

# Asymmetrical Force Sensor for Rowing Biomechanics

Date: 2/14/2025

Client: Jill Thein-Nissenbaum, Tricia DeSouza

Advisor: David Appleyard

Team:

Team Leader: Alicia Moeller ([aamoeller@wisc.edu](mailto:aamoeller@wisc.edu))

Communicator: Neha Kulkarni ([nnkulkarni@wisc.edu](mailto:nnkulkarni@wisc.edu))

BWIG: Simerjot Kaur ([kaur26@wisc.edu](mailto:kaur26@wisc.edu))

BSAC: Emily Wadzinski ([ewadzinski@wisc.edu](mailto:ewadzinski@wisc.edu))

BPAG: Colin Fessenden ([ckfessenden@wisc.edu](mailto:ckfessenden@wisc.edu))

## Problem statement

Many college rowing athletes, particularly women, are susceptible to lifelong lower back or hip injuries due to disparate weight distributions on each leg while rowing. This issue can be addressed through gathering real-time data on athlete biomechanics, but this data is often difficult to obtain. Collection and analysis of biomechanical data will enable athletes to adapt their technique towards better performance, and will assist coaches and trainers in preventing injury. The client, Dr. Jill Thein-Nissenbaum, has tasked the team with creating a force plate system that can collect biomechanical data from rowers' lower extremities. The team's goal is to create a wireless sensor system in the rowboat that will capture load distribution during time of use and will assess lower extremity asymmetry to establish risk stratification. Additionally, the team aims to translate the force plate system into a user-friendly interface that will enable coaches and athletes to understand essential biofeedback information, thereby improving both performance and safeguarding against potential injuries.

## Brief status update

This week, the team made significant progress on the IRB submission process. All team members have done their CITI training and OAR, and the IRB is nearly ready to submit. New custom PCBs were designed and ordered with their corresponding electrical components. Neha

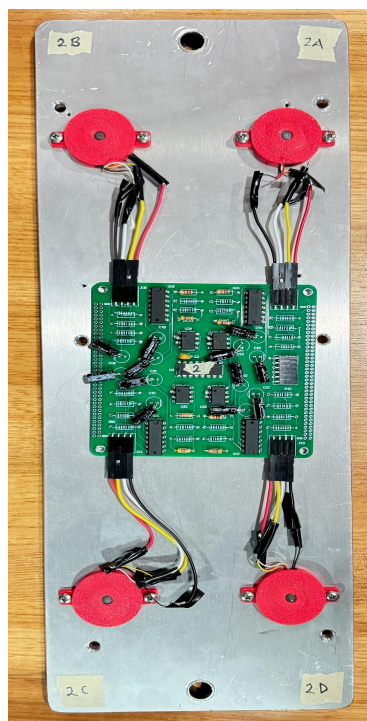
has been looking into ways to automate some of the validity test on the MTS machine by coding dynamic testing functions.

## Difficulties / advice requests

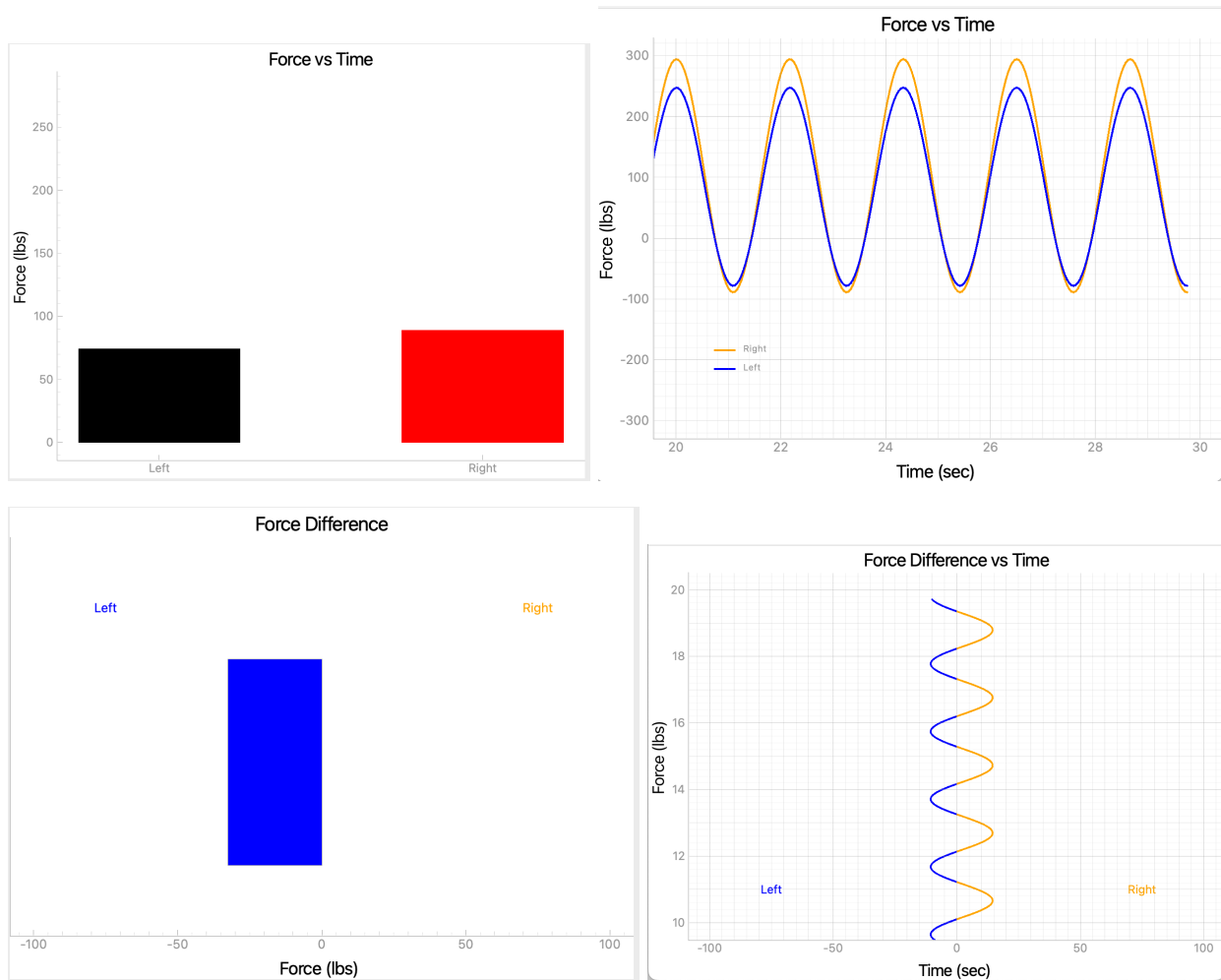
Dr. Bell mentioned that Tricia has not yet completed her Outside Activities Report (OAR) which is needed for the IRB. If this has been done by now, please disregard. In addition, we learned that the MTS does not have the robust dynamic capabilities we thought it did. We might have to look into different test designs or equipment to get the loading patterns we want.

## Current design

Stationary Force Plate



GUI (graphical user interface):



## Materials and expenses (from last semester)

Description	Item #	Specs	Link	Price	Qty	Item Total
Alloy Steel Sleeve Shoulder Screw	91259A632	3/8" Shoulder Diameter	<a href="#">Link</a>	\$2.86	4	\$11.44
PTFE Sleeve Bearing Shell	60695K2	3/8" OD 0.5" Length	<a href="#">Link</a>	\$2.44	4	\$9.76
One End Threaded Stud	97042A145	6-32 Thread, 1" Long	<a href="#">Link</a>	\$3.86	5	\$19.30
Steel Compression Springs (Pack of 5)	9434K113	0.48" OD 0.5" Length	<a href="#">Link</a>	\$4.83	1	\$4.83
Dowel Pin (Pack of 5)	8381A172	1/8" Diameter	<a href="#">Link</a>	\$5.92	1	\$5.92
Bronze Sleeve Bearing	6391K173	3/8" OD 0.5" Length	<a href="#">Link</a>	\$1.40	1	\$1.40
TI Connectivity Compression Load Cells	824-FX292X-100A0100L	100lb Operating Force	<a href="#">Link</a>	\$28.43	8	\$227.44
12 BIT MCP3008 ADC	MCP3208-CI/P-ND	12 Bit IC ADC	<a href="#">Link</a>	\$4.97	2	\$9.94
TLV274IN	296-14379-5-ND	Op Amp 4 Circuit	<a href="#">Link</a>	\$1.06	10	\$10.58
1K Ohm Resistors	RNF14FTD1K00	1k ohm resistors	<a href="#">Link</a>	\$0.03	100	\$3.15
Raspberry Pi Pico H	2648-SC0917-ND	microcontroller	<a href="#">Link</a>	\$5	1	\$5.00
Jumper Wire	1528-1967-ND	M-M 6"	<a href="#">Link</a>	\$2	2	\$3.90
10 BIT MCP3008 ADC	MCP3008-I/P-ND	10 Bit 16 DIP	<a href="#">Link</a>	\$3	1	\$3.12
LM358 Amplifiers	296-1395-5-ND	8 DIP	<a href="#">Link</a>	\$0	30	\$5.10
Stainless Steel Flat-Tip Set Screws (Pack of 25)	9435A337	10-32 0.5" Long	<a href="#">Link</a>	\$5	1	\$5.41
Aluminum Footplates	6061 T651	12x16x.25	<a href="#">Link</a>	\$31	2	\$61.16
Custom Printed Circuit Boards		95x95mm (5 copies)	<a href="#">Link</a>	\$10.61	1	\$10.61
Compression Spring	9657K374	124 max load, 1.75" L	<a href="#">Link</a>	from last year	12	
					<b>Total</b>	<b>\$398.06</b>
<b>Final Design Parts</b>					<b>Total After Shipping</b>	<b>\$446.86</b>

## Team goals for the next week

1. Assembly PCBs (if they arrive)
2. Update the GUI code
3. Program test on MTS Software
4. Draft CAD model of MTS Test fixture

## Next week's individual goals

- Neha
  - Write test on MTS software
  - Prototype MTS testing fixture with cardboard/acrylic
- Simmi
  - Clean up code and write code on creating csv file
  - Research potential journals to publish
- Allicia
  - Clean up code with Simmi
  - Assemble PCBs if they arrive
- Emily
  - Buy parts
  - Fix hole dimensions on footplate
- Colin
  -

## Timeline

Task	Jan	Feb				March					April				May	
	26	2	9	16	23	1	8	15	22	29	5	12	19	26	3	10
<b>Project R&amp;D</b>																
Empathize	X	X	X													
Background...	X	X	X	X												
Prototyping																
Testings																
<b>Deliverables</b>																
Progress Reports	X	X	X	X												
Prelim presentation			X													
Final Poster																
<b>Meetings</b>																
Client																
Advisor	X	X	X													
<b>Website</b>																
Update	X	X	X													

Filled boxes = projected timeline  
 X = task was worked on or completed

## Previous week's goals and accomplishments

- Neha
  - Finalized IRB submission
  - Gained basic understanding of MTS capabil
- Simmi
  - Work on cleaning up code
  - Read about design on device validity studies
- Allicia
  - Order PCBs
  - Clean up code with Simmi.
- Emily
  - Measured and documented MTS load cells for testing fixture
- Colin
  - Buy parts
  - Fix CAD for plates