ON PASSIVE DYNAMIC BIPEDAL WALKING

J. Chen, A. Greaves, I. Lohrenz and Q. Wu

Department of Mechanical and Manufacturing Engineering

Winnipeg, Manitoba, Canada

Project Goals

Design a four-legged passive walker with knees

Develop gait measurement procedure

Compare gait patterns of passive bipedal walkers

Two Passive bipedal walkers

Walker-1

Weight=220gram

Height=30.5cm

Width =13cm

Length of Thigh=15.5cm (51%)

Length of Shank=15cm (49%)

$z_{outerthigh} = 3.09cm$ 24% from the hip

$z_{innershigh} = 3.88cm$ 30% from the hip

$z_{shank} = 6.261cm$ 41% from the knee

Walker-2

Weight=9.15kg

Height=67.31cm

Width=30.48cm

Length of Thigh=31.75cm (47%)

Length of Shank=35.84cm (53%)

$z_{Innerthigh} = 13.9cm$ 44% from the hip

$z_{outerthigh} = 13.6cm$ 43% from the hip

$z_{shin} = 14.93cm$ 42% from the knee

Gait Measurement procedure

Record test parameters

Video analysis of trials yields

Success rate

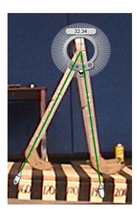
Step count

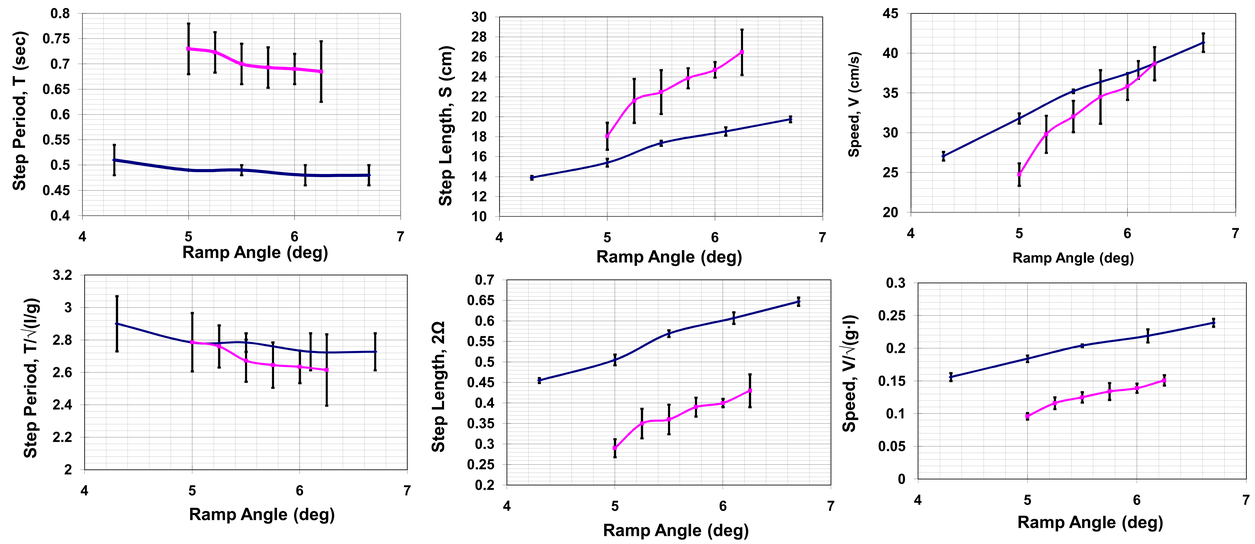
Step period

Step distance

Leg angle

True leg angle





Comparison of gait patterns between the two walkers.

The trends of the changes in the step period (decrease with the increase in the ramp angle) and the step length (increases with the increase in the ramp angle) are consistent. The dimensionless step lengths for walker-2 are higher than those from Walker-1, while the differences in the dimensionless step periods are in significant.

	McGeer's walker		Walker-1		Walker-2	
Ramp angle (deg)	0.29°	3.4°	5°	6.25°	4.3°	6.7°
Step period $/\sqrt{l/g}$	3.5	2.5	2.79	2.62	2.900	2.727
Inter-leg angle (rad)	0.10	0.70	0.29	0.43	0.455	0.647
Walking speed $/\sqrt{gl}$	0.029	0.28	0.096	0.151	0.157	0.237

In spite of the similarity among the three walkers, the results agree poorly.

Question: How to compare the gait patterns among the passive dynamic walkers in spite of different sizes, i.e., what measures should be used to characterize the natural dynamics?

What's the role of friction? Should we use the friction to enhance walking?

The funding from Natural Science and Engineering Research Council of Canada (NSERC) is gratefully acknowledged.