University of Washington
Computer Science and Engineering
Winter 2007
CSE 490 I: Design in Neurobotics

Lab 4

Date: 1/30/2007 or 2/1/2007
Write-up Due: 2/6/2007 or 2/8/2007
Submit electronically

Goals:

1. To learn the concept of system identification
2. To identify the provided black box mapping

Assignment:

In this lab, you will use the dataglove to control the robot's movement. We provide you with three black boxes that contain the mapping between the dataglove and the robot joint angles. Your job is to: (1) decode what the mapping is (this is called System Identification), and (2) use it to execute a task (pick up the screw and put it in a cup).

1. System Identification
System identification is a process to identify what is in the black box given inputs and outputs are observable.

In our case, the inputs are the dataglove fingers movement, which can be acquired by reading the sensors, and the outputs are the target angles of the robot arm joints, which we can read from the control chip (or visual inspection).

Recall that in Lab3, you implemented a linear mapping between the inputs and the outputs so that every finger controlled one of the robotic joints. In this lab, you are provided with three mappings. Your job is to explore to find what the mapping are. Take turns with your partner so that everyone can enjoy and learn from exploring and identifying the black box.

Tips:
- Be patient.
- Always start with a slow motion when you first apply a new black box.
- Take advantage of Matlab to help you visualize and analyze the trace of inputs and outputs.
- Design questions to help you break down the riddle. For example,
  - Does individual finger work alone, or do they cooperate?
  - Can each joint move independently, or are the movement synchronized?
  - Change the speed of the fingers movement, does it matter?
  - What is the most directly controlled by the dataglove fingers, the angles of the joints, their velocity, or other form of the movement?
- Take note through your exploration. Even if you fail to figure out the mapping, write down all your observations. It is your approach to analyzing the mapping, rather than your ability to find the exact mapping, will determine your grade.

2. Executing tasks

As you can guess by now, the task is to control the robot to pick up the screw from the table and drop it in the cup. You (and each partner) should practice this task with each of three black boxes. Use all the knowledge you learned from your observation in 1, make a good guess if necessary. In other word, even if you fail to decode the mapping hidden in the black box, you might still accomplish the task. Take notes of your approach. Remember that you will be judged ONLY by your ability to analyze the problem.

Coding Support

The black boxes are implemented in a new library (CtrlBoxLib.dll,CtrlBoxLib.lib). The exported functions of the library is declared in CtrlBoxLib.h. Read the comments in this header file to learn the usage.
A sample main file is also provided. It chooses a black box, applies it and records all the inputs/outputs traces in a text file. The format of the text file is a 11-column matrix: the first column is time stamp, then 5 inputs, then 5 outputs. You are welcome to use this main file.
The most related variables/functions include:
✧ int youBox = 2; // the index of the black box applied: 1-3
✧ char fname[30] = "take1.txt"; // name of the file to save recording
✧ void initRange(Glove& g, Lynx& l) ;// set the valid range for glove fingers and robot joints. you can change the values to suit your device

Questions:

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

1. Report the mapping you found for Box 1 (if you couldn't find the mapping, provide what you know).
2. Report the mapping you found for Box 2 (if you couldn't find the mapping, provide what you know).
3. Report the mapping you found for Box 3 (if you couldn't find the mapping, provide what you know).
4. Explain the strategy you used to find the mapping for Box 1 (a paragraph). You are encouraged to use MATLAB to demonstrate your technique, if you used MATLAB for assistance.
5. Explain the strategy you used to find the mapping for Box 2 (a paragraph). You are encouraged to use MATLAB to demonstrate your technique, if you used MATLAB for assistance.
6. Explain the strategy you used to find the mapping for Box 3 (a paragraph). You are encouraged to use MATLAB to demonstrate your technique, if you used MATLAB for assistance.
7. Which one was easiest to execute the task and explain why (2 – 3 sentences).
8. Which one was the hardest to execute the task and explain why (2 – 3 sentences).