Ankle Tracking Device
Collapsible Skateboard
Disc Packaging
Smart Gasket
Ankle Tracking Device
Assessment of Fine Motor Control at the Ankle

OBJECTIVE
Design an affordable, portable system that can be used to quantify outcomes of a lower limb mirror therapy program for people with stroke.
1. Portable and easy to use - Task will be directed at remote sites by staff with varying amounts of familiarity with the protocol.
2. Affordable - Pilot study
3. Adjustable - Multiple participants, both legs
4. Precise - Ability to sense small movements in a population that may have as little as 5 degrees active range of motion in the ankle.
HARDWARE

Leg Stand

- Adjustable...
- ...angle
- ...height
- ...size (Velcro straps)

Ankle Tracking Boot

- Modified AFO
- Goniometer
- Linear taper potentiometer

SOFTWARE

- Arduino
- Processing
- MATLAB

Preintervention Assessment 1 - Unaffected Limb - Tracking

Accuracy Index: 47.52
IMPLEMENTATION

1. Portable and easy to use - System can be run from a laptop. Three simple components: boot, Arduino, leg stand. Simple calibration process, two keystrokes.
2. Affordable - off-the-shelf hardware, Arduino, and repurposed ankle-foot orthosis.
3. Adjustable - removal of toe box allows device to be used on either leg. Velcro straps allow toes to be strapped down firmly. Leg stand is fully adjustable (height, angle, Velcro straps for different leg sizes).
4. Precise - Data collection at 1000 Hz. Arduino ADC resolution of 10 bits can detect angular movements of less than 1 degree.

ASSESSMENT

1. Reduce AFO hinge resistance: Participants with significant ankle weakness are unable to move the boot.
2. Incorporate other forms of optional feedback (e.g. real-time score, color feedback)

NEXT STEPS

(video)
Collapsible Skateboard
Physics-themed Board That Fits in a Backpack

OBJECTIVE
Design a skateboard that will collapse and fit into a standard backpack.
REQUIREMENTS

1. Portable and easy to use — Quickly collapse into a backpack.
2. Sturdy — Board must be able to withstand forces higher than body weight.

CONCEPTS

Slide Bolts
- Concealed Screw Slide Bolts
- McMaster-Carr #1253A11
- Labeled Dimensions
  - A - 6"
  - B - 7/8"
  - C - 2 1/2"

Thumb Screws

Latches
- Work-Load Rated Multidirection Draw Latches
- McMaster-Carr #6682A33
- Latch Holding Capacity (lbs.)
  - X - 880
  - Y - 880
  - Z - 1,980

Dimensions
- A - 3 15/16"
- B - 1 13/16"

Top View
Bottom View

www.ramihamzey.me
Design Portfolio — Rami Hamzey
**Solution 1: Channel and wing nuts**

Advantages:
1. Sturdy
2. Wing nuts are easily replaceable if they become damaged.

Disadvantages:
1. Complicated disassembly.
2. Too much loose hardware (12 wing nuts, washers, screws)
3. If left attached to one side of the board, the two pieces are too long to fit into the backpack.

**Solution 2: Draw latches**

Advantages:
1. Sturdy
2. Quick to assemble
3. All hardware remains attached to the board.

Disadvantages:
1. Difficult to replace or fix draw latches if they break.
2. More expensive than wing nuts.
Draw latches (Solution 2) are quicker to disassemble and allow the surface of the board to remain flat. (video)

Portable and easy to use - Fits in backpack with space for other gear. (video)

1. The next version will use a flat deck that will allow the addition of hinges. It will be able to fold into a smaller effective volume.

Sturdy - Work load-rated multi-directional draw latches support body weight, bouncing, turning, and kicking. (video)
Packaging Redesign
Evolving Story CD packaging

OBJECTIVE
Redesign the cover art for a music CD.
1. Graphic Design class assignment was to redesign the cover artwork for any music CD.
2. My personal objective was to redesign the packaging to create a more engaging consumer experience.

CONCEPT

2. Style keywords: entrancing, melodious, dreamscape, earworm, robotic versus organic.
   In each track, E*Vax lulls the listener into a comfortable dreamscape that builds complexity while feeling cohesive.
4. Final Goal: Create an evolving story line that grows in its absurdity with every flip of the book. At each turn, the context becomes more elaborate while maintains graphical continuity.
ASSESSMENT

1. This project exceeded the assignment, whose aim was creative rather than technical. If this packaging were mass produced, higher quality materials and manufacturing processes would be required.
“Smart” Gasket Sensor
Piezoresistive polymer gasket
Winning entry, EPIC Design Competition sponsored by Garlock

OBJECTIVE
Develop an industrial grade “smart” gasket with the ability to sense leaks, failures, and blowouts.
1. Design Prompt: Pick from a variety of different Garlock products, learn about the product, and design ways for embedding sensors to monitor performance. Garlock is the global leader in sealing and pipeline protection products for industry and infrastructure.

2. Blowouts and leaks have the potential to put the environment, community, employees, and company at risk. None of Garlock’s products have sensing capabilities, thus failures and rigorous inspections are the only way to know when a gasket is damaged.

CONCEPT

Rather than embedding sensors, take advantage of the materials and processes in Garlock’s manufacturing process. Gasket bulk material could act as a piezoresistive sensor by doping it with the appropriate carbon allotrope.
Silicone polymer with graphene and carbon black. Varying carbon concentrations.

Technical drawing of prototype gasket with one possible electrode geometry. Five layers of piezoresistive carbon. Two layers include electrodes.

ASSESSMENT

Could be implemented in existing production process, but significant development challenges remain:

1. Catering polymer properties to have a functional strain curve over typical application pressures.
2. Higher carbon content leads to more brittle gaskets.
3. Maintaining seal integrity with electrode placement.
4. Determining ideal layout for electrode geometries experimentally.