ReActive Comfort: Enhancing Ankle Support Through Pressure Adaption

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Problem

Traditional ankle braces are **stiff** and non-adaptive, often causing discomfort and **reduced compliance**.

Objective

Design a **pressure-responsive ankle brace** that adjusts tension in real time to maximize comfort and stability.

Figure 4: *Bettergaurd Adaptive Brace, used as a design model for ReActive Comfort*

Low cost ankle brace with dynamic support.

Methodology

Sensor and Actuator Placement: Test Sensors in different locations and map out best placement

Figure 1: *Round High Force Sensitive Resistor (FSR) · 1 ~ 100 Newton Force*

Figure 2: *Small Reduction Stepper Motor - 5VDC 32-Step 1/16 Gearing*

Pressure Adaption System: Establish the system where increased pressure increases support

CAD Model: Design a brace model that accomadates the external hardware

Figure 3: *Standard Lace-Up Brace for Prototyping*

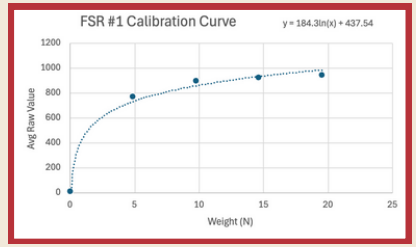
onshape

Simulation for Data Collection: Use a simulation to gather data about the brace in different situations

Implement RL: Use simulation data to train an RL model that adapts to user preferences

Results

- Two **Force Sensitive Resistors (FSRs)** were **calibrated** to ensure reliable pressure measurements.
- Calibration curves (Figure 4) show a **clear nonlinear increase** in sensor output with applied force.
- **High sensitivity at low forces** ensures detection of subtle pressure changes around the ankle.



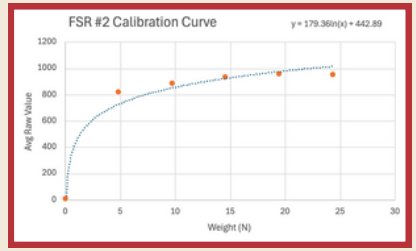


Figure 5: *Calibration curves for FSRs #1 and #2*

Final Design

- Pressure-sensitive sensors (FSRs) placed at key ankle contact points
- Real-time tension adjustment mechanism (motor or actuator-based)
- Adaptive control system that responds to ankle pressure changes

Conclusion

Pressure-responsive sensing is feasible for adaptive ankle support, with consistent sensor behavior indicating potential to reduce discomfort compared to rigid braces.

Future Work

Future work will integrate actuators for real-time tension adjustment, test the prototype on human subjects, and incorporate machine learning or reinforcement learning for personalized adaptation.