Design and Undulatory Gait Tests of a Meter-size Modular Centipede Robot

Dan Zhao[1], Haotian Li[1], Shai Revzen[2,3]
[1]Mechanical Engineering, University of Michigan, Ann Arbor, MI, US
[2]Faculty of Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, MI, US
[3]Faculty of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, MI, US
Email: danzhaoy@umich.edu

Summary

Bioinspired legged robots have been widely used for locomotion on challenging unconstructed environments as well as scientific study of biological locomotion. We investigated the motion of a family of robots ranging from 6 to 12 legs.

Our modular "Multipod" robot has both pitch and yaw actuation of backbone between segments, making it possible to test a wide range of new gaits. Its meter-size scale offers a better chance to test centipede locomotion performance in some human-centric environments, like stairs, etc. We present results from a preliminary test of an undulatory gait over a range of inter-segmental phase differences.

The results show that robots with different numbers of body segments(legs), move the same distance when actuated at the same phase difference. This implies that longer robots might be very similar to a set of shorter robots walking in caravan.

Introduction

While other groups have built multi-legged "centipede like" robots, many have used passive links between consecutive segments (e.g. [1]). The ability of our design to actively bend the body in any direction could potentially enable it to better adapt to the terrain and transition from horizontal to vertical surfaces. We attempted to move the robot with an undulating gait similar to that used by *Chilopoda* and *Pauropoda* [2]. The modularized design we use enabled us to study the influence of number of segments (2 to 6 studied so far) on locomotion performance at difference undulation wave numbers, which correspond to inter-segment phase differences.

Methods

The Multipod design (see Figure 1) is similar to our Mechapod design in [3]. Each segment consists of three Dynamixel servos(1 MX106 drives the leg roll, 2 MX64 drive connection pitch and yaw) and a pair of compliant spring steel legs [1095 Spring Steel]. The stiffness was chosen to provide the 0.1 dimensionless stiffness common to animals.

Results and Discussion

We tested the undulatory gait on 6, 8, 10 & 12 legged versions of the Multipod with different phase offsets between adjacent segments (see Figure 2).

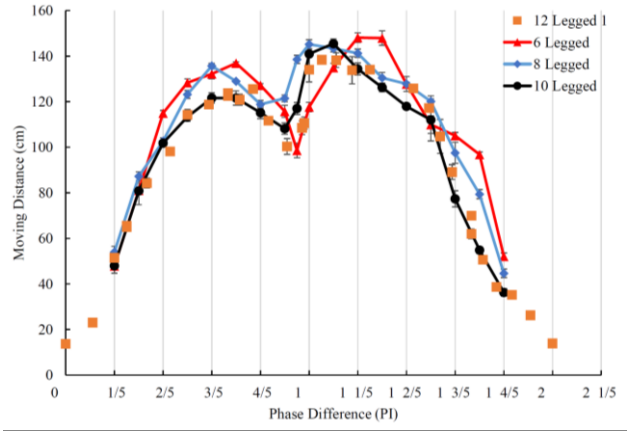

Figure 2: Moving distance at 5 strides (N=3 trials) vs. phase difference between segments. Different numbers of legs produce similar motion.

Acknowledgments

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References

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[2] S. Manton and M. Harding, "The evolution of Arthropodan locomotory mechanisms - Part 3. The locomotion of the Chilopoda and Pauropoda," *Journal of the Linnean Society of London, Zoology*, vol. 42, no. 284, pp. 118–167, 1952.

[3] D. Zhao and S. Revzen, "Slipping helps steering in a multilegged robot,". *Dynamical Walking,* 2016.

Supplemental Media

https://drive.google.com/open?id=1OmSBv4m4C4GzGFU9j48BaXWXik_l3gLW

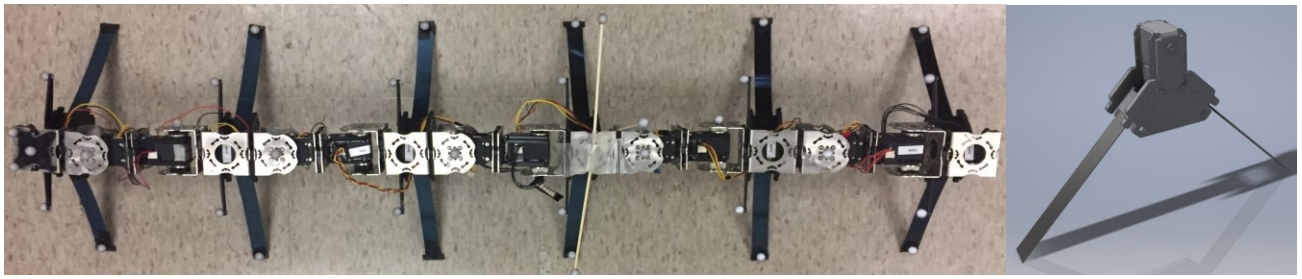

Figure 1: Multipod and leg segment CAD