Use of Octopus-Arm Muscle for Engineering a Bioinspired Soft Robotic Arm

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RESEARCH QUESTION

What muscle groups – axial, right, left, aboral, oral, or transverse – are active in each of the eight octopuses' arms during extension, contraction, bending or torsion movements?

ABSTRACT

Soft robotics incorporates physically flexible bodies and electronics into robots to achieve organic movements for carrying out tasks. The octopus is a soft-bodied animal and bioinspired insights can be gained by studying its muscles. Electromyography (EMG) studies the electrical activity of an octopus arm's muscle response and distinguishes the degree that each muscle is involved in tension, compression, bending, or twisting movements. The characterized muscle activity will guide the design and construction of soft robotics that can mimic this complex and valuable behavior.

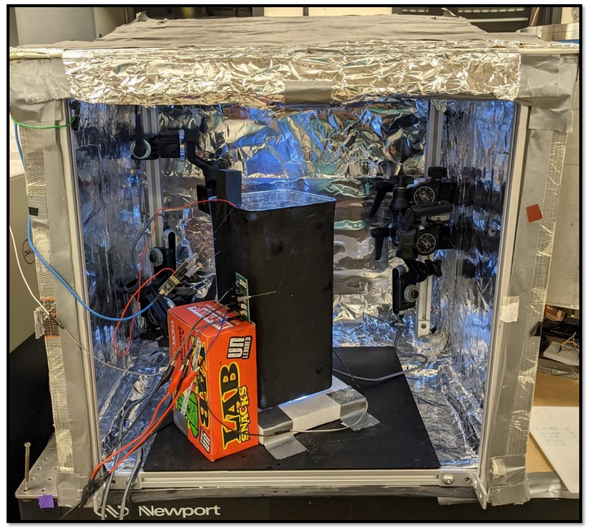
WHY OCTOPUS AND EMG?

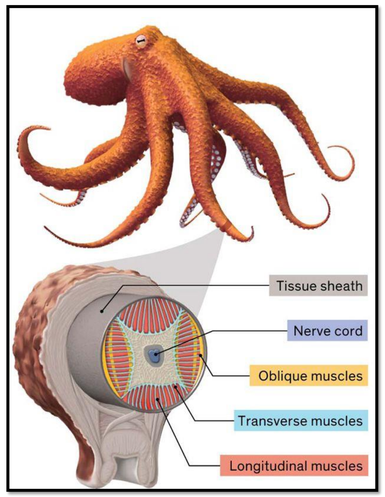
Octopus:

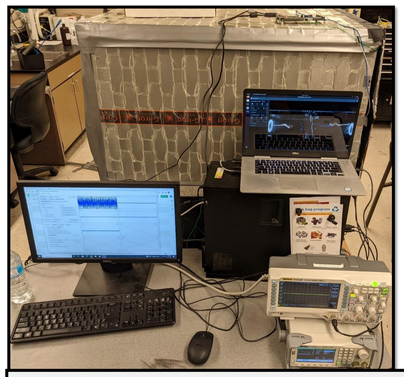
- Soft bodies
- Complex centralized nervous system
- Soft body can radically alter its shape
- Nearly infinite degrees of freedom along length of the arm
- Can extrapolate the learned insights to soft robotics applications

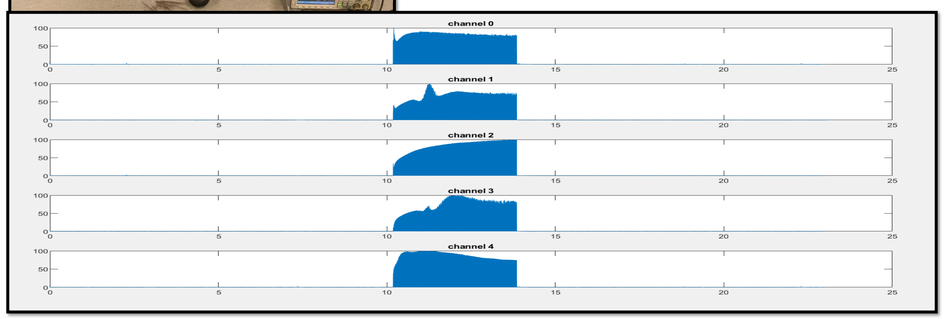
EMG (Electromyography):

- Technique for measuring electrical activity produced by muscles
- Measured signals are analyzed to determine the biomechanics of the animal movements
- Can determine active muscle groups for each movement type



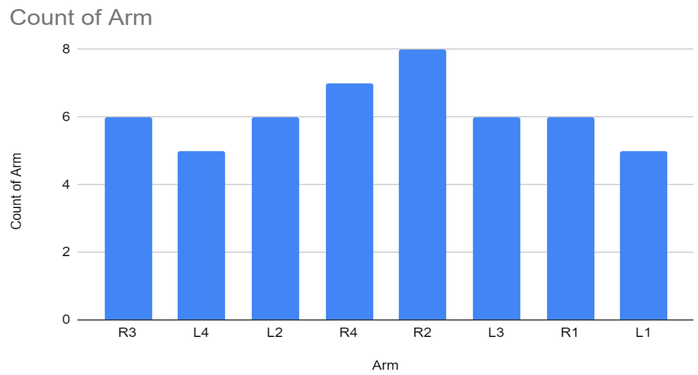






RESULTS

- Experimented on 12 animals, including 7 male and 5 female octopus'
- Conducted a total of 1130 trials.
- Experimented with 49 arms (distribution as seen in the chart below)



- The signal is processed in MATLAB and the EMG and Background are calculated as:

$$\text{EMG: } \int V \, dt_{emg}$$

$$\text{Background: } \int V \, dt_{background}$$

$$t_{emg} = t_{background}$$

- The project is currently in the stage of data analysis.

ACKNOLEDGEMENTS

This research was made possible with the support and guidance from my mentor Dr. Marvi.
Special thanks to Hosain Bagheri, Salaheddin Ahmadi & Benjamin Bethke from the BIRTH Lab.

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