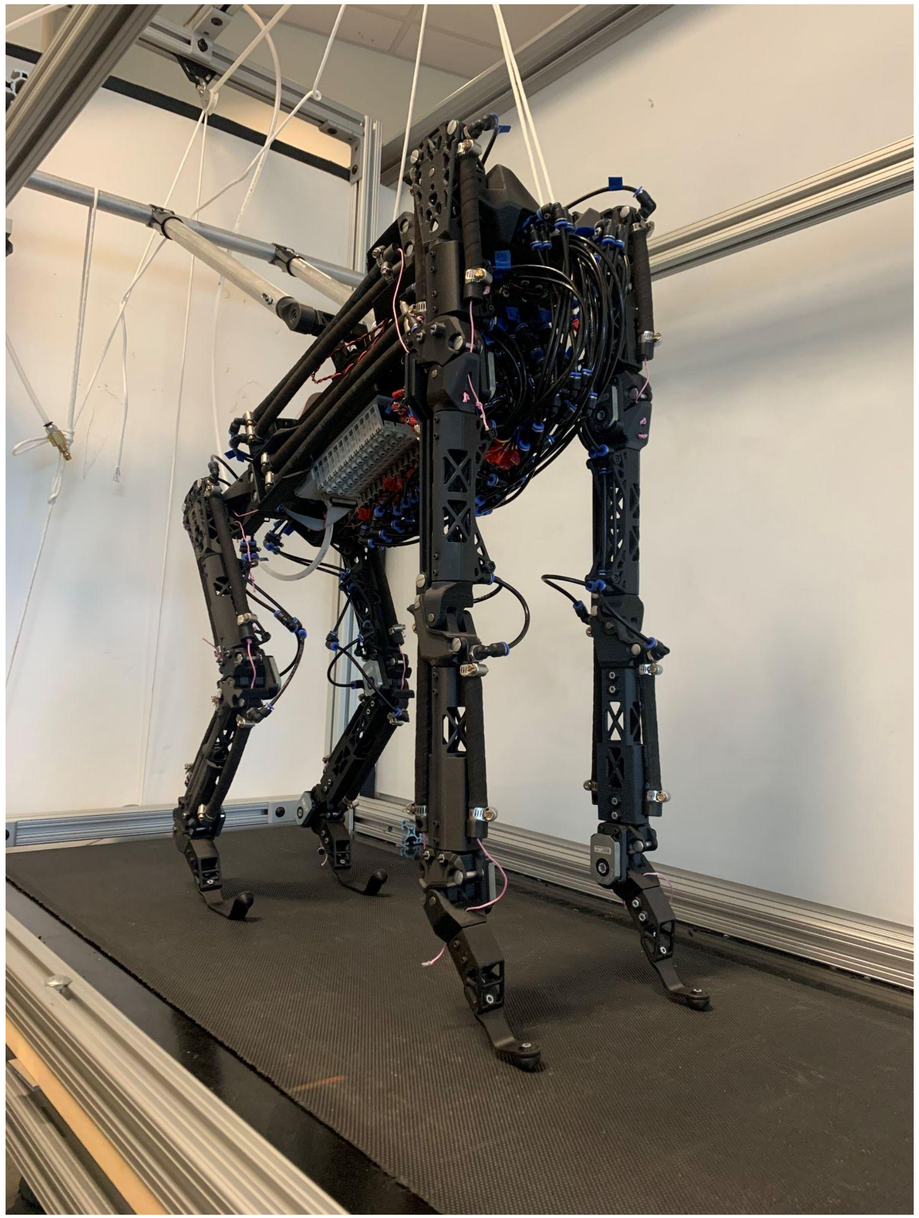
Conclusions and Future Research

Hysteresis and strain rate do impact calibration.

New methods of applying sensors and calibrating could yield less error.



Ultimately, using flexible strain gauges to mimic sensory neurons is a viable and biomimetic method for capturing real-time BPA length measurements.



Questions?

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Figure 34.14. (n.d.). https://www.macmillanhighered.com/BrainHoney/Resource/6716/digital_first_content/trunk/test/hillis2e/asset/img_ch34/c34_fig14.html

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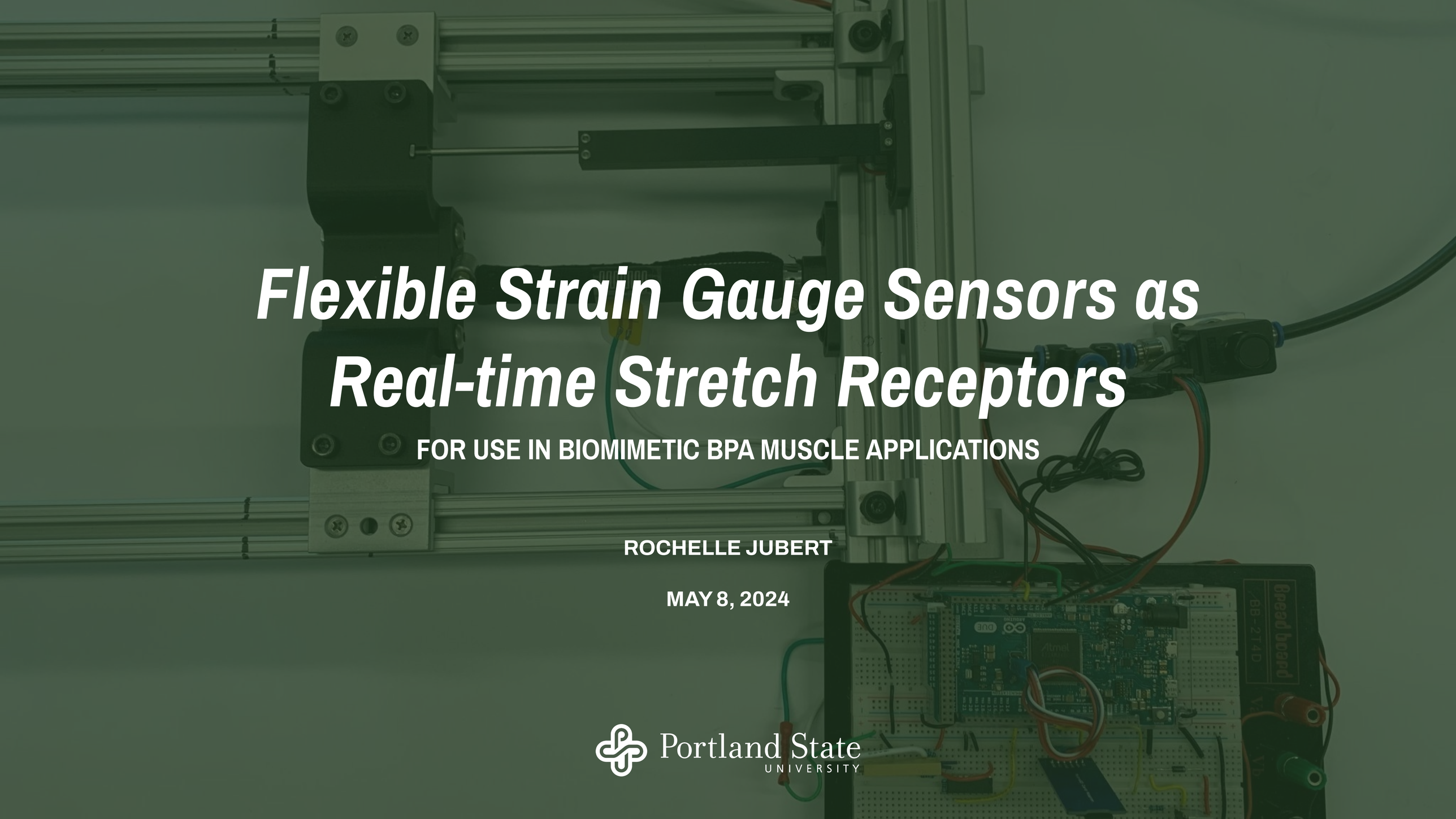

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