PASSIVE DYNAMIC BIPEDAL WALKING WITH KNEES

Derek Koop and Dean Ferley
Supervisor: Dr. Christine Q. Wu
Department of Mechanical and Manufacturing Engineering
Winnipeg, Manitoba, Canada

University of Manitoba

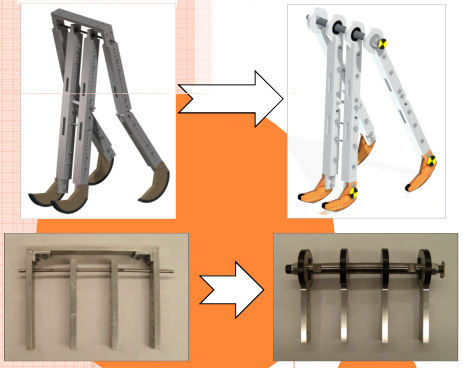
NSERC CRSNG

Project Goals

1. Redesign previous walker
2. Identify and gain an understanding of the dynamic parameters and how they affect the gait pattern.

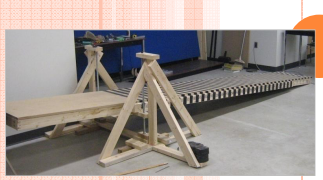
Redesign

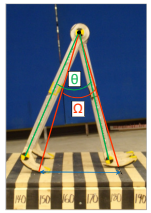
Dexter → Dexter Mk II



Testing Procedure

1. Launch walker down the ramp
2. Record video of the gait
3. Measure leg angle and step period from video

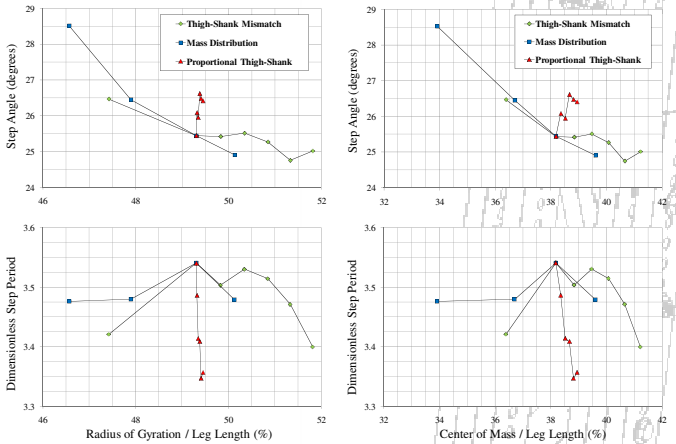




Experimental Studies

1. Thigh-Shank Proportional (TSP)
   The thigh and shank lengths were increased by ½" per study.
2. Thigh-Shank Mismatch (TSM)
   The thigh length was increased by ½" per study while the shank length remained constant.
3. Mass Distribution (MD)
   Mass plates were added to different locations of the walker.

Results



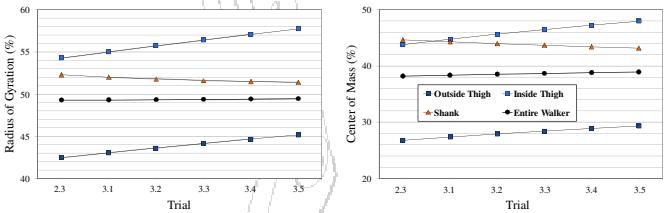
Step Angle (Ω): The angle formed by the points where the walker contacts the ground and the hip. It is calculated from the leg angle (θ).

Step Period: The time it takes the walker take one step, which is two step lengths (↔).

Analysis & Conclusions

From the TSM (◆) and MD (■) studies, a significant increase in step angle is evident as the radius of gyration and center of mass decrease. Trends in the step period are not yet clear enough to be conclusive. Nevertheless, the trends in the step angle show that the radius of gyration and center of mass are the key parameters affecting the gait, and they cause similar trends in the step angle.

At first glance, the TSP study (▲) appears anomalous to the previous conjecture. The gait varies despite relatively constant radius of gyration and centre of mass parameters. However, after examining the thigh and shank individually, it became apparent that these parameters were indeed changing but in opposing directions for each link. This caused the overall walker parameters to remain relatively constant as shown below.



Based on the results obtained, the radius of gyration and center of mass appear to be the key dynamic parameters that affect the gait pattern, and further dimensional analysis of passive dynamic walking is needed.