How one might realize practical, energy-efficient legged robots: lessons from the Cornell Ranger project

Jason Cortell*, Pranav Bhounsule **, (Andy Ruina *)

* Biorobotics and Locomotion Laboratory, Cornell University, Ithaca, NY, 14850 USA. jbc2@cornell.edu, ruina@cornell.edu
** Disney Research, Pittsburgh, 4720 Forbes Avenue, Lower Level, Suite 110 Pittsburgh, PA 15213 USA. pab47@disneyresearch.com

1 Abstract

Human walking is considered relatively energy effective (energy metric Total Cost Of Transport, defined as energy used per unit weight per unit distance moved is about 0.3) and robust (like 0-2 falls a year) and super-reliable (works all the time). In comparison, walking robots are still energy hungry and unreliable. Some robots, like passive dynamic robots, are highly energy-effective (TCOT around 0.05) but fall down all the time, while others like PETMAN, ASIMO are reasonably robust and reliable but use lots of energy (TCOT of 2 or more). We present our robot called the Cornell Ranger [1, 2] (see figure 1) in this context.

Cornell Ranger is a relatively simple (it has only 4 degree of freedom), essentially planar, 1 m tall, knee-less bipedal robot that was custom built at BioRobotics Lab at Cornell University. So far it has achieved two feats in two separate trials, 1) It walked 65 km non-stop on a single battery charge, setting a legged robot distance record, and 2) It walked stably with a TCOT of 0.19, apparently less than that of any other legged robot to date.

We present some aspects of design and control that helped us achieve high energy-efficiency, high reliability and modest amounts of robustness on the Ranger. It is our hope that the lessons learned from this project will extend to more complicated practical legged robot systems.

2 Keywords

Experiment bipedal robot, Energy-efficiency, Reliability.

References
