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Somatosensory Stimulation Apparatus for Rodent Cages

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Overview

- Problem Statement

- Background

- Design Specifications

- Preliminary Designs

- Design Matrix

- Competing Designs

- Future Work

Problem Statement

Doctors studying neural regeneration are looking for a hindlimb stimulator for rats having undergone surgical nerve repair.

The doctors are looking for a way to assess the effectiveness of various treatment options.

Image courtesy of Royal Oakes.

Background

- Neural regeneration in adult mammals in the CNS is extremely limited [1].

- Long distance axon regeneration in adult mammals is possible in the PNS [1].

- There is a lot of variability in the damage level and recovery results from case to case.

Product Design Specifications

DESIGN MUST

- Fit on a laboratory bench.
- Stimulate rodents' hindlimbs using vibration that:
  - Stimulates only one leg
  - Has controllable frequency
  - Does not injure rodents
- Computer controlled
- Hold one rodent at a time
- Waterproof and easily sanitizable

Current Design Issues

- What is the desirable frequency range of the vibration

- How to control the frequency of the vibration

- Which motors can create a desirable vibration

- How to integrate the vibrational platform with a motor in the cage

- Isolate vibrations between legs

Linear Actuator

- Produces a simple linear motion using a rod and screw

- Would utilize a delay in the code to create the vibration

- Largest in size

Cell Phone Micro Vibration Motor

- Produces a vibration through the spin of a head with unbalanced weight

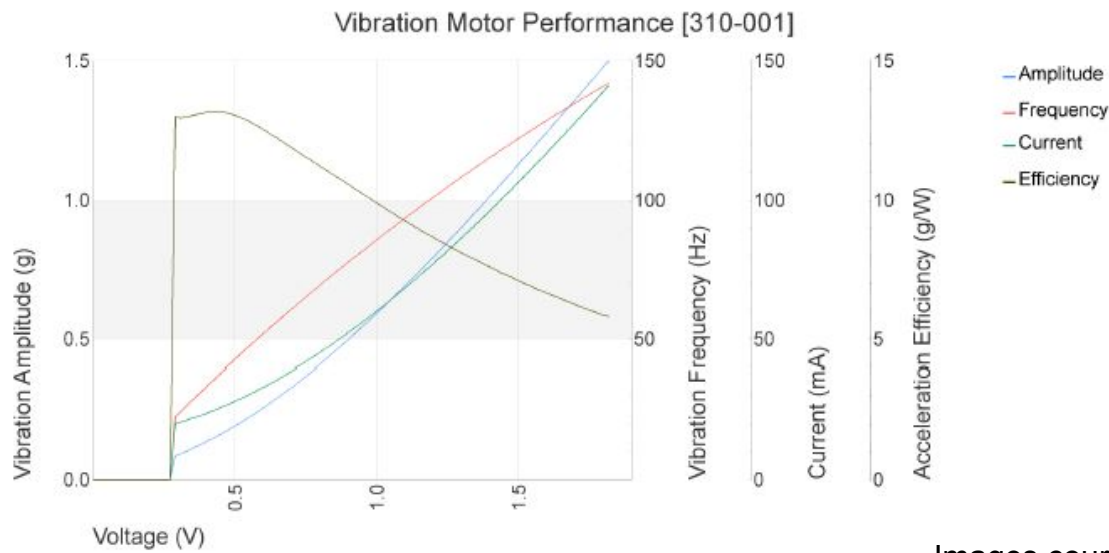- Can only work with fixed frequency, 3 motors are needed to control frequency

- Cheap

Micro Vibration Motor for Cell Phone. Retrieved from https://www.amazon.com/ [4]

Precision Vibration Motor

- Produces circular rotation

- Known frequency output to voltage input

Vibration Motor Performance [310-001]

Images courtesy of https://www.precisionmicrodrives.com/ [5]

Design Matrix

| Criteria	(Weight)	Linear Actuator		Micro Vibration Motor		Precision Vibration Motor	
Segregation of stimulation	25	5/5	25	4/5	20	4/5	20
Frequency range	20	3/5	12	3/5	12	5/5	20
Ease of integration	15	3/5	9	2/5	6	3/5	9
Size	15	3/5	9	4/5	12	5/5	15
Ease of acchieving desired effect	5	5/5	5	3/5	3	4/5	4
Cost	5	3/5	3	5/5	5	4/5	4
Total	85		63		58		72

Solidworks Model

45 cm

5 cm
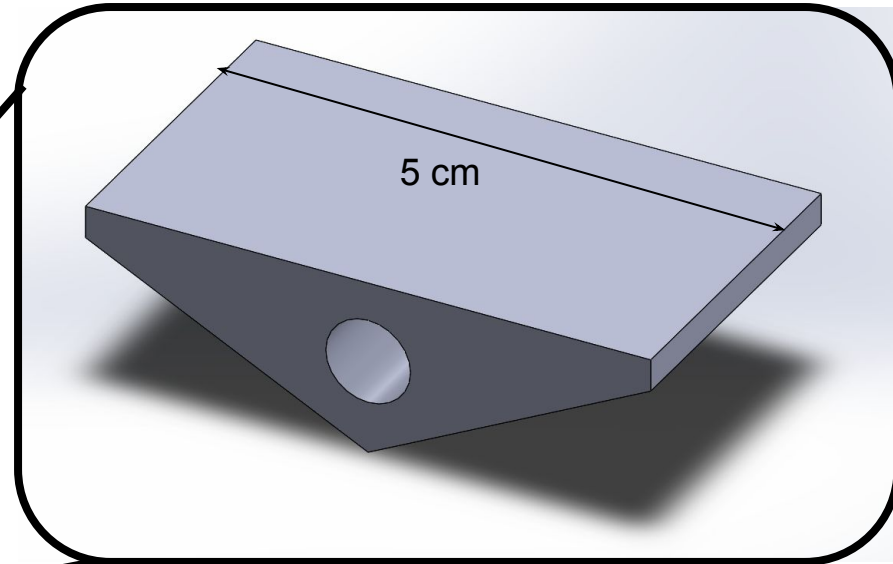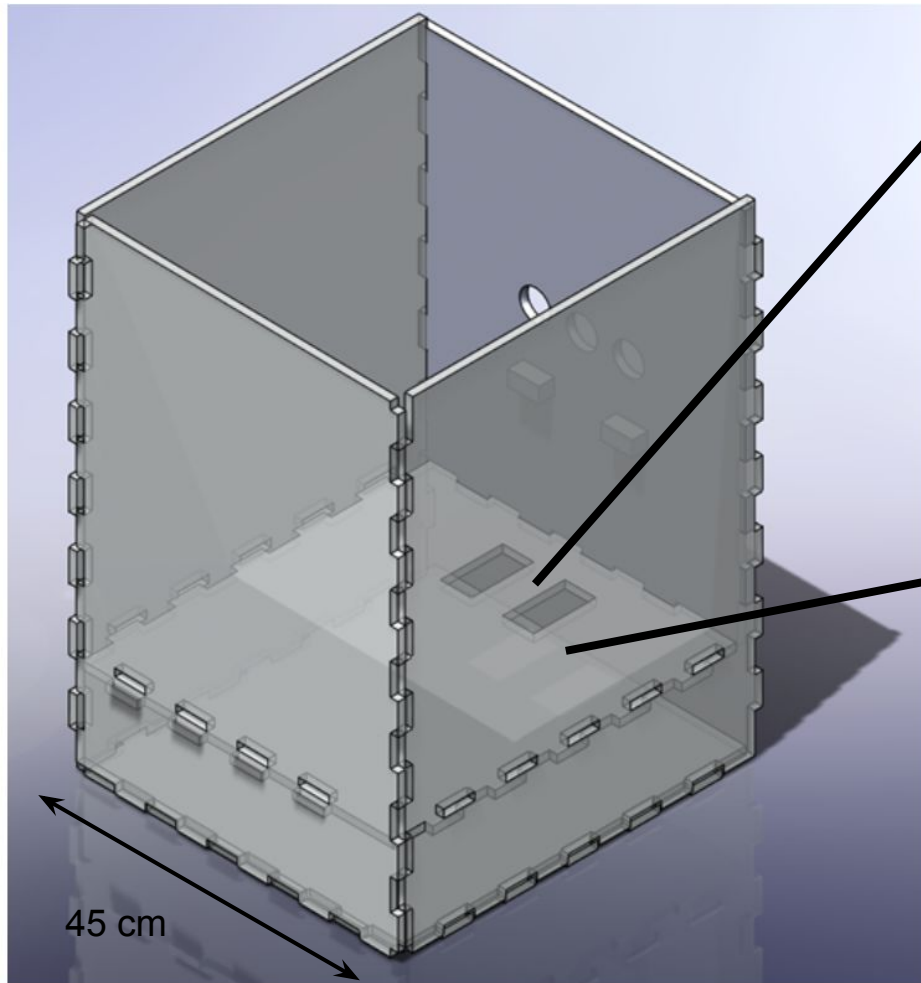
Competing Designs

Passive Avoidance Cages
- It has a dark room and a white room.
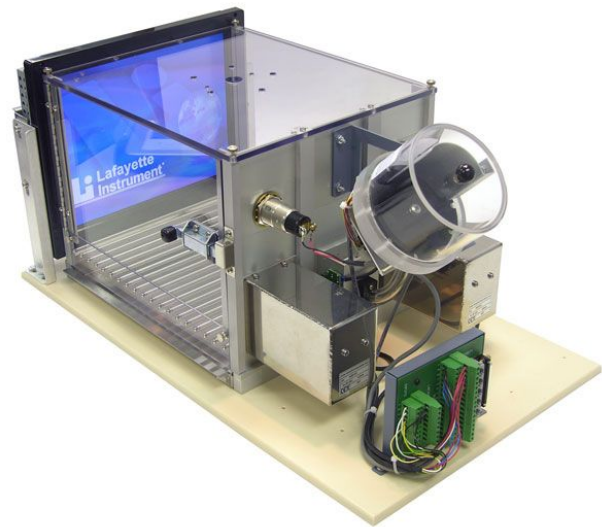
Rat Touch Screen Chamber
- Enclosure for rats with a touch screen to interact with.

Both will be used to determine desirable sizes for the cage in the hindlimb experiment.

Future Work

- Circuit and code design
- Cage design
  - Sanitizable
  - Waterproof
  - How to make the rodent stay at desirable position
- Vibrational platform design, dependent on motor
  - Size and material
  - Waterproof

Acknowledgements

- Special Thanks To:

•Aaron Dingle, PhD[1]

•Aaron Suminski, PhD[2]

•Jeremy Rogers, PhD[2]

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[5]   Precision Microdrives, "5mm Vibration Motor - 8mm Type - Precision Microdrives," 2018. [Online]. Available: https://www.precisionmicrodrives.com/product/304-109-5mm-vibration-motor-8mm-type. [Accessed: 04-Oct-2018].

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Questions?

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