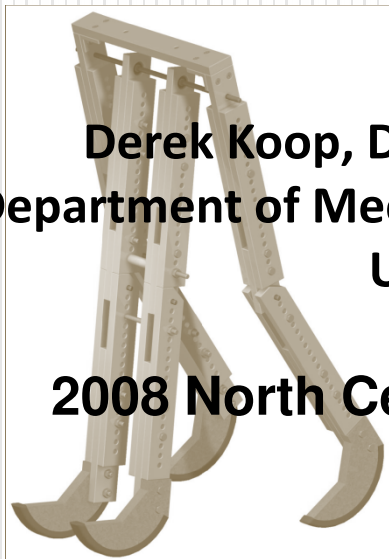


Passive Dynamic Bipedal Walking with Knees

The Effect of Parameter Variation



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What is passive dynamic walking ?

- **Passive walking:**

A natural steady gait maintained by gravitational forces.

-no actuators

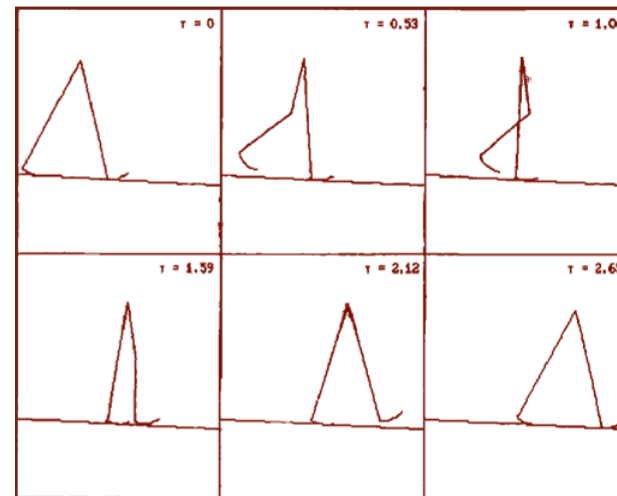
- **Static vs Dynamic Walking:**

A static walking mechanism maintains static equilibrium throughout its motion while a dynamic walking mechanism does not.

T. McGeer. (1990). "Passive Dynamic Walking," [Online], pp. 62-82. Available: Sage Journals Online
<http://ijr.sagepub.com.proxy1.lib.umanitoba.ca/cgi/reprint/9/2/62> [Sept 17, 2008].

What purpose does it serve ?

- Understanding the natural dynamics behind bipedal locomotion.
- Reduces energy requirements when incorporated into actuated designs

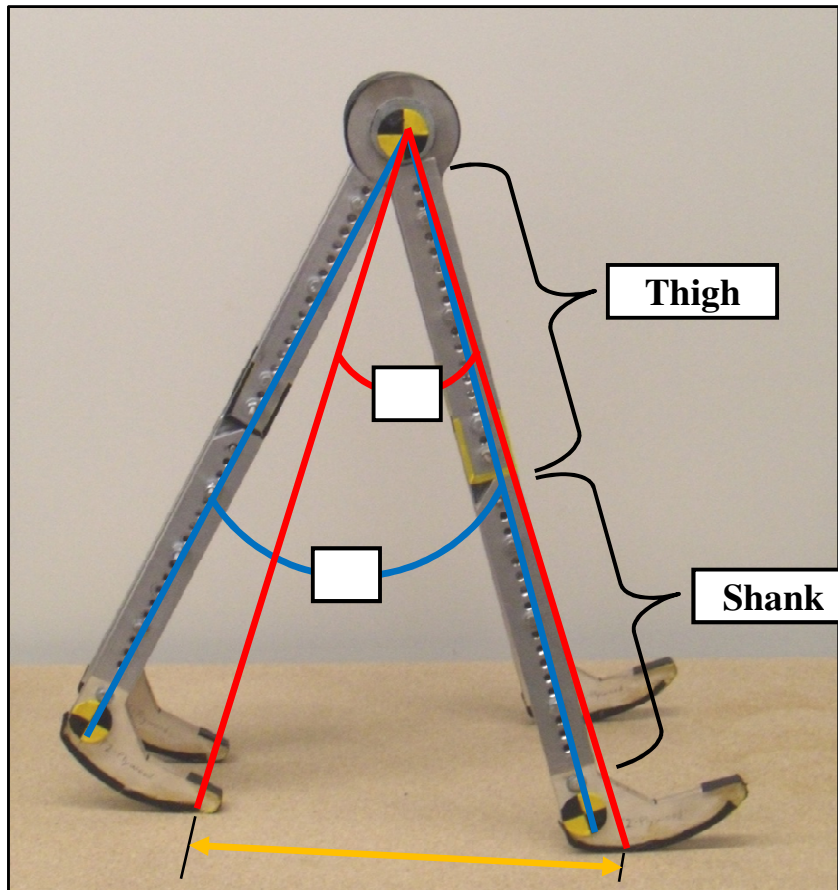


T. McGeer. (1990). "Passive Dynamic Walking," [Online], pp. 62-82. Available: Sage Journals Online <http://ijr.sagepub.com.proxy1.lib.umanitoba.ca/cgi/reprint/9/2/62> [Sept 17, 2008].

Our walker – Dexter Mk II



Dexter Mk II - Terminology

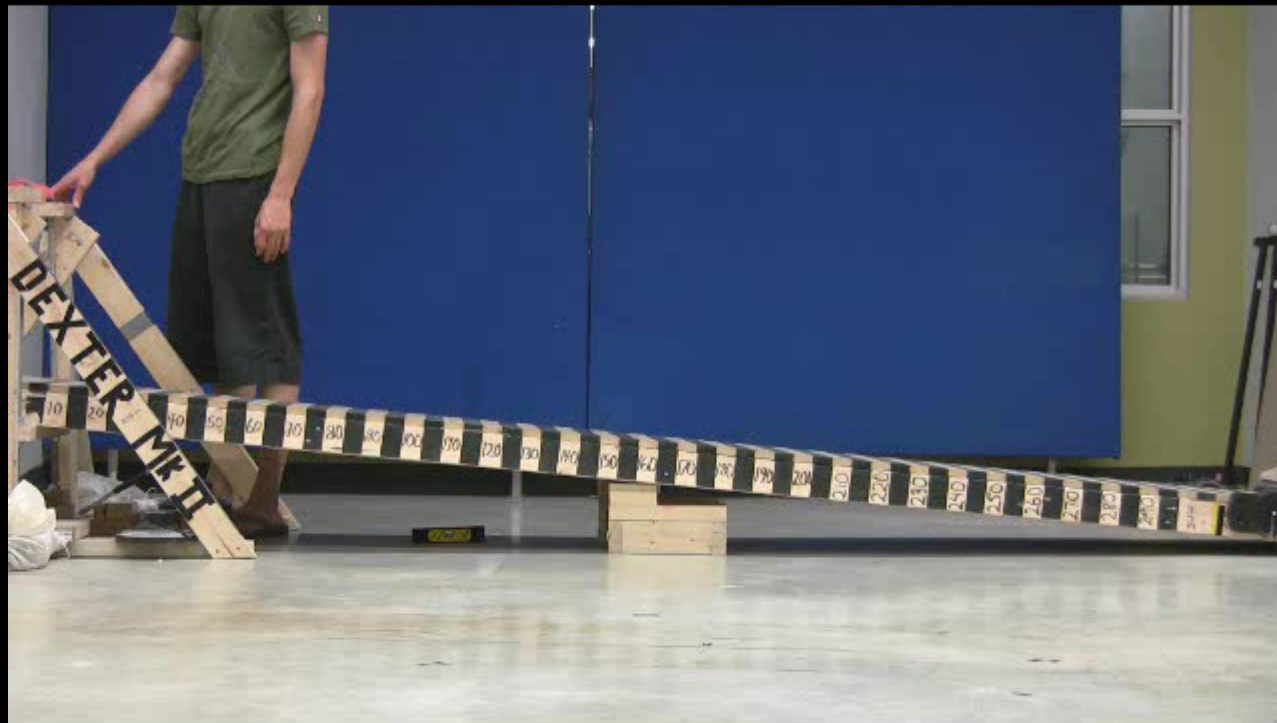


- Leg Angle

- Step Angle

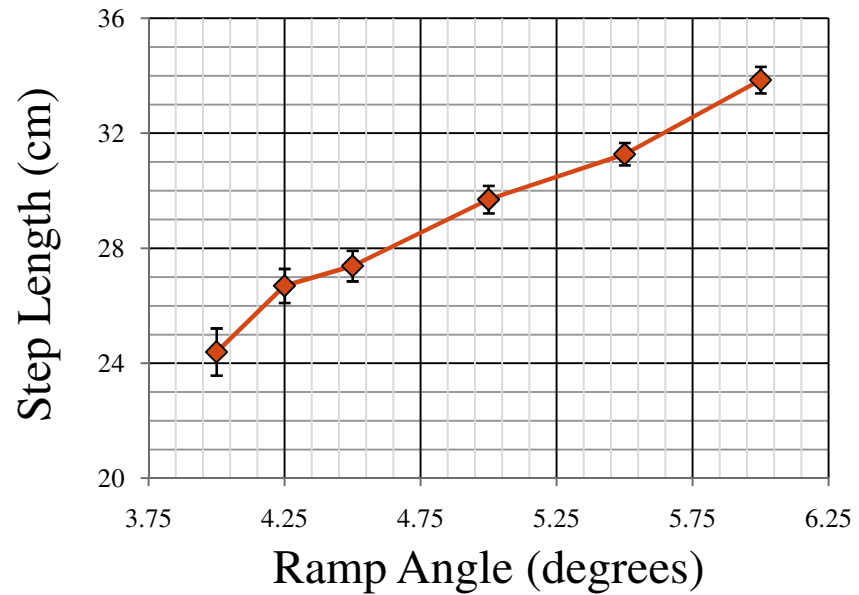
↔ - Step Length

Data Collection

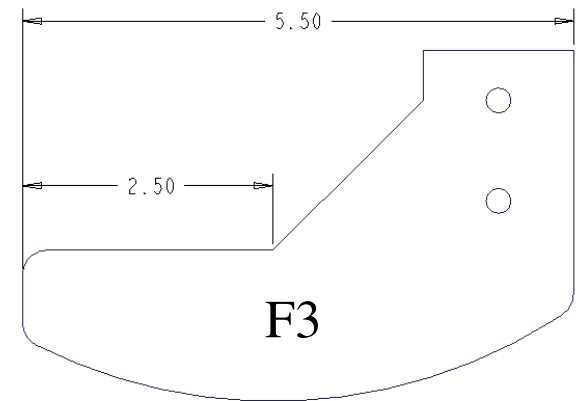
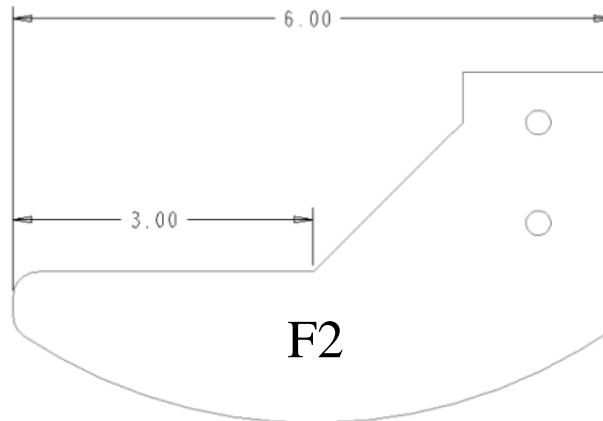
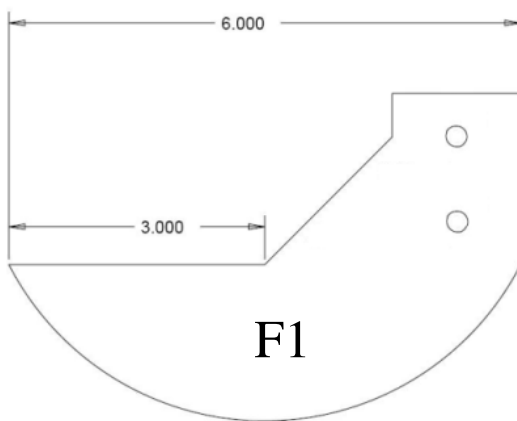


Parameters Varied

- Ramp Angle
 - Home configuration

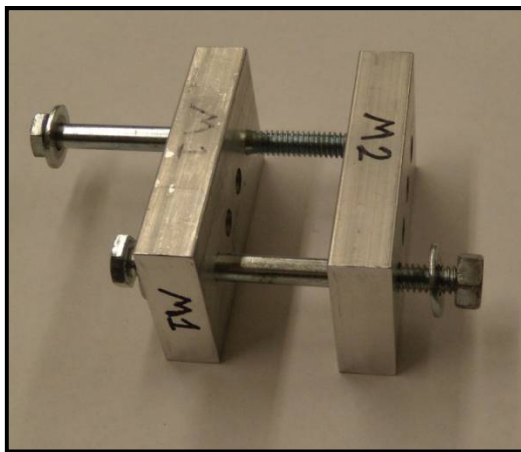


- Foot Design



Parameters Varied

- **Limb length**
 - Thigh and shank are proportional
 - Thigh and shank are mismatched
- **Mass Ratio**
 - Mass added



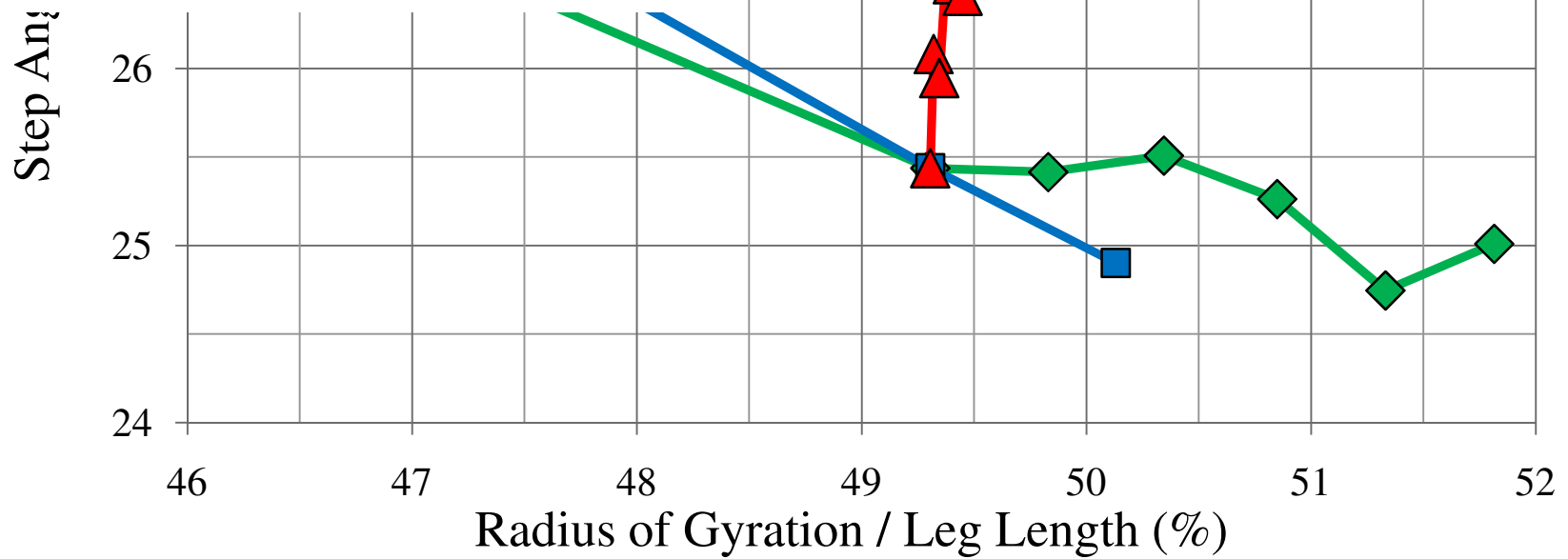
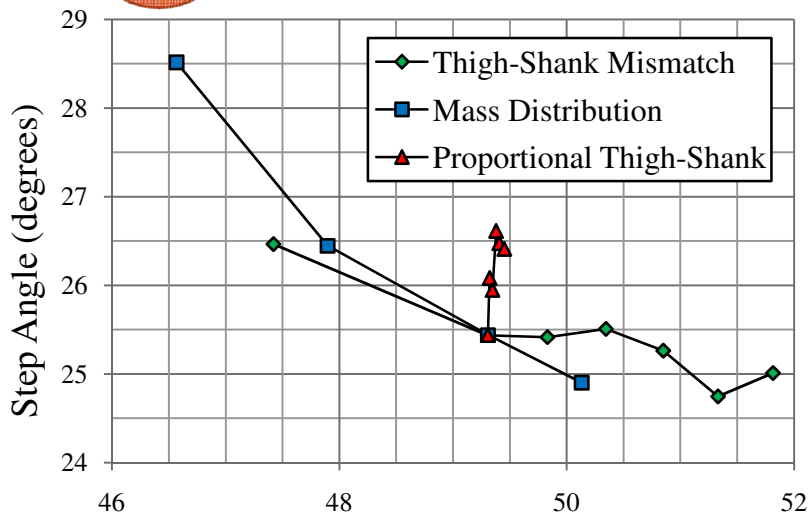
A. Greaves and I. Lohrenz, *A Study in Passive Dynamic Walking*, B. Sc. thesis, Department of Mechanical Engineering, University of Manitoba, Winnipeg, Manitoba, 2008.

Dynamic Parameters

- Key Dynamic Parameters that affect the gait pattern:
 - Radius of Gyration
 - Center of Mass
- Radius of Gyration = $\sqrt{\frac{\text{Mass Moment of Inertia}}{\text{Mass}}}$
- Center of Mass is measured from the hip downward

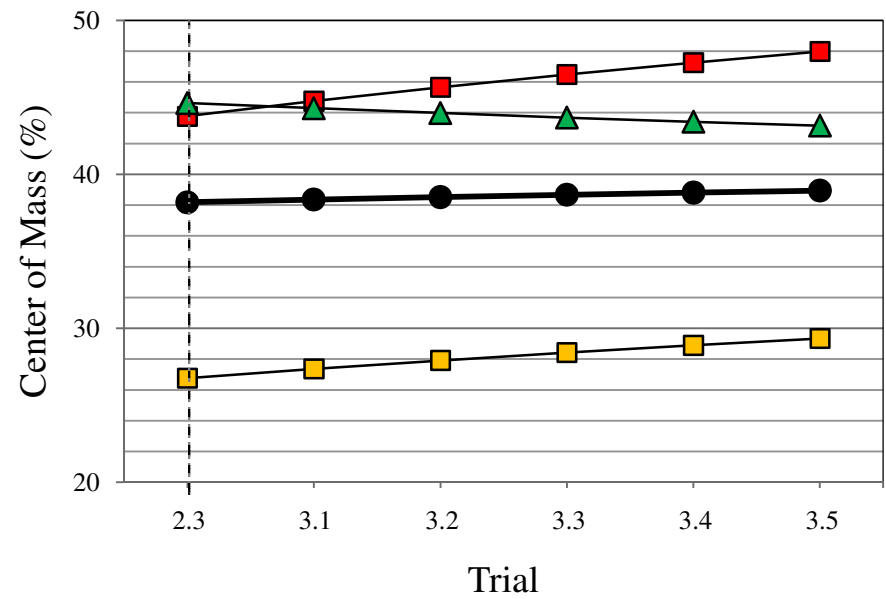
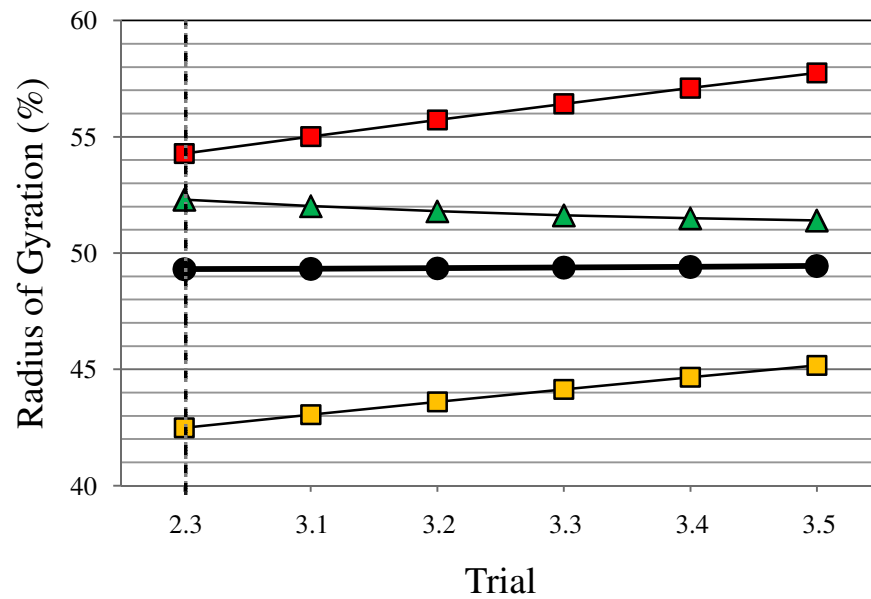


Study Comparison

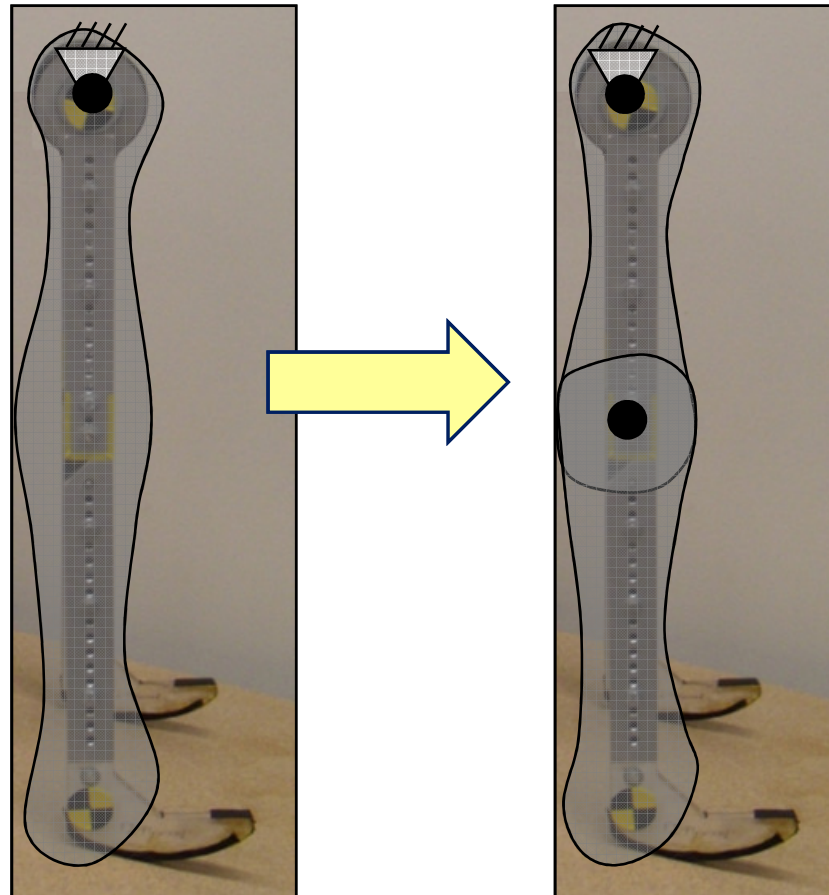


Proportional Thigh-Shank Study

- Originally seems anomalous
- Individual link properties analyzed

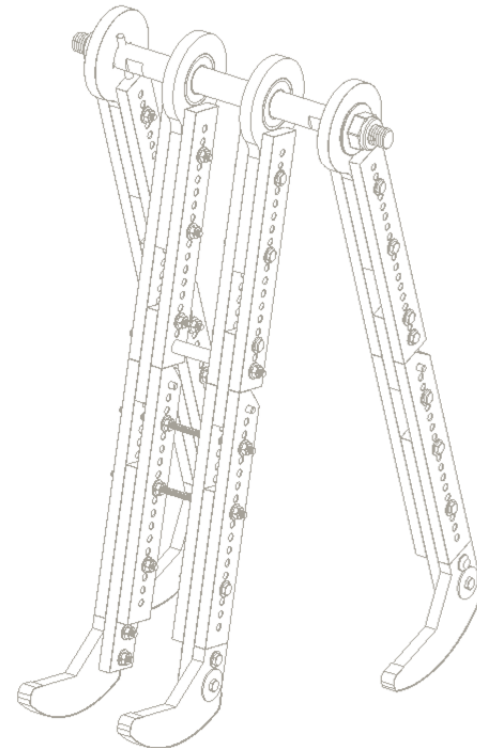


Double Pendulum Simplification



Summary

- That the radius of gyration and center of mass are the key dynamic parameters that effect the gait pattern.
- For non-uniform walkers use a double pendulum simplification.



Questions ?

