Asymmetrical Force Sensor for Rowing Biomechanics

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Team:

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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

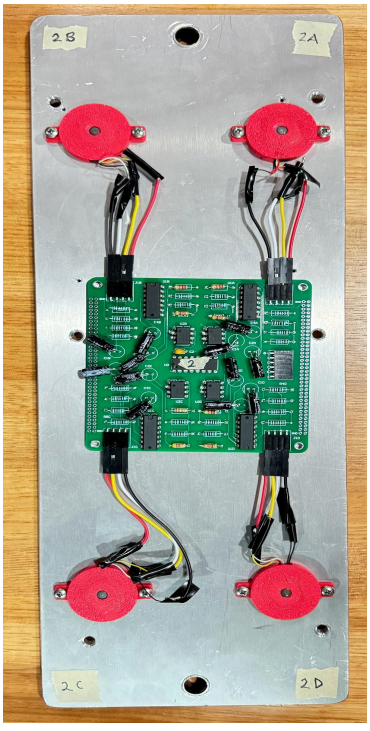
This week, the team made significant progress on preparing for MTS testing. The team gained familiarity with the MTS software and was able to program a sample test and decide on key test parameters of the loading profile. The team also received the redesigned load cell and Raspberry Pi PCBs and assembled them.

Difficulties / advice requests

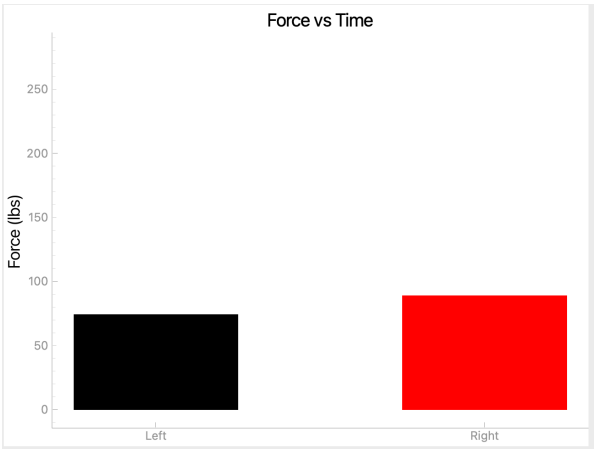
The team is still working on designing a fixture to secure the plate to the compression platen on the MTS. Since the surface area of the plate is much larger than that of the platen, there must be a way to secure the two together while ensuring the platen/plate are absorbing all of the load. Beyond the physical design of this platform, the team is considering several different materials that could be used; however, it is critical that the chosen material can withstand the loading conditions applied.

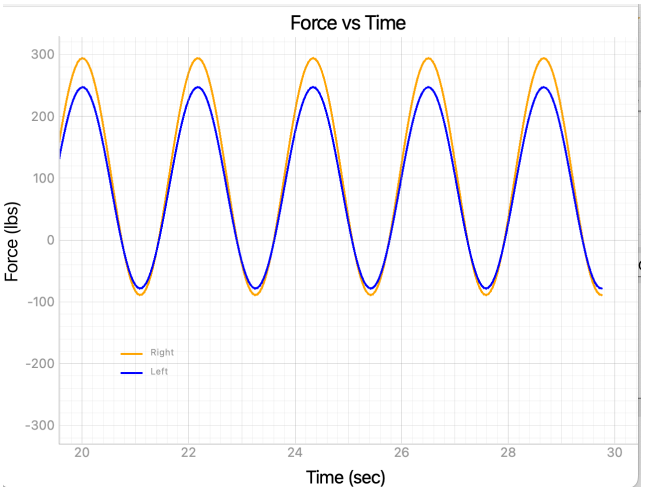
Current design

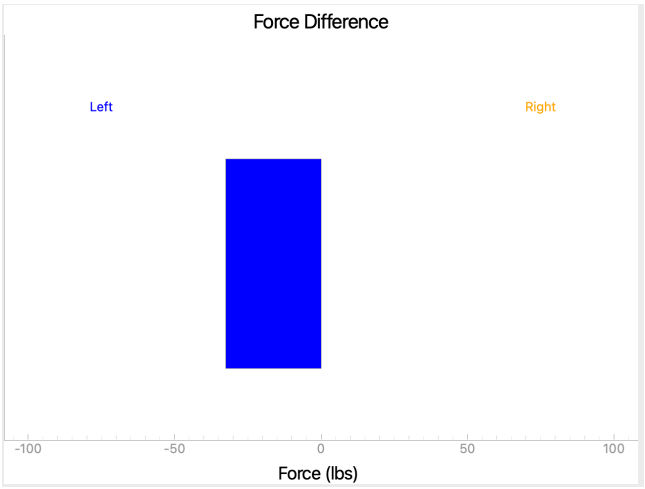
Stationary Force Plate

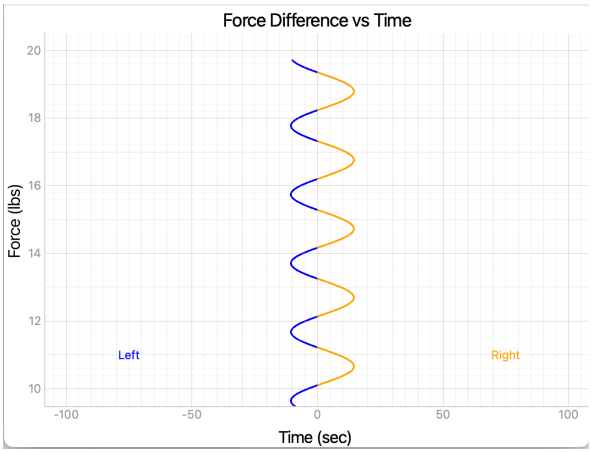


GUI (graphical user interface):









Materials and expenses (from last semester)

Description	Item #	Specs	Link	Price	Qty	Item Total
Alloy Steel Sleeve Shoulder Screw	91259A632	3/8" Shoulder Diameter	Link	$2.86	4	$11.44
PTFE Sleeve Bearing Shell	60695K2	3/8" OD 0.5" Length	Link	$2.44	4	$9.76
One End Threaded Stud	97042A145	6-32 Thread, 1" Long	Link	$3.86	5	$19.30
Steel Compression Springs (Pack of 5)	9434K113	0.48" OD 0.5" Length	Link	$4.83	1	$4.83
Dowel Pin (Pack of 5)	8381A172	1/8" Diameter	Link	$5.92	1	$5.92
Bronze Sleeve Bearing	6391K173	3/8" OD 0.5" Length	Link	$1.40	1	$1.40
TI Connectivity Compression Load Cells	824-FX292X-100A0100L	100lb Operating Force	Link	$28.43	8	$227.44
12 BIT MCP3008 ADC	MCP3208-CI/P-ND	12 Bit IC ADC	Link	$4.97	2	$9.94
TLV274IN	296-14379-5-ND	Op Amp 4 Circuit	Link	$1.06	10	$10.58
1K Ohm Resistors	RNF14FTD1K00	1k ohm resistors	Link	$0.03	100	$3.15
Raspberry Pi Pico H	2648-SC0917-ND	microcontroller	Link	$5	1	$5.00
Jumper Wire	1528-1967-ND	M-M 6"	Link	$2	2	$3.90
10 BIT MCP3008 ADC	MCP3008-I/P-ND	10 Bit 16 DIP	Link	$3	1	$3.12
LM358 Amplifiers	296-1395-5-ND	8 DIP	Link	$0	30	$5.10
Stainless Steel Flat-Tip Set Screws (Pack of 25)	94355A337	10-32 0.5" Long	Link	$5	1	$5.41
Aluminum Footplates	6061 T651	12x16x.25	Link	$31	2	$61.16
Custom Printed Circuit Boards		95x95mm (5 copies)	Link	$10.61	1	$10.61
Compression Spring	9657K374	124 max load, 1.75" L	Link	from last year	12	
					Total	$398.06
Final Design Parts					**Total After Shipping**	**$446.86**

Team goals for the next week

1. Prototype MTS test fixture
2. Test PCBs and finish cleaning code
3. Finalize test parameters and run full protocol on wood block/scrap material
4. Complete testing protocol of force plate

Next week's individual goals

- Neha
    - Write MTS test
    - Experiment with Digital I/O
- 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
    - Add PCB holes to plates
    - Make MTS mount
- Colin
    - Fabricate fixture for MTS testing.

Timeline

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

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

Previous week's goals and accomplishments

- Neha
  - Assisted in PCB assembly and testing
  - Refined MTS test parameters
- Simmi
  - Worked on preliminary report
  - Read about design on device validity studies
- Allicia
  - Assembled PCBs
  - Tested PCBs
- Emily
  - Mounted components on PCBs
  - Wrote section of prelim report
- Colin
  - Wrote section of preliminary report