Design and Construction of the First Quadruped Passive Dynamic Walking Robot

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The purpose of this summer research was to design and construct a quadruped passive dynamic walking (QPDW) robot. With no available information on quadruped passive dynamic robots, it is believed that this may be the first functioning QPDW robot in the world. Both straight-legged QPDW robots and kneed QPDW robots were studied using the same robot with a slight modifications

Project Goals

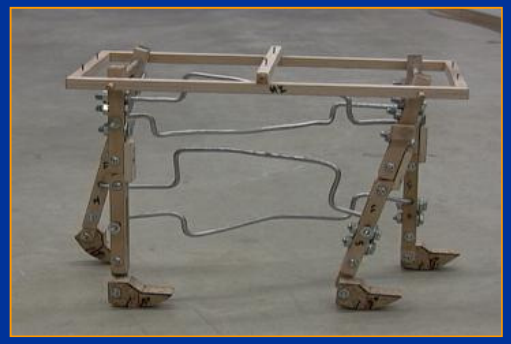
- Design, build and optimize a quadruped passive dynamic walking robot capable of a trot gait pattern with or without knees
- Allow for the QPDW robot to be easily changed from a straight legged walker to that of a kneed leg walker so that both types could be tested.
- Change mass by designing regions for mass to be added/removed and to create a light weight ramp for testing on
- Create a foundation for the study of quadruped passive dynamic walking robots at the University of Manitoba.

Design

LENGTH:	33 cm
WIDTH:	18 cm
HEIGHT:	24 cm
WEIGHT:	315.16 g

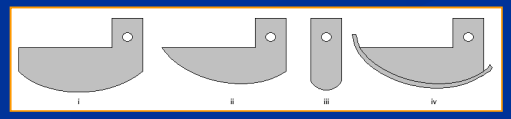
COMPUTER MODEL:

CONSTRUCTED MODEL:



Note: The QPDW robot was changed from a kneed version to a straight legged version by tightening the bolt on the knee

FEET VARIATIONS:



Experimental Procedure

1. Test feet were attached
2. The additional mass was distributed along the leg with 8.0 g bolts and 3.3 g nuts. The following configurations were attempted: (i) 3 bolts on the thigh and 1 on the chin, (ii) 3 bolts on the chin and 1 on the thigh, or (iii) 1 on the shin and 1 on the thigh.
3. 50 trials were conducted at three different ramp angles and video was captured.
4. The video was analyzed.
5. The mass on the shins and thighs was redistributed and the third step was repeated.
6. Once all the mass arrangements had been attempted, the process was repeated for a new type of feet.

Results and Conclusions

Straight-Legged QPDW Robot:

Using feet (iv), mass arrangement (ii) and a ramp angle of 3.14 degrees, the straight-legged QPDW robot had a successful walking rate of 88%... 38% above target.

Kneed QPDW Robot:

The QPDW robot with knees did not yield successful results. The using feet (iv), mass arrangement (i) and a ramp angle of 3.3 degrees, the kneed QPDW robot walked 1-1/2 steps on numerous trials but did not walk further.

Conclusions:

The first quadruped passive dynamic walking robot that was designed and built in the world at the University of Manitoba has been a successful venture into quadruped passive dynamics. When comparing accomplishments to objectives defined, the QPDW robot overcame all the objectives, only faltering in the ability to deliver a greater step count during the kneed configuration.