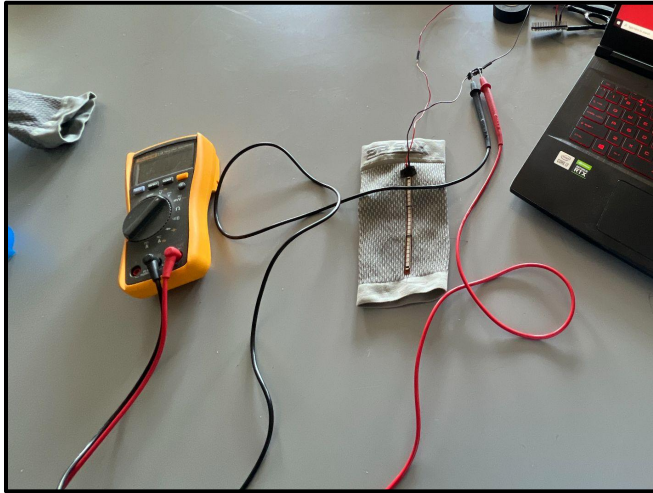


How can we make sports training more accessible?

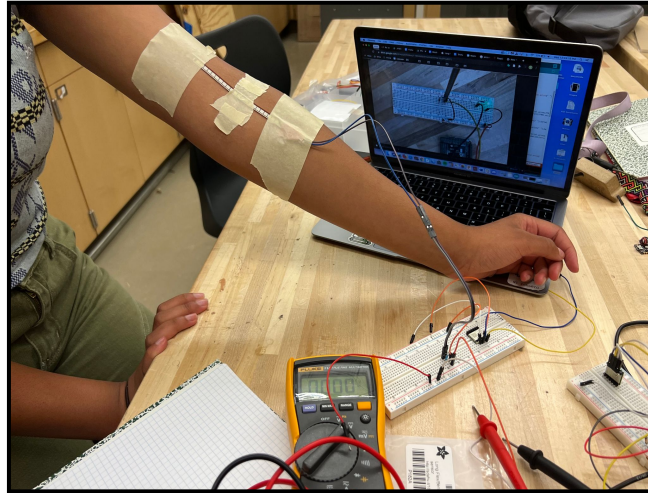
- 31% of children in households below the poverty level participate in sports (70% in households earning over four times the poverty level)
- Accessible sports training will enable many more children to become better athletes and pursue healthy lifestyles.
- Current full body motion capture haptic feedback training systems are inaccessible, costing up to \$20,000.

Our purpose was to design an inexpensive full-body sensor system to track where an athlete's body is and provide real-time feedback to correct their form

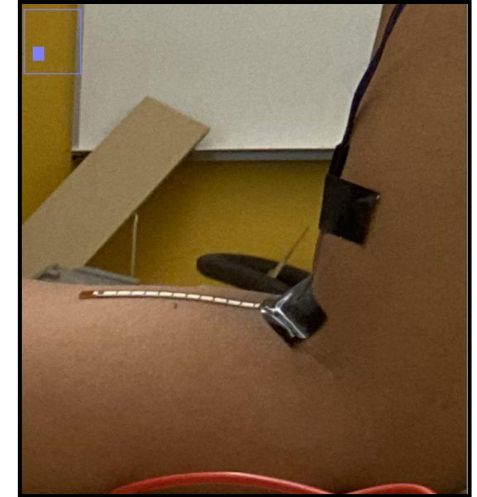
Methods: Flex Sensors for Joint Deflection & IMUs for Limb Position



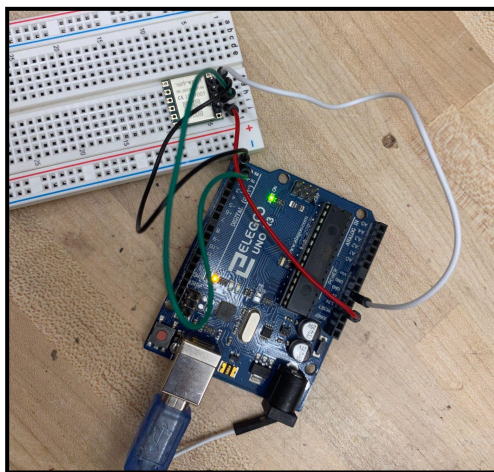
Flex sensor voltage resistance during deflection



Securing flex sensor to arm and testing range of values



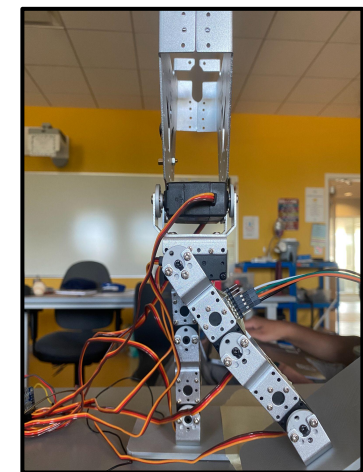
Inner elbow flex sensor trial ImageJ angle computation



Inertial Measurement Unit (IMU) Calibration

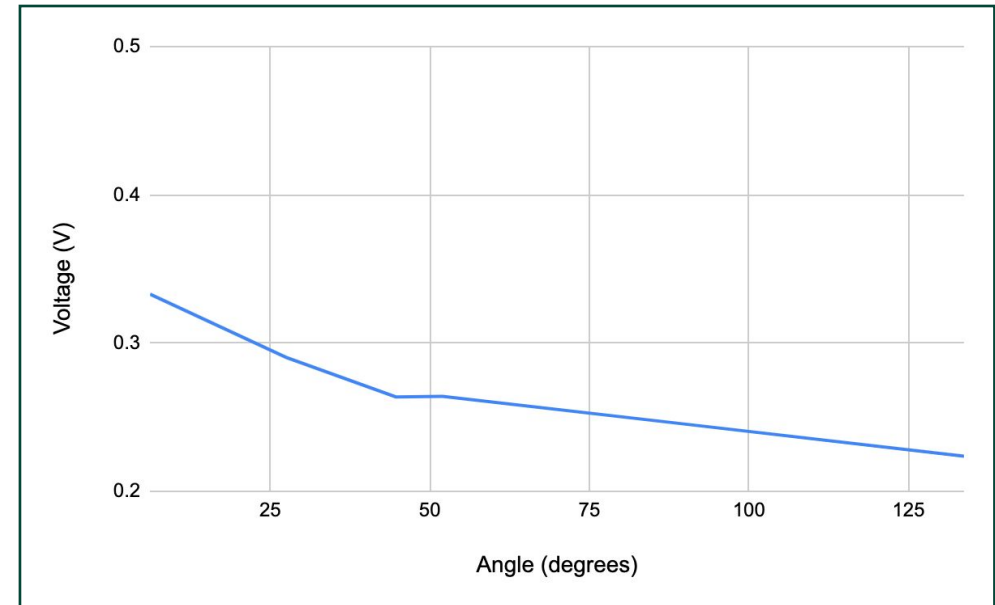
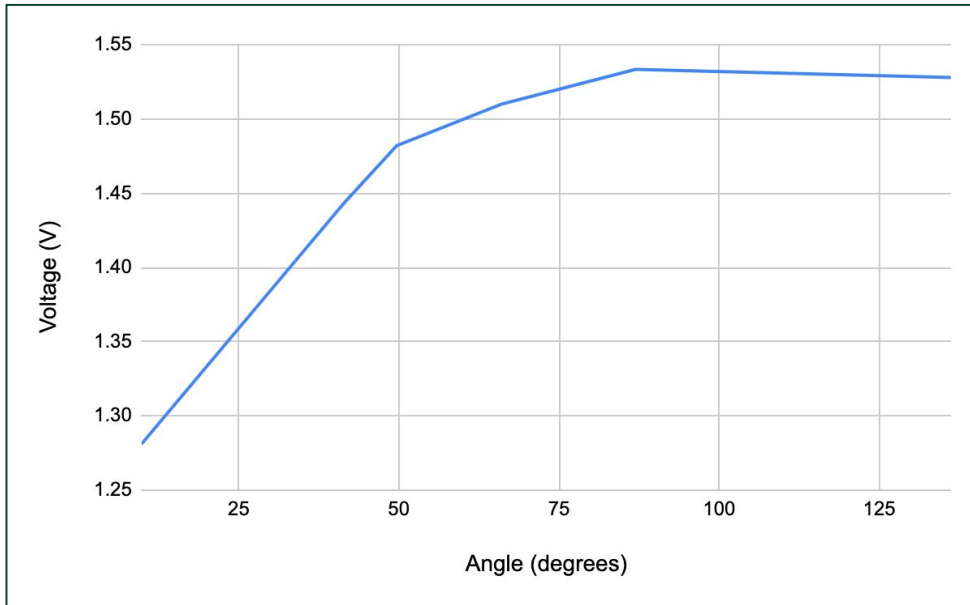


Preliminary data collection to verify angle accuracy

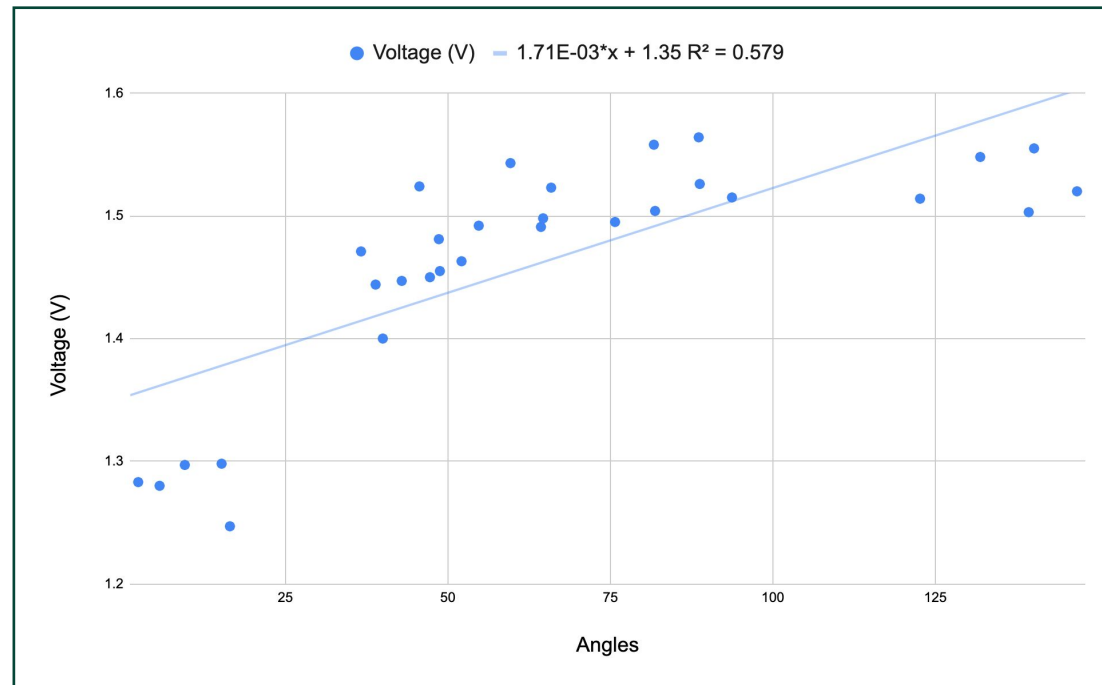


Testing with IMU attached to the biped at fixed angles

Flex Sensor Results: Large Range, Accurate, Positive Correlation in Joint Angle Detection



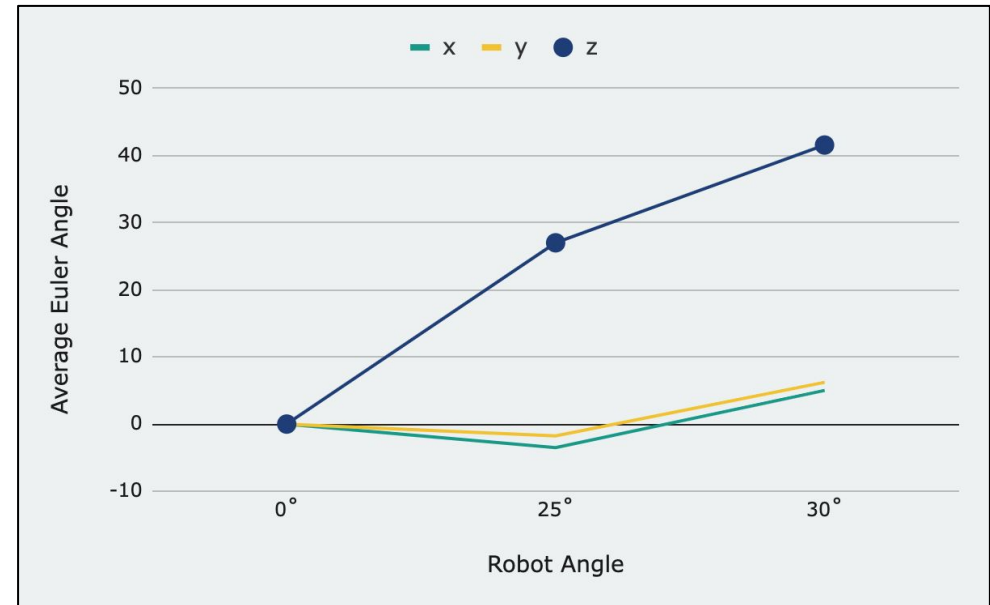
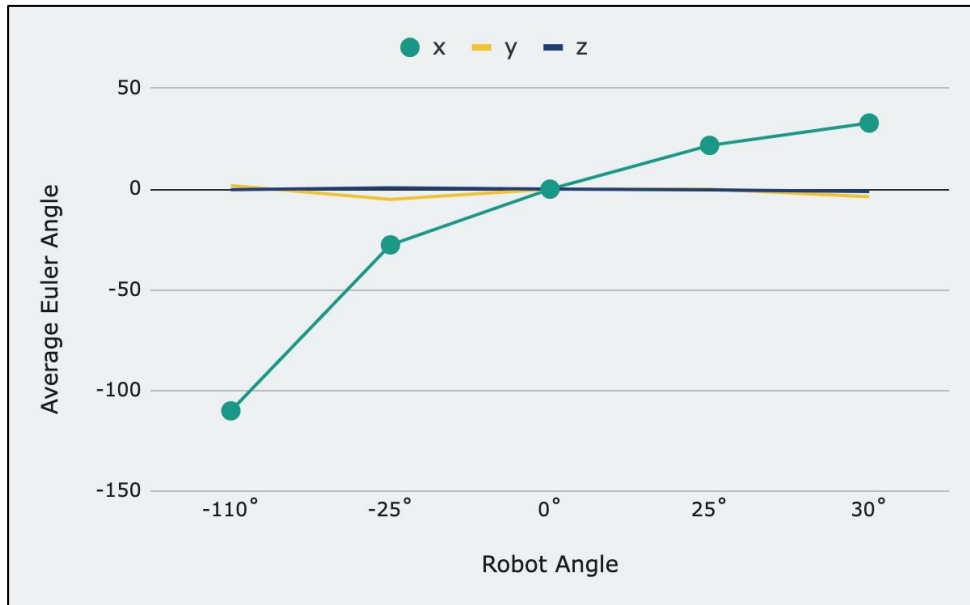
↑ **Right side up Flex Sensor Trials**
Averages: Greater Range (0.3V)



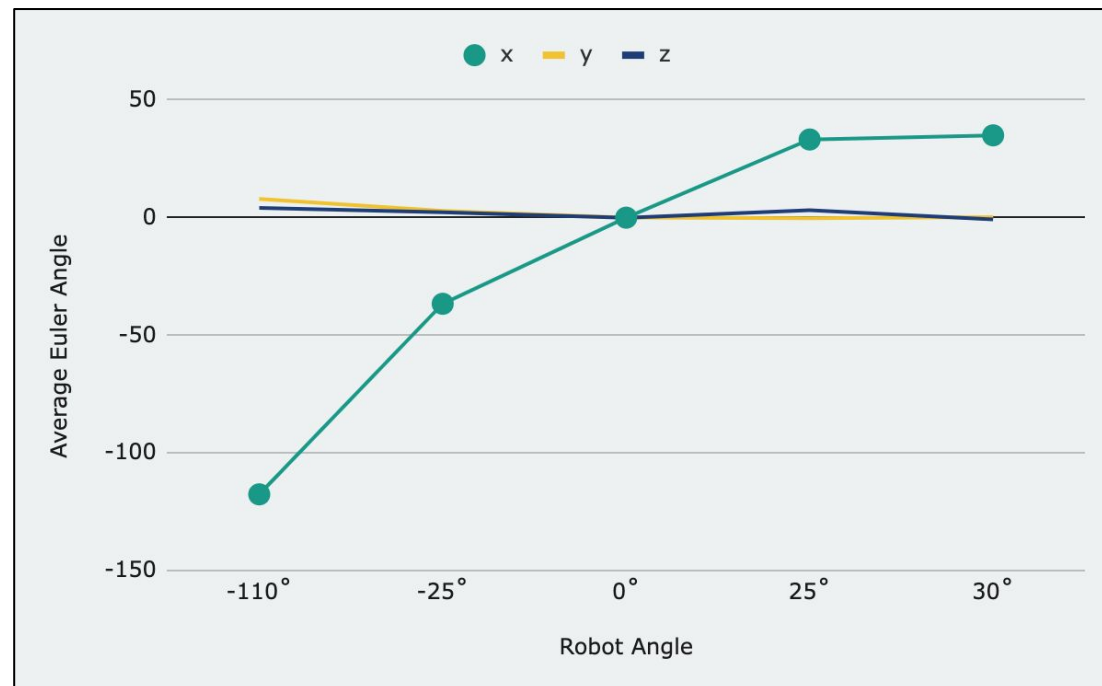
↑ **Flipped Flex Sensor Trials**
Averages: Smaller range (0.15V)

← **Right side up Sensor Data.**
Point Variability with Linear Accuracy

Inertial Measurement Unit (IMU) Results: Accurate, Positive Correlation in Single Axis Movement



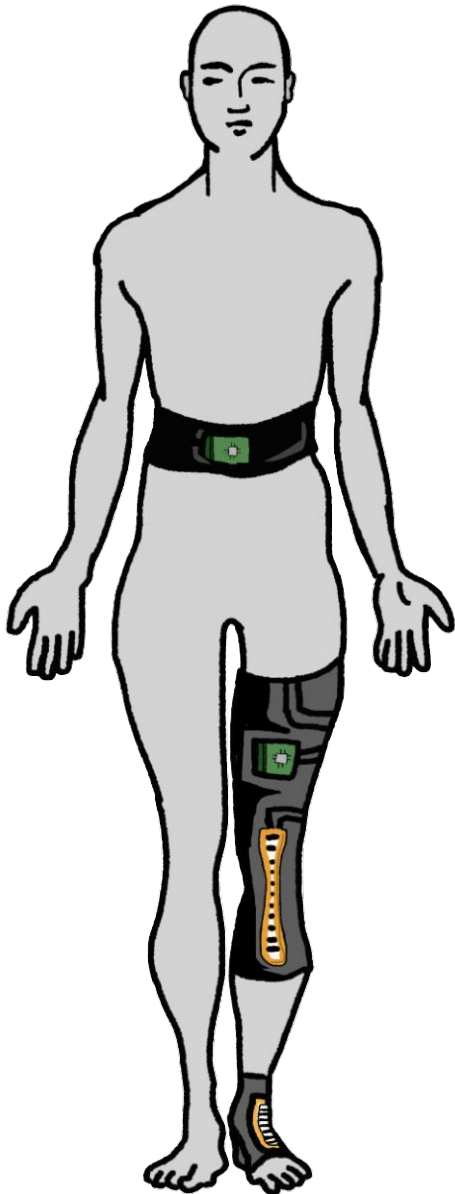
↑ **Thigh:** IMU Euler Angle **Positively Correlates** with Robot Angle in X-axis.



↑ **Hip:** IMU Euler Angle **Positively Correlates** with Robot Angle in Z-axis.

← **Shin:** IMU Euler Angle **Positively Correlates** with Robot Angle in X-axis.

Conclusion



- Flex sensor: high level of angle measurement accuracy when right side up
- IMU: positive correlation of averages with the actual robot measurement
- Effective alternatives to expensive high-resolution motion sensors.
- The flex sensor and IMUs range of accuracy used to accurately and efficiently tele-operate a bipedal robot.

Future Work

Limitations

- Flex sensor values varied between trials

Future Work

- Interface 1-2 more flex sensors to improve resolution and reduce point variability.
- Can be applied to wide range of skills (ex: range of sports, manual job training, and physical therapy).
- May be simplified into inexpensive customizable kit use to correct various sports drills.
- Next phase of development: incorporate vibration motors for haptic training feedback