University of Washington
Computer Science and Engineering
Winter 2007

CSE 490 I: Design in Neurobotics

Lab 5 Date: 2/6/2007 or 2/8/2007
Write-up Due: 2/13/2007 or 2/15/2007
Submit electronically

Goals:

1. To learn to move your hand to control a robot with a given mapping.
2. To program protocols to make learning/control easier.

Assignment:

This lab is geared toward understanding how to execute the task well, given a specific mapping between the glove and the robot.

By now, you have learned (through laughs and tears) that there are many things that can make it difficult to control the robot using the glove. Even when your mapping algorithm looks perfect on paper, it is never easy to control the robot to execute a simple task in real world.

In this lab, you will learn to master using Box 2 from Lab4. The mapping algorithm and source code will be available before the lab. You will use this control box for a simple task: touch 5 stickers placed on your lab bench with the robot gripper in the order specified (note you don't have to open/close the gripper).

Your goal is to improve the movement and make the robot to move as smoothly and efficiently as possible. Your job is to tackle this problem in two ways: (1) refine the mapping algorithm to make the learning/control easier; and (2) challenge your brain to learn the movement well. This time around, you MUST wear the glove (you can't just move the sensors on the table).

1. Refine the mapping

Implement 3 – 5 augmentation to this control box that enhances your ability to use it (without changing the mapping itself). We called them "smarter controller" in Lab 3: for example, you wrote a code to compensate for the fact that your fingers moved together even when you didn't want them to. Identify problems that cause this mapping to be difficult to learn, and work on augmenting them.

2. Challenge your brain

When you first sat in front of a videogame you never played before, you probably felt clumsy and awkward. You played, you played more, and you got much better at it. The same philosophy applies here.

Train your brain with the program you wrote in **1** (with augmentations) to execute the task. Capture your learning progress over time: write a program that records your glove and robot movements.

a) Record the first time you try the task without any practice. Make sure to complete the task (reach (or get as close as you can to) all five targets) even if it takes a long time.

b) Start training. Here are some suggestions:
   (1) Practice the task over and over (this is important even if you pursue other options).
   (2) Go back to **1** to improve your program.
   (3) Write a tutor program that helps speed up the learning. For example, your program can plot the glove movement in real time so that you can use the visual feedback to correct your movements. You can also write a videogame-like environment that enhances learning.

   NOTE that (1)-(3) are only suggestions. You can come up with a creative solution outside of these suggestions (ask the TA for permission) or only try (1) (which ***could*** be more effective use of your time).

Each partner should get a go several times. One should record the movement, spend the next 10 minutes learning the movement, then record again. Then switch to the other partner.

Every time you record a new set of movements, you should note the time and date, and what you did since the last recording (including changes in the mapping algorithm, tutor program, the count/time of practice/sleep/ etc).

Questions:
Please submit individually. However, you CAN work together with your partner and submit the same solutions as your partner's. Write your partner's name on top of your assignment.

a. Write down the changes you made to the control box to make the control/learning easier.
b. Describe your tutor program, if you created one (no points off for not doing this).
c. Make a diary of your learning activities. For each trial, you should plot your recorded movements, denote problems (on the graph), list all improvements you make for the next trial. Plot the next trial. And repeat. Make as many notations as possible to demonstrate your understanding of this learning process.
d. Plot the following learning curves (x-axis is the trial index, y-axis is the value of certain feature of each trial):
    1) Total time it took to complete the task.
    2) Average movement jerk. (jerk – the derivative of acceleration)
    3) Number of movement peaks. (peak – the local min/max of a curve)
e. Define TWO other features of trials and plot your learning curves. What defines as the "feature" is what you can get from passing the entire set of data in MATLAB without hand marking (or counting points by hand). Rather than trying random features, print your graphs and see if there are things that are clearly changing over time.
f. Comment on the learning curves.
    i. What features allow you to capture your learning the best? Explain (2-3 sentences).
    ii. What learning methods (practice, etc) worked the best? Explain (2-3 sentences).
g. Write a paragraph (1/3 to 1/2 pages) on your thoughts on learning this task. For example, did you feel that you were able to learn the task well after many trials? What was the most challenging thing about this learning process (for your brain)? In your project, you will be asked to come up with your own mapping that allows best task execution. Did this process give you an idea about what may be a good mapping for your project?