

Background

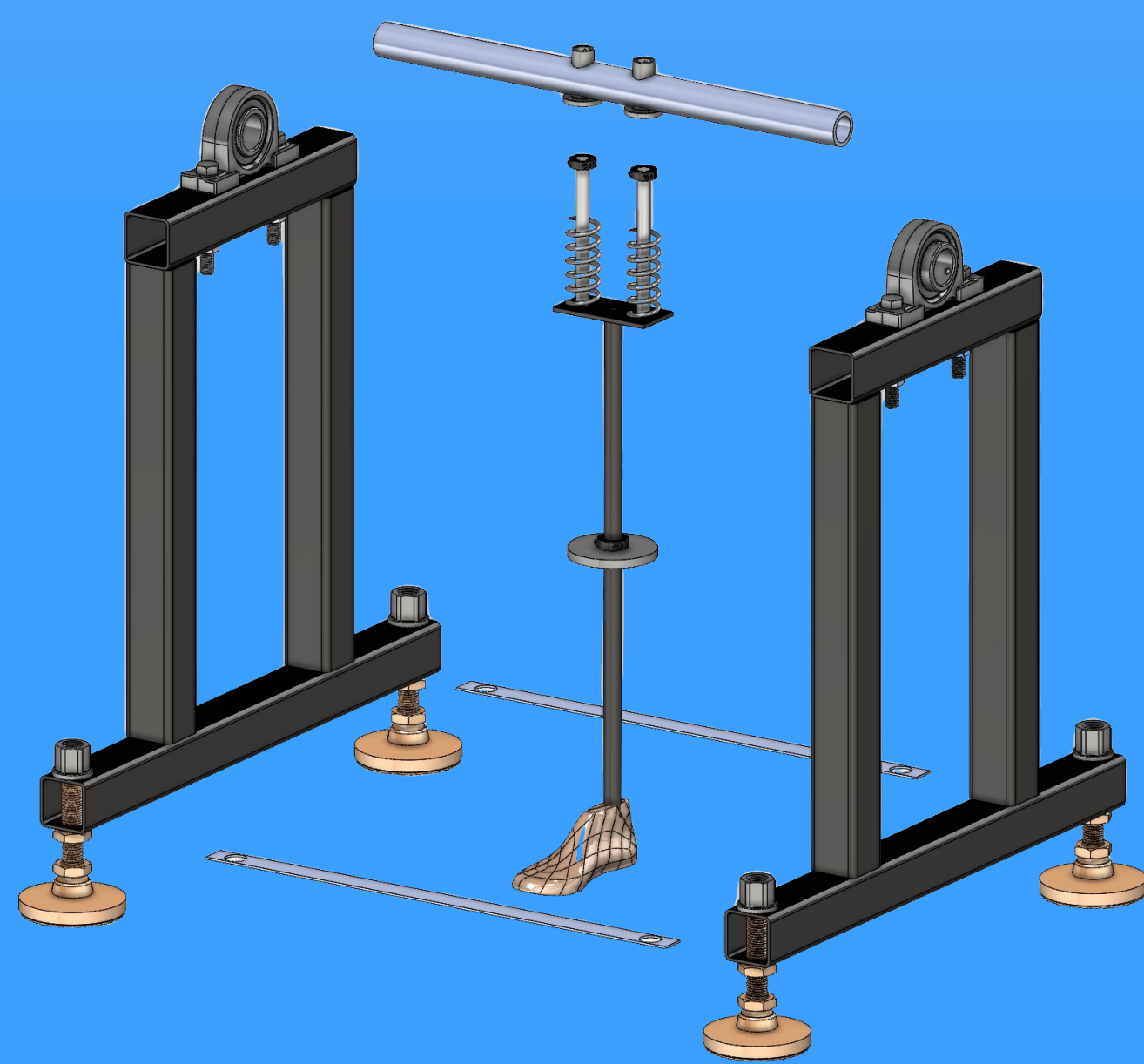
This project involves creating a repeatable, reliable, and accurate scuff tester that will be used to determine the effectiveness of the innovative variable friction Cadense shoe. In order to characterize this shoe, data to describe the interaction between this shoe and the ground is important. An effective characterization will explain the conditions and reasons that the Cadense shoe may be a better suited shoe for subjects with foot drop than other options on the market and ultimately provide a scientific backing for the function of the shoe. The project is a high fidelity pendulum system that can be used to run repeated trials through manual activation during which a scuffing force will be applied to a high precision force plate that can output a force profile over time.

Design Specs

Key design specification involve;

- 1) Fits around the force plate (60 cm x 40 cm)
- 2) Highly accurate and repeatable system
- 3) Mimics scuff force of a human
- 4) Modular – can be fit to different shoes and weights
- 5) Able to be dismantled, moved, and stored easily

Exploded View



Final Design



- Modular scuff tester that can be used for repeated and consistent testing of the scuff forces of different shoes.

Key Components



Adjustable Frame Legs

Easily adjustable legs allow for layout freedom in setting up the pendulum to be level around the force plate.



Compliance on Leg Component

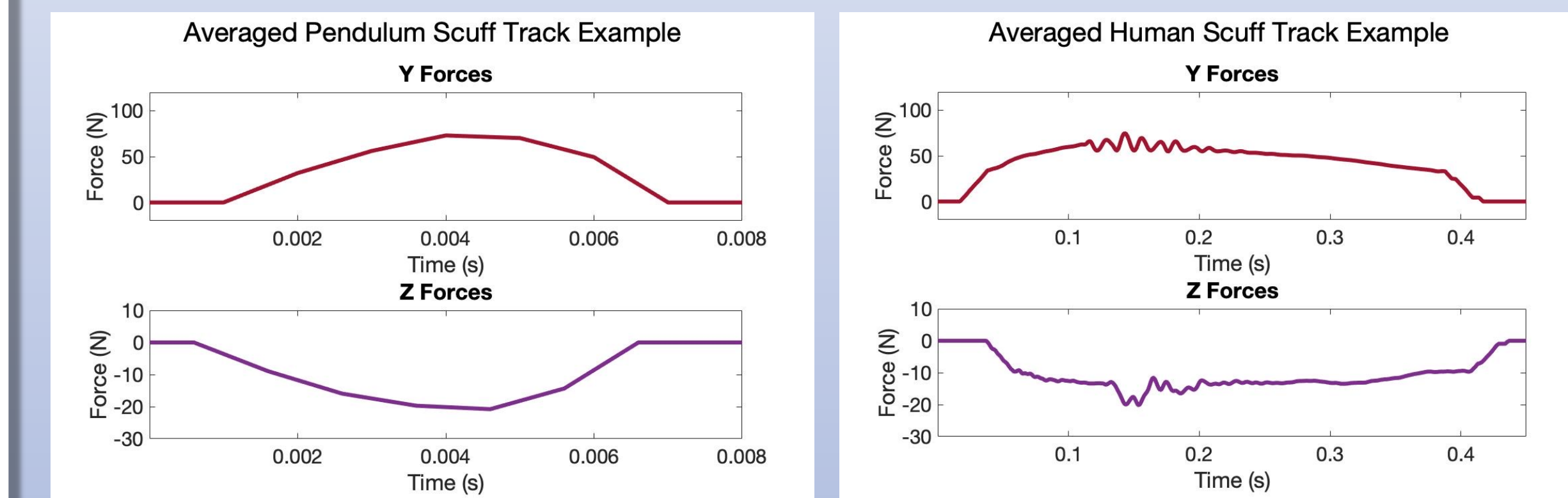
Elastic elements (springs) are used to ensure solid contact and a smooth pass through over the force plate.



Robust Steel Frame

Very strong frame provides a solid and heavy base that can withstand scuffing forces with ease and provide a high factor of safety.

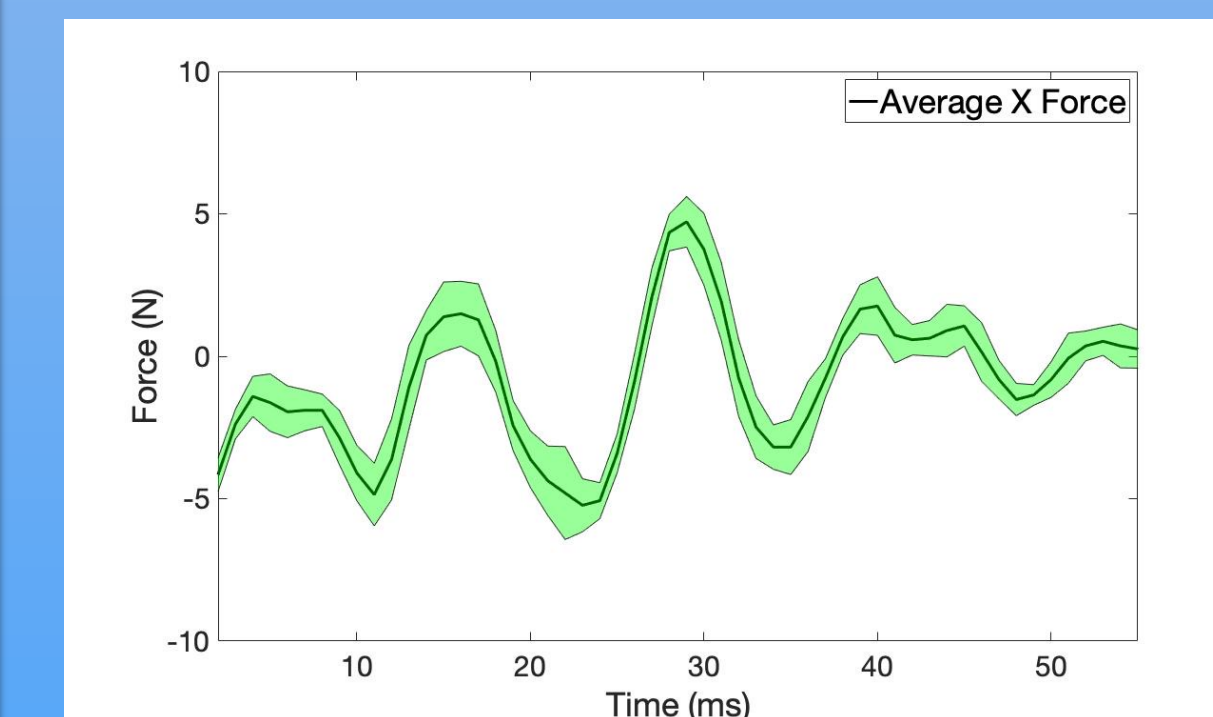
Scuff Comparison to Human Scuff



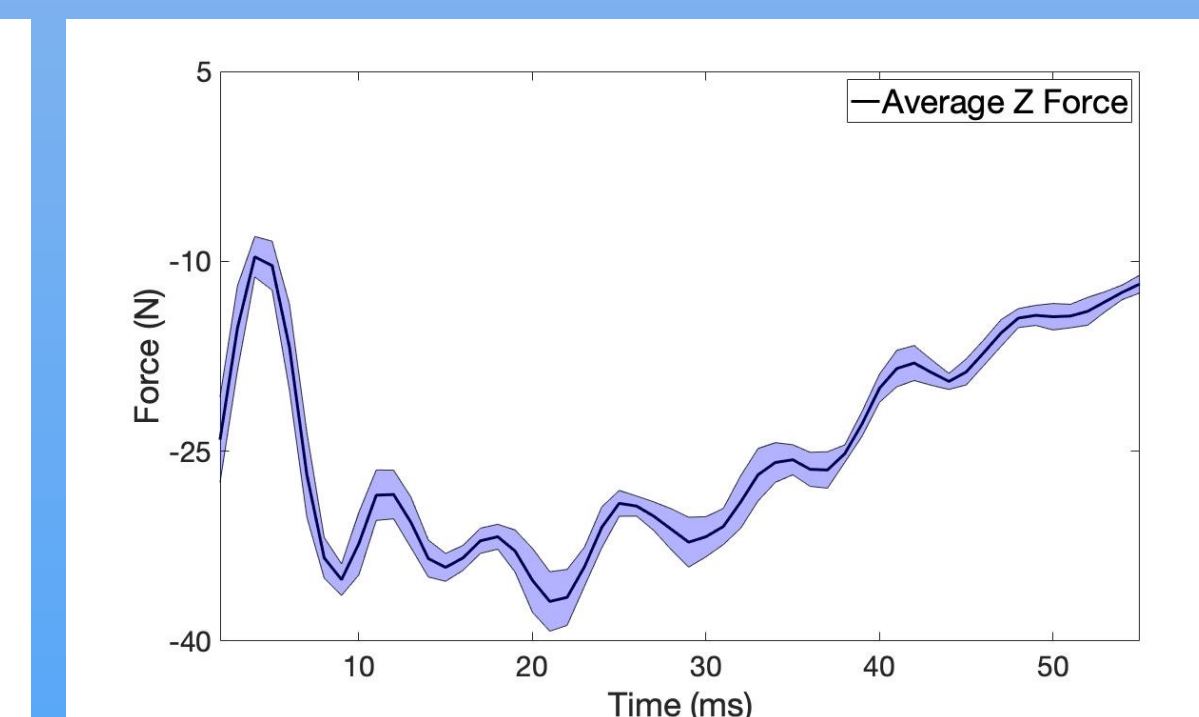
- Force tracks taken as an average of 5-10 scuffs
 - Human vibration damped using a moving average
- Shape of pendulum scuff mimics that of a human
- Different time scales
 - Pendulum ~ 10 ms
 - Human ~400 ms

Pendulum Repeatability

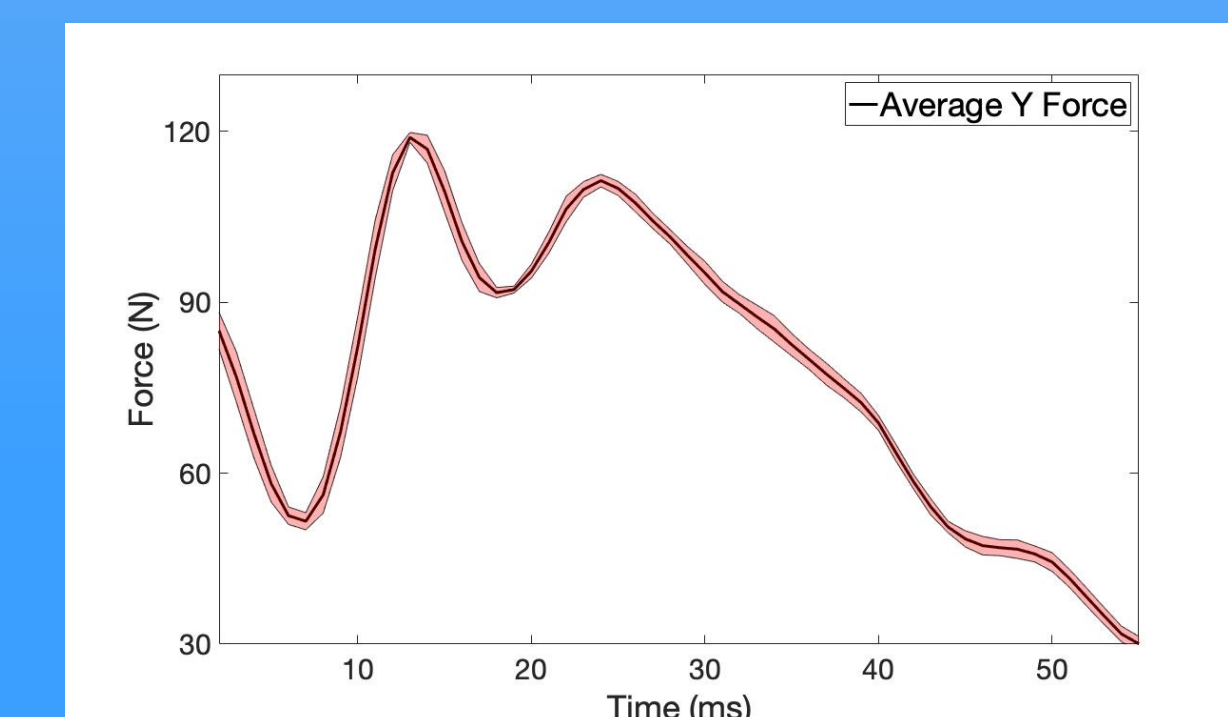
Horizontal Force: Side To Side



Horizontal Force: Opposing Motion



Vertical Force



- Pendulum force bins taken as average of 10 identical drops
- Drops were from 60 degrees and would stick to the plate
- Central line is average force output over time
- Outer shaded bounds are one standard deviation away
- Results show consistency and repeatability within a couple newtons in any direction