Portable Pneumatic Ankle-Foot Orthosis

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Implemented Software

- Used LabVIEW to control actuation of AFO
- Valves open/close based on which sensors are above/below pre-set voltage thresholds, corresponding to where the patient is in the gait cycle
- Toggle switches implemented to allow assistance during dorsiflexion, plantarflexion, or both

Heel and Toe Sensor Placement

Correct sensor readings are imperative when determining which gait event is occurring and the type of necessary assistance.

Original location problems:
- Originally located between insole and carbon fiber footplate
- Sensor readings dependent on how tightly patient secures AFO
- Inaccurate positive loading of sensors while in swing phase

Solutions ensuring proper sensor reading:
- Move sensors below footplate
- Design a cutout insert to place between footplate and outsole to prevent loading during swing

Next objective: develop a program to set two modes of operation:
- **Walking mode**: the AFO provides assistance as needed by the subject
- **Standing mode**: no assistance is provided as the subject is not walking

Ankle Angle Calibration

The ankle angle is measured with a potentiometer located on the actuator of the AFO.

Problems with ankle angle reading:
- Output voltage of potentiometer is **nonlinear** with changing ankle angle
- No intuitive interface for displaying and reading angle

Ankle angle solution:
- Fit output voltage to **second-order polynomial**
- Implement polynomial into LabVIEW
- Create simple gauge to display angle

Plots of the heel sensor output, before (left) and after (right) the sensors were moved below the footplate and the cutout was inserted.

Future Work

- **Improve actuation timing** by implementing linear regression/correlation control
- Continue to develop more **efficient and compact** components (power supply, actuator, control panel, and valves)