UCONN SCHOOL OF ENGINEERING
MECHANICAL ENGINEERING
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ME Team 68
Design of an Articulating Ankle for Enhanced Performance

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Sponsor: University of Hartford of Rehabilitation Sciences

Introduction/Motivation

Objective: Design and develop a functioning articulating prosthetic ankle that can be utilized both on land and in subsurface environments for rehabilitation purposes

Scope: Research, design, fabricate, and test an articulating ankle that allows for effective and comfortable use both on land and for SCUBA Diving without adjustment to ankle position when switching environments

Parties of Interest:
- Transtibial amputees
- Ex Military & Veterans

Metrics:
- Ankle range of motion
- Recovery & Down stroke

Critical Design Features:
- Obtaining "ideal" ankle range of motion
  - 65 degrees from the vertical
- Limit Energy Exertion
- Weather and water resistant

Design/Methodology

VS.

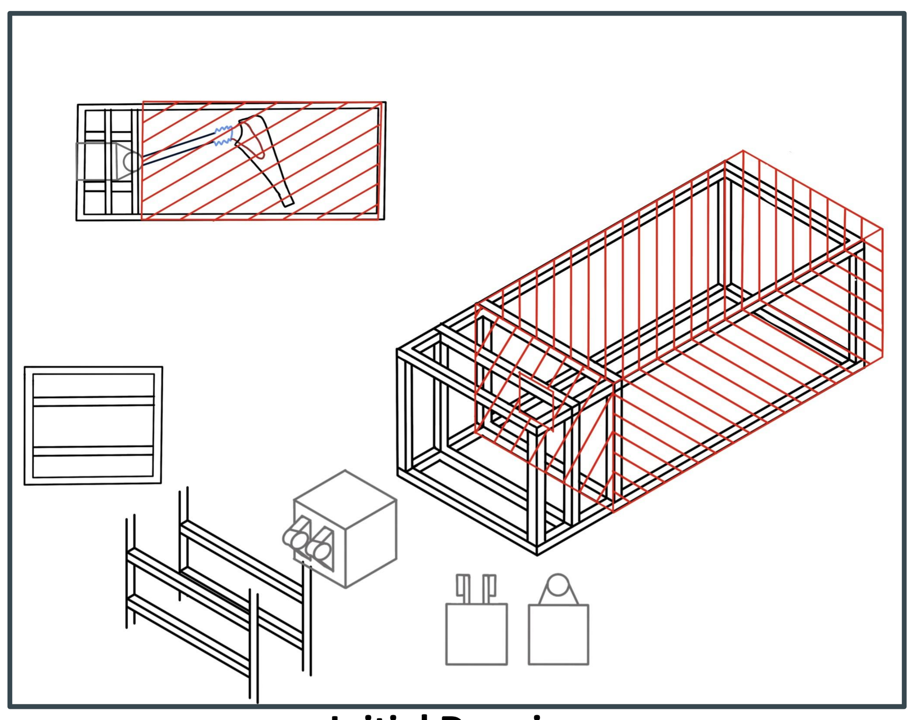
- Goal: Create a device that allows for a balanced stroke while not locked in a fixed position
  - Prosthetic ankle produces similar stroke as able ankle - focus on recovery & down stroke
- Inspirational Research
  - Rampro "Swimankle"
  - Nakashima Design
  - Human Anatomy

Rampro "Swimankle"

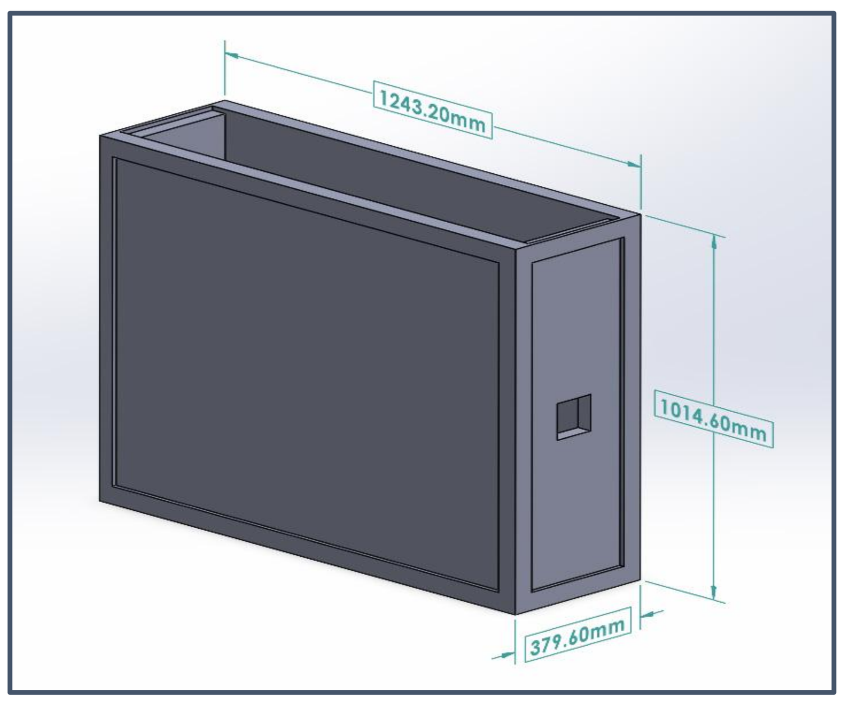
Test Rig Setup

Motor Set Up:
- 1800 rpm motor
- Gear box of 40:1 ratio
  - Allowed for 45 kicks per minute
- Motor stand to fit over the tank
  - 80/20 stand
- Arm configuration
  - 2 aluminum pieces - 508 mm
  - 1 wooden piece - 1219.2 mm
  - 1 aluminum piece - 482.6 mm
    - Key cut out for motor attachment
    - Hole location for wooden arm connection

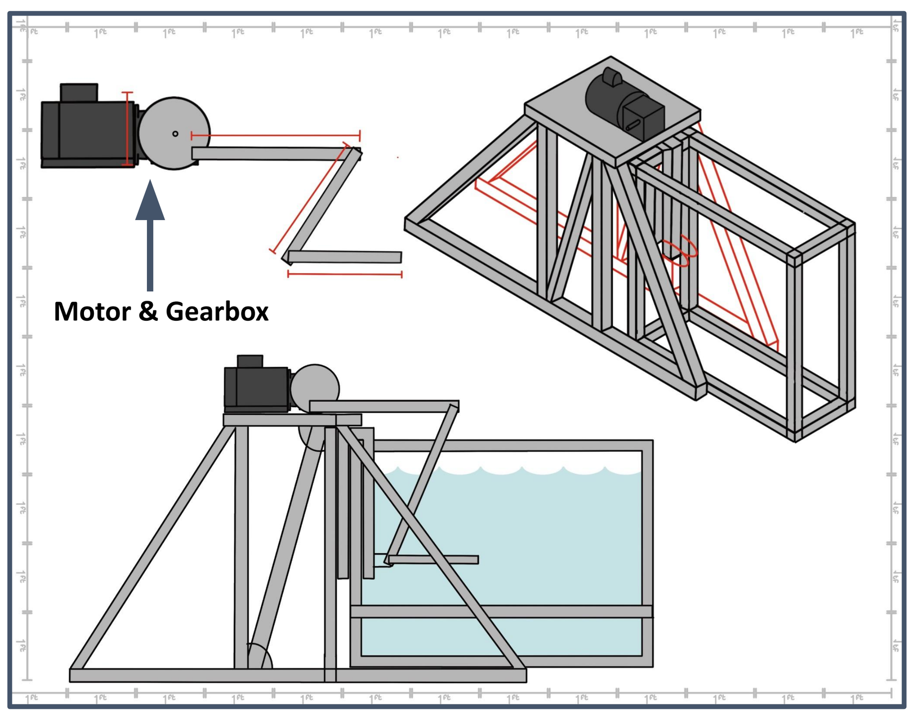
Tank Construction:
- 80/20 frame was used for frame
- Plexi glass was used for the sides and bottom of tank
- Water leakage prevention
  - Gasket & Caulk
  - Flex tape & Spray
- Wooden supports
  - Reduce bowing of plexiglass due to pressure of water



Initial Drawing



CAD Model



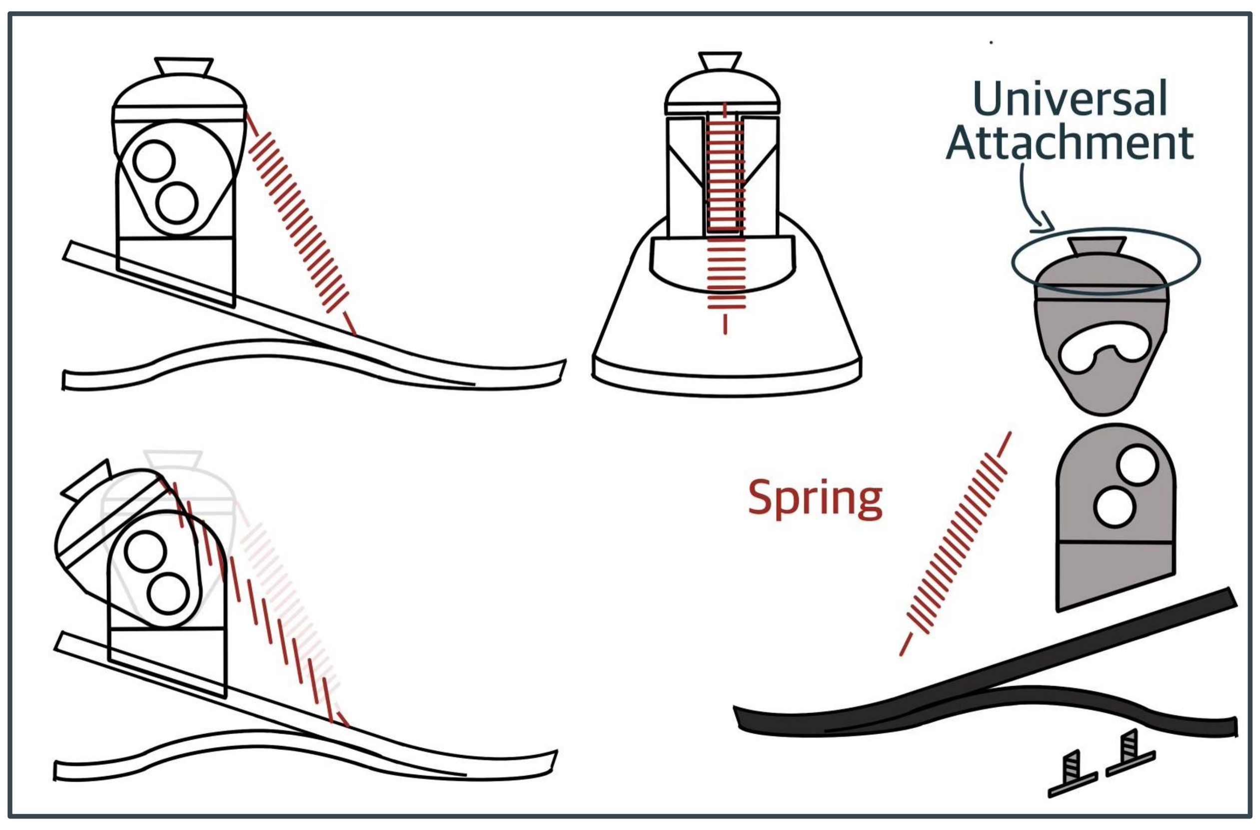
Drawing with Motor Set Up

Final Design

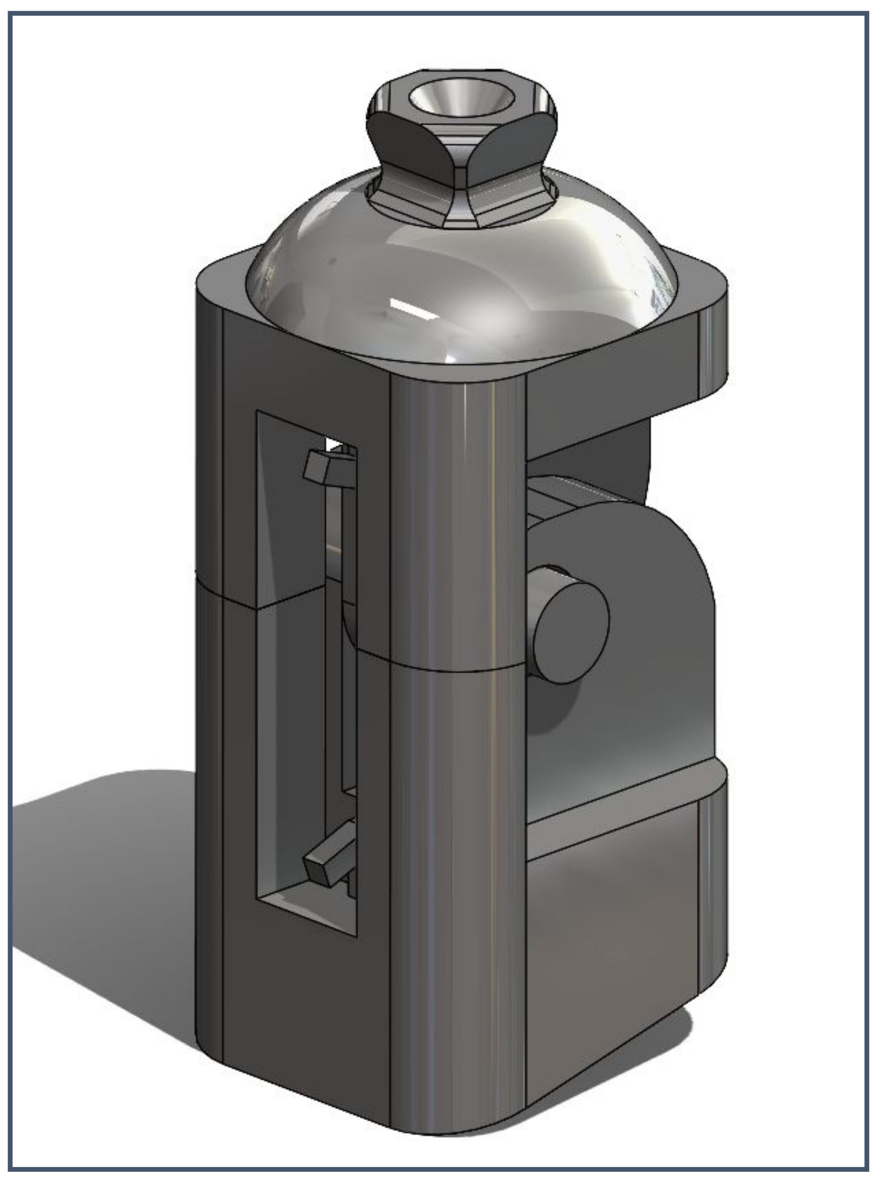
Design 1: Tension Spring & Elastic Band

- **Design Components:**
  - **Spring Constant Range:** .1 - 1.5 N/mm
    - 0.1 N/mm, 0.5 N/mm & 1.3 N/mm
  - **Elastic Band Length:** 50.8 mm
    - 1, 5, 10
  - **Pin:** 10.5 mm diameter
- **Initial Concerns:**
  - Longevity
    - Solution - Decrease pin diameter

Attractions:
- Previous research has been conducted
- Variation of design has been used
- Allows for variation in type of component used
  - Spring or band

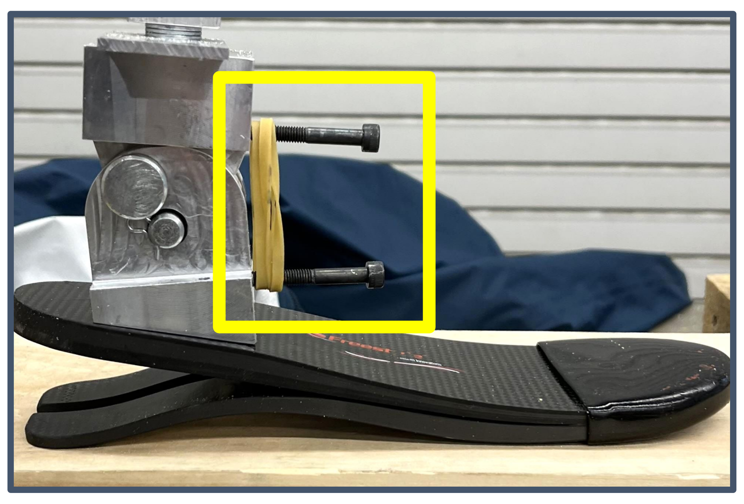


Initial Drawing



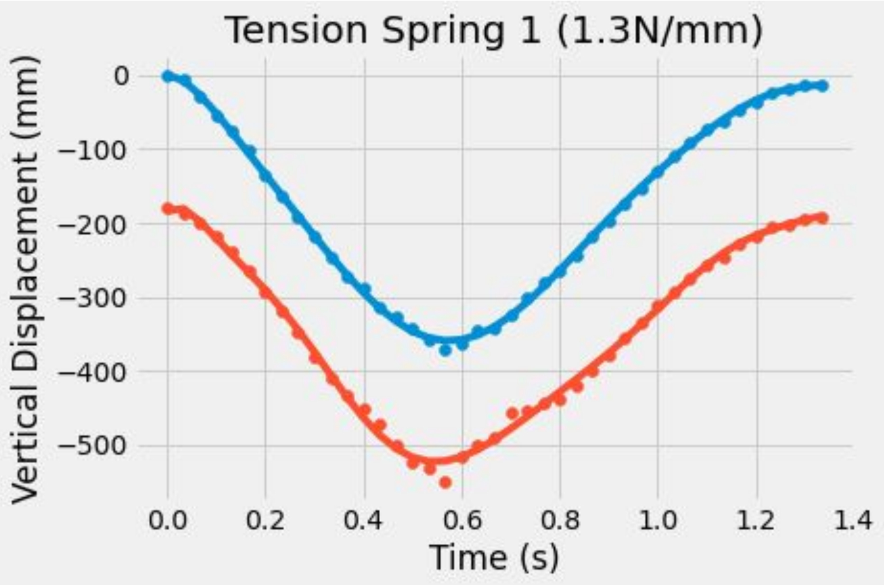
Initial CAD Model

Final Design - Tension Spring

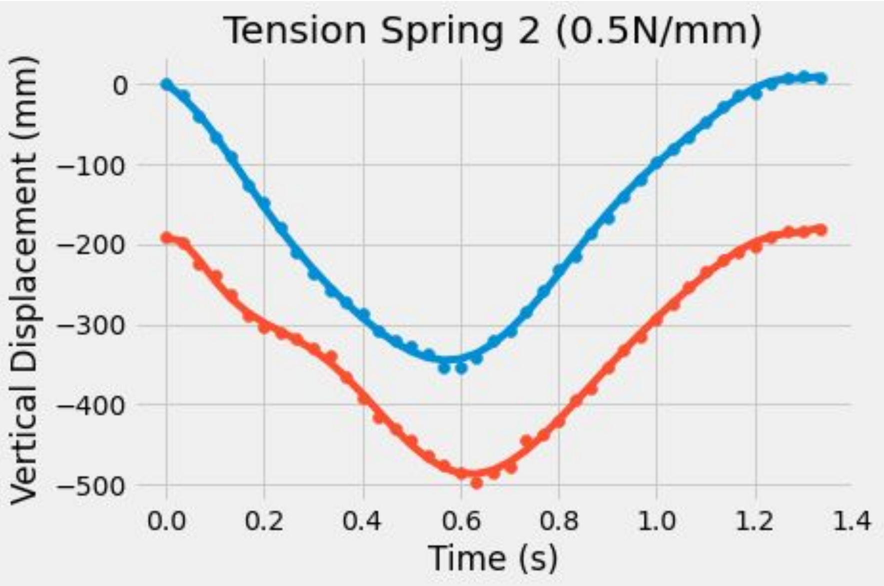


Final Design - Rubber Band

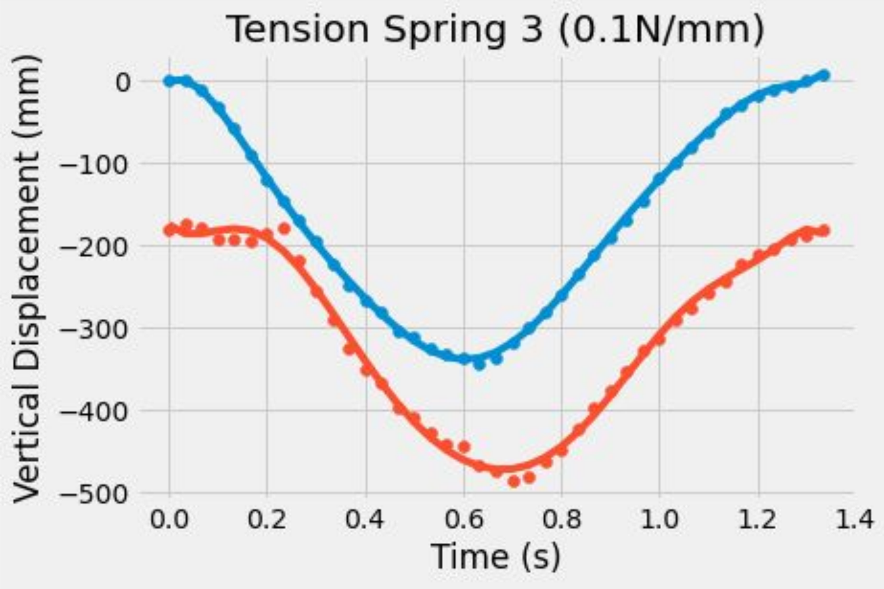
Results & Analysis Design 1



- Strongest recovery stroke
  - Narrowest peak
- Weakest downstroke
  - Lacks full ankle extension



- Good downstroke
  - Near full extension of foot
- Good recovery stroke
  - Narrow peak
- Most balanced design of three tension springs



- Weakest recovery
  - Thickest peak
- Strong downstroke
  - Full ankle extension