

6.894 Legged Locomotion in Robots and Animals

Handout No. 11

November 9, 1999

Problem Set 8: Design

Problem 1

1.1 Compare the strength to weight ratio (in Newton/Newton) of some common engineering and biological materials. For strength, use the maximum tension force on a 1m long, 0.1 m radius cylindrical column. Typical material properties follow. Hint: Cross sectional area cancels out and length is irrelevant in the comparison but still necessary to compute strength/weight ratio as defined.

Material	Yield Stress (Pa * 10 ⁶)	Density(10 ³ Kg/m ³)
Bone	100	1.0
Stainless Steel	700	7.8
Titanium	1100	4.5
2024-T4 Aluminum	400	2.7

1.2 What are other criterion for choosing one engineering material over another?

Problem 2

2.1 A good weight lifter can bench press 1.5 his/her body weight and squat 2.0 times his/her body weight. During each lift, the weight is lifted at approximately 0.6 m/s. Assuming bench pressing and squatting use different muscles, what is an approximate lower bound to the lifter's power to weight ratio (in Watt/Newton)?

2.2 Spring Turkey, a walking robot, has a mass of approximately 10 kg. Each of its 4 motors has a maximum power output of 30 watts. What is an upper bound on Spring Turkey's power to weight ratio (in Watt/Newton)?

2.3 Compare the above two results and discuss.

Problem 3

(Extra Show and Tell) Describe and bring in (if possible) a sensor, actuator, design structure, or other component which could be useful in building a robot or biological creature. Compare it to its alternatives in terms of any relevant design trade-offs.