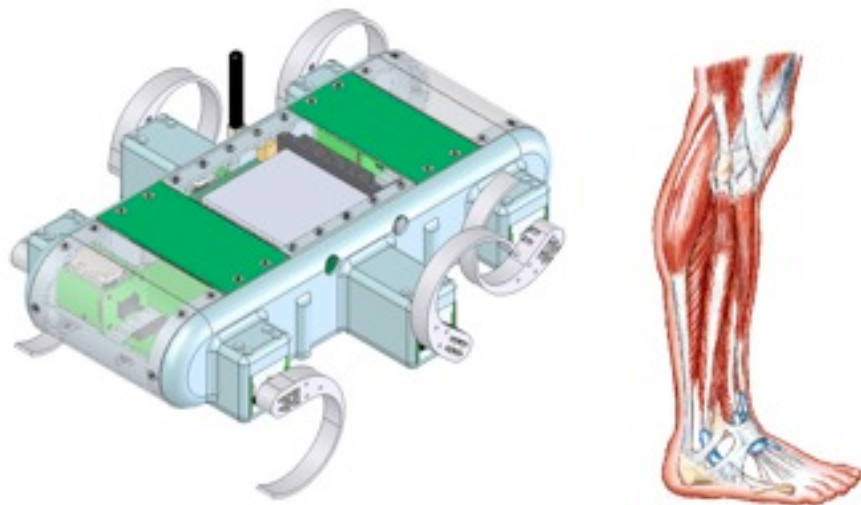


Lab 2

ESE 112 Fall 2007

Getting a Leg Up!



1.) Introduction

In the animal kingdom locomotion is almost universally essential for the success of any particular species. Furthermore, (snakes aside) almost all land-based animals have evolved legs to aid in locomotion. In this lab, you will be given a set of 6 hips (one for each leg of our hexapedal robot) and asked to consider what qualities are important in the morphology of legs. You will then build a set of legs for the robot and test the legs out with the goal of having the robot walk successfully.

2.) Pre-lab Exercise (due before start of the lab)

- 1.) What is the budget for each group?
- 2.) Humans have focused primarily on building wheeled locomotion, yet the animal kingdom has evolved primarily legs. Discuss the advantages and disadvantages of each with a focus on scientific principles such as energy consumption, robustness, kinematics, etc. What kind of situations would favor legged locomotion as opposed to wheels? Give specific situations to back up your arguments (You may use any resource available to you, however you must cite used resources). Your answer should be as scientific as possible (think about energy consumption, robustness, kinematics etc).
- 3.) The shape, number, and use (control) of legs vary widely across the animal kingdom. Give two examples that show this diversity (cite sources from the literature). Give examples of how each animal uses their own leg morphology to their advantage and how the control of the legs differs across the animals.
- 4.) What do we mean by the work “metric” in the write-up section. What possible metrics would you use to measure the success of your design?

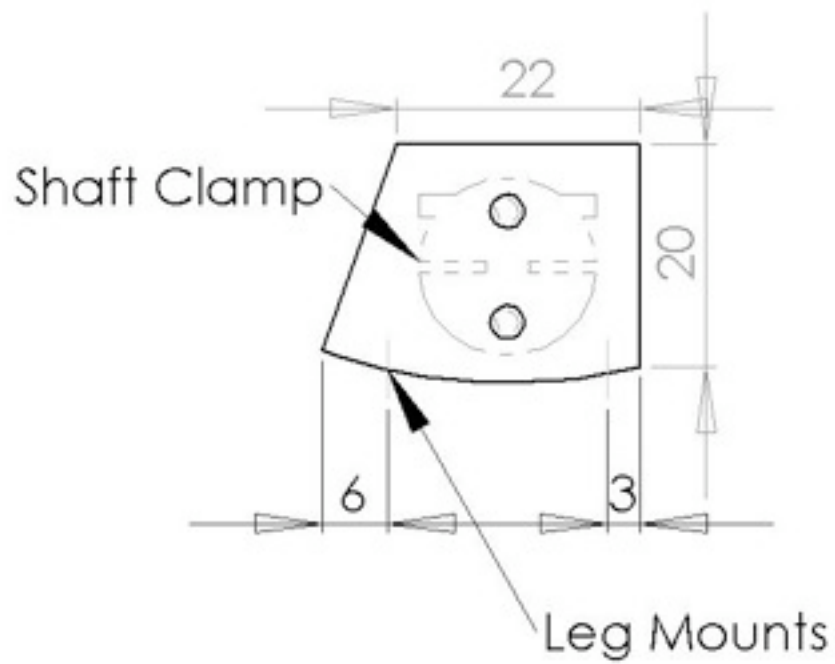
3.) Lab Exercise

In this lab you will be given a budget of \$20 (this is so you won't spend too much) and a set of six hips. Your task, in groups of 3 of your choice,) will be to add legs to the hips. Once you have completed the legs you will then run the legs on the robot and test how successful they are. This will be a two-week lab.

Materials and Equipment: Your budget of \$20 can be used to buy materials for the legs or related items (you can purchase materials from home depot, hardware stores, art supply stores etc. If you need any tools please email the course instructors and we will try to provide them to you where feasible.

Leg Construction: You should first come up with a careful design for the legs, taking into consideration your knowledge of what works in the animal kingdom and your ideas of what makes for successful legged locomotion. In this lab, part of the grade will be assigned based on your thought process and design choices in the construction of the legs. Once you have come up with a design (please submit it to the course staff by the end of week 1 of this lab), you should begin implementing it. In second and week of the lab you will have access to the robot to test your legs on the standard walking gait of the robot. As you can see from the figures below, each hip has two through-holes with which you will use to attach your leg to the hip.

Note: Many of you have seen the legs that we have built for RHex and Edubot. Although you may use these ideas to aid in your design, your design should certainly not be a replica of these legs (Besides we have no evidence that these legs are even close to an optimal design). Remember you must justify any design decision that you make.



Note - All measurements are in mm

Testing your legs on the robot: You should test your legs on the robot (you will be shown how to do this in week two of the lab) and possibly iterate on your design based on the results of your tests. In order to use your legs you must first attach them to the robot (you will be shown how to do this in class) and walk the robot around.

4.) Lab Write-Up (To be done individually: Due Two weeks from start of lab)

- 1.) Show your legs running on the robot to one of the course staff (make sure they video tape the robot with your legs).
- 2.) Describe your leg design. Carefully explain the choices you made in your leg design.
- 3.) How well did your legs work? What metrics did you use to determine success?
- 4.) For the most part the legs you have designed will have little or no actuation (motors, active parts etc). How would your design have changed if you had had the ability to incorporate serious actuation?
- 5.) You tested your legs on a particular gait for the robot that used no feedback (sensory information) from your legs. How would you have changed the legs if you could have fed-back information from the legs? What sensors would you have used? How would the morphology have changed? How would you use the sensor information to adapt the gait?
- 6.) Describe your contribution to your group. As a percentage, how much of the work did you do? How much did everyone else do? Did you group work well together?