Robotic Foot
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Special thanks to:
Professor Charles Kim, Professor Peter Stryker, Dan Johnson, Tom Thul, Tim Baker, Bob Brungraber

Components:
- **Body Section:**
  - Bolted two plate design
  - Material cut out between plates for weight
  - Ankle connection screwed to top plate
  - Bearings for smooth motion
  - Rubber tread on bottom of toe plate

- **Toe Section:**
  - Bolted two plate design
  - Material cut out between plates for weight
  - Dummy load cells between plates
  - Space for adding load cells in the future
  - Rubber tread on bottom of toe plate
  - Contoured shape to look more like human foot

- **Steel axle in hinge:**
  - Springs on axle to store energy when toe is deflected
  - Calculated to provide appropriate force during toe-off
  - Easily interchangeable

- **Sensors:**
  - Encoder bracket mounts encoder to top of foot
  - Wiring goes to main robot
  - Pulley connects encoder to toe section to measure angle of toe deflection
  - Load cells placed between plates at corners
  - Load cells are held in place with bolts
  - Measure total force and center of pressure

Testing:
- **Load Bearing Capacity:**
  - Verification of FEA results
  - Weights hung from hinge on body section
  - Deflection measured to be linear

- **Electrical Testing:**
  - Encoder verified to work
  - Load cells tested independently
  - Homemade amplifier used for verification, final amp will be made in-house
  - Algorithms tested for finding center of pressure from the four load cells

- **Theoretical:**
  - SolidWorks/COSMOSWorks used for FEA
  - Models created in SolidWorks, simple integration
  - Tested for various load conditions, including the physical test case for verification
  - Accuracies of various components used to determine theoretical margin of error and standard deviation

Functions/Requirements:
- **Load reading & Center of Pressure calculation:**
  - Four load cells on corners of body section
  - Measure 0 to 500lb each
  - Pre-loaded to 100lb to allow for negative force
  - Balance of all loads yields equivalent single force
  - Gives magnitude and location
  - Potential to add 3 load cells in toe to allow measurement when balancing only on the toe

- **Pivoting toe section for energy storage and release:**
  - Hinge connects toe and body sections
  - Axles connected with set screws to toe, and freely rotates within body section
  - Springs around axle provide energy storage
  - Horizontal and vertical limit stops on hinge

- **Strength and durability for walking:**
  - Using 6061-T6 aluminum
  - Plate dimensions determined with FEA
  - Load tested after parts were machined to verify FEA results

- **Weight less than 2.5 lbs:**
  - 2.2 lbs with spacers instead of load cells
  - Weighs less than 2.5 lbs with all components

- **Deflection of Top Plate**
  - Sensors:
    - Encoder bracket mounts encoder to top of foot
    - Wiring goes to main robot
    - Pulley connects encoder to toe section to measure angle of toe deflection
    - Load cells placed between plates at corners
    - Load cells are held in place with bolts
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